SEH
421 FRENETTE DRIVE, CHIPPEWA FALLS, WI 54729 715 720-6200 800 472-5881 FAX 715 720-6300
ARCHITECTURE • ENGINEERING • ENVIRONMENTAL • TRANSPORTATION

May 19, 1997

RE: Ashland Lakefront Property
Comprehensive Environmental
Investigation Report
Ashland, Wisconsin
SEH No. WIDNR9401.00

Mr. James R. Dunn, District Hydrogeologist
Wisconsin Department of Natural Resources
Highway 70 West, P.O. Box 309
Spooner, WI 54801

Dear Mr. Dunn:

Short Elliott Hendrickson Inc. (SEH) is submitting nine copies of the enclosed report titled "Comprehensive Environmental Investigation Report – Ashland Lakefront Property." In accordance with your request, a copy of the report has also been submitted to Mr. Jim Musso at the Northern States Power Company in Eau Claire, Wisconsin. This report summarizes the results of historic environmental investigations performed on the property by Northern Environmental, Inc., SEH, and Dames and Moore. A set of plan size (22" x 34") figures accompanies the report. Smaller 11" x 17" copies of the figures have been bound into the report for your convenience.

SEH appreciates the opportunity to provide the Wisconsin Department of Natural Resources (WDNR) with continued environmental services on this project. If you have any questions regarding the report contents, please contact me at (715) 720-6231.

Sincerely,

Cyrus W. Ingraham III, P.E.
Principal

JEG/jeg/ls/CWI
c: Jim Musso, Northern States Power Company (w/enclosure)

SHORT ELLIOTT HENDRICKSON INC. ST. PAUL, MN MINNEAPOLIS, MN ST. CLOUD, MN MADISON, WI LAKE COUNTY, IN
EQUAL OPPORTUNITY EMPLOYER

Distribution List

No. of Copies	Sent to
9	James R. Dunn, District Hydrogeologist Wisconsin Department of Natural Resources Highway 70 West, P.O. Box 309 Spooner, WI 54801
1	Jim Musso, Manager of Environmental Affairs and Lands Northern States Power Company 100 North Barstow Street Eau Claire, WI 54702

Comprehensive Environmental Investigation Report

Ashland Lakefront Property
Ashland, Wisconsin

Prepared for:
Wisconsin Department of Natural Resources
Spooner, Wisconsin

Prepared by:
Short Elliott Hendrickson Inc.
421 Frenette Drive
Chippewa Falls, WI 54729
(715) 720-6200

I, John E. Guhl, hereby certify that I am a Hydrogeologist as that term is defined in s. NR 712.03(1) Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

John E. Guhl PG #120 5-19-97

John E. Guhl, P.G. Date
Hydrogeologist

JOHN E.
GUHL
120
CHIPPEWA FALLS,
WI

I, Cyrus W. Ingraham, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Cyrus 024690 5-19-97

Cyrus W. Ingraham III, P.E. P.E. Number Date
Principal

CYRUS W.
INGRAHAM III
E-24690
CHIPPEWA FALLS,
WI

Table of Contents

Table of Contents (Continued)

List of Tables

List of Figures

Executive Summary

Short Elliott Hendrickson Inc. (SEH) was authorized by the Wisconsin Department of Natural Resources (WDNR) to prepare a Comprehensive Environmental Investigation Report of the Ashland Lakefront Property vicinity in Ashland, Wisconsin. The Ashland Lakefront Property is approximately ten acres is size and is located between Prentice Avenue and Ellis Avenue along the Chequamegon Bay shoreline. Subsurface contamination was discovered at the property in the late 1980's. Environmental investigations of the property and vicinity have since been performed by several consultants. The intent of this Comprehensive Environmental Investigation Report is to summarize historic environmental investigation results presented by Northern Environmental Technologies, Inc., SEH, and Dames and Moore.

The Ashland Lakefront Property was created by filling along the Chequamegon Bay shoreline in the late 1800's and early 1900's. The property was occupied by various lumber companies until approximately 1936. The City of Ashland Wastewater Treatment Plant (WWTP) was located at the property from the early 1950's until the late 1980's. The Ashland Lakefront Property is currently part of a City park (Kreher Park).

A 30 foot high bluff is located immediately to the south of the Ashland Lakefront Property. A ravine ran through the upper bluff area prior to approximately 1909, when the ravine was filled. Historic use of the upper bluff area included residential and commercial development as well as operation of a manufactured gas plant (MGP) from the late 1800's until 1947.

Chequamegon Bay is located immediately to the north and west of the Ashland Lakefront Property. Historically, the bay was an important transportation route to the Ashland area.

Subsurface conditions at the Ashland Lakefront Property consist of a fill layer (mostly wood waste) underlain by a low-permeability clay unit. The clay unit acts as an aquitard to the underlying sand and gravel (Copper Falls) aquifer, resulting in strong upward hydraulic gradients and artesian conditions.

The upper bluff area is comprised of a relatively thin fill layer outside of the former ravine. The clay unit occurs near the surface in the upper bluff area except in the vicinity of the former ravine, where thicker fill units are encountered. The clay unit becomes thin at some locations below the former ravine and may be completely absent somewhere along the ravine axis. The underlying Copper Falls aquifer is present in the upper bluff area, although the upward hydraulic gradient diminishes and disappears moving to the south.

The bottom of Chequamegon Bay consists of a layer of lake sediments overlying the clay unit. The Copper Falls aquifer has not yet been penetrated during offshore investigation.

Environmental investigation at the Ashland Lakefront Property began in the late 1980's after subsurface contamination was discovered during WWTP construction activities. The area of investigation has since been expanded to include the upper bluff area to the south and the offshore sediments to the north and west.

Contamination within the areas of investigation consists largely of widespread volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs) along with scattered inorganic contaminants. The VOCs and PAHs have been identified in soil samples, groundwater samples, and offshore sediment samples. In addition, the VOC and PAH contaminants appear to occur as non-aqueous phase liquids (NAPLs) within the areas of investigation.

Executive Summary (Continued)

There are approximately 21 acres impacted by VOCs and PAHs, with impacts identified at the Ashland Lakefront Property, in the upgradient ravine area, and in offshore sediments. VOC and PAH contamination is present in the shallow soils and sediments as well as in the Copper Falls aquifer. These areas of contamination are separated by the low permeability clay soil unit except at a probable breach in the clay located somewhere in the former ravine area.

The source of VOC and PAH contamination in the former ravine area and in the Copper Falls aquifer has been identified as past waste disposal by the former MGP. Potential sources of VOC and PAH contamination at the Ashland Lakefront Property and in the offshore sediments include possible former wood treatment activities at the Ashland Lakefront Property, possible migration of MGP wastes to these locations, a "Coal Tar Dump" depicted on a historic site map, migration of waste through a historic open sewer, and a potential unidentified source of contamination located at or near the mouth of the former ravine.

A number of issues remain in which there is differing professional interpretation of complex site data between consultants. These issues include shallow aquifer hydrogeology, degree and extent of deep aquifer contamination, evidence of former wood treatment activities, the likelihood of MGP waste migration from the former ravine area onto the Ashland Lakefront Property, and the separation of contaminants along the south side of the Ashland Lakefront Property. Issues that may require further investigation include additional source area definition, viscosity determination of NAPLs, impacts to offshore biota, potential human health risks, and remedial alternatives.

Comprehensive Environmental Investigation Report

Ashland Lakefront Property

Ashland, Wisconsin

1.0 Introduction

Short Elliott Hendrickson Inc. (SEH) has prepared a Comprehensive Environmental Investigation Report and accompanying Figures 1 through 9 summarizing environmental investigations performed at and adjacent to a ten acre parcel in Ashland Wisconsin, and referred to herein as the Ashland Lakefront Property. The property is located along the Chequamegon Bay shoreline between Ellis Avenue and Prentice Avenue. This report and accompanying Figures 1 through 9 (22" x 34" format) were prepared for the Wisconsin Department of Natural Resources (WDNR) under an existing contract with SEH. Smaller copies of the figures are included within the report for easier reference.

1.1 Purpose

Subsurface contamination was identified at the Ashland Lakefront Property during site construction in the late 1980's. Environmental investigation of the property and vicinity began in 1988 and is ongoing at the time of this report. Several environmental consultants have performed subsurface investigation at or in the vicinity the property, resulting in numerous reports and other documents relating to the contamination. The purpose of this report is to summarize the results of past investigations at the Ashland Lakefront Property and in the immediate vicinity.

2.0 General Site Information

The Ashland Lakefront Property is located in Section 33, Township 48 North, Range 4 West in Ashland County, Wisconsin. The property is a ten acre parcel located below the lakeshore bluff along the Chequamegon Bay shoreline between Ellis Avenue and Prentice Avenue. The Ashland

Lakefront Property is bounded by Chequamegon Bay to the north, Prentice Avenue to the east, the Wisconsin Central Rail Line to the south, and Ellis Avenue to the west. A City park (Kreher Park) comprises much of the property. The location of the Ashland Lakefront Property is presented on Figure 1, "Site Location Map/Index."

The past and ongoing investigation of the Ashland Lakefront Property has resulted in investigation activities in the bluff area south of the site and in offshore sediments located north and west of the site. The adjacent bluff area will be referred to herein as the "Upper Bluff Area," and is located immediately south of the Ashland Lakefront Property between Prentice Avenue and Ellis Avenue. A portion of the upper bluff area receiving considerable investigative effort is a filled ravine located between Prentice Avenue and 3rd Avenue. The filled ravine is referred to herein as the "Former Ravine Area." The general features associated with the Ashland Lakefront Property vicinity are depicted on Figure 2, "Existing Conditions."

2.1 Site History

A summary of the site history has been developed based on written information, historical maps and plans, historical business data, and aerial and still photographs. Other information has been obtained by various parties through interviews with long-term residents of Ashland. This information is viewed as anecdotal and can not be substantiated due to the significant length of time since site activities occurred.

2.1.1 Ashland Lakefront Property

The land comprising the Ashland Lakefront Property was created anthropogenically during the late 1800's and early 1900's. Fill materials were placed along the shoreline of Chequamegon Bay during this time period, extending the former shoreline approximately 300 feet north to its approximate present configuration. The fill materials used consisted mainly of wood waste materials (wood slabs, pieces and sawdust) along with earthen fill and solid waste materials (bottles, concrete, bricks etc.). The wood waste fill was generated during operation of an onsite lumber mill which operated from prior to 1885 until approximately 1930. The solid waste may have been placed by local residents or by the City of Ashland. The source of the earthen fill was not determined. Various materials including solid wastes, fly ash, and dredge spoils were reportedly dumped on the property during the last 60 years.

Land use at the Ashland Lakefront Property has consisted of the following:

Lumber yard and lumber mill	
- Barber Mill	1884 - 1887
- W.R. Sutherland Mill	1887 - 1897
- Pope Lumber	1897 - 1901
- J. Schroeder Lumber Co.	1901 - 1930
Vacant Land	1930 - 1953
Ashland Wastewater Treatment Plant	1953 - 1988 (approx.)
City Park (Kreher Park)	Unknown - Present

The lumber yard activities occurred during the deforestation of the northern portion of Wisconsin around the turn of the century. Logs were floated into the Ashland area on Chequamegon Bay. A log boom extended into the bay at the Ashland Lakefront Property which was used to extract the logs from the water for processing into lumber products. Historic site photographs indicate that railroad ties were among the products produced at the lumber yard. In addition, the John Schroeder Lumber Company made reference to the manufacturing of wood preservatives and products in their Articles of Incorporation. No historic documents have been identified to-date that conclusively indicate treatment of the railroad ties and/or other wood products occurred at the facility. Anecdotal information obtained during various stages of the environmental site investigation indicated that wood treatment may or may not have occurred at the site depending on the source of information.

The site remained vacant for approximately 23 years after the end of lumber mill operations. Anecdotal information indicates the site was vegetated at this time, and there may have been a ponded area of a black tarry substance during at least a portion of this time interval. A 1953 site map prepared by Greeley and Hanson Engineering indicates a "Coal Tar Dump" was present at the site at this time. Greeley and Hanson was the design engineer for the construction of the original wastewater treatment plant (WWTP). Anecdotal information regarding historical dumping on the site was obtained during interviews. Various materials including solid waste, fly ash, and dredge spoils were reportedly dumped by property owners, residents, and the Army Corps of Engineers over the past 60 years.

The City of Ashland WWTP was constructed on the north side of the site in approximately 1953. Operations continued into the late 1980's at which time a new facility was constructed offsite after subsurface contamination was identified at the site. The WWTP structures remain at the site at the time of this report. However, much of the wastewater treatment equipment has been removed from the site.

Kreher Park was established at the site some time during operation of the WWTP. The park currently consists of mowed grass area with roadways, a boat launching ramp, and parking areas. A rail line owned by Wisconsin Central Railway runs along the south side of the park. An area of brushy vegetation is present on Kreher Park along the north side of the rail line.

2.1.2 Upper Bluff Area

The upper bluff area south of the Ashland Lakefront Property is close to the downtown area of Ashland, and has been historically used for various residential, commercial, and industrial purposes. Prior to 1909, a ravine ran through the upper bluff area, with the mouth of the ravine located just to the north of the present 3rd Avenue at the southern border of the site. The ravine was filled sometime between 1901 and 1909 based on review of historic Sanborn Fire Insurance maps of the vicinity.

A manufactured gas plant (MGP) facility originally owned by the Lake Superior District Power Company operated on the southwest corner of 3rd Avenue and Prentice Street near the southern end of the ravine area from prior to 1885 until approximately 1947. The MGP facility discontinued the manufacture of natural gas from coal at this time, and has since been converted to an office and maintenance facility. The ownership of the MGP property has changed over time. The current owner of the property is Northern States Power Company (NSP).

The MGP produced gas utilizing different processes, equipment, and feed stock through the time of operation. The plant reportedly produced gas by coal carbonization until approximately 1920, when the plant was reportedly converted to a carburetted water gas process. Records regarding plant gas production, tar production estimates, tar sales estimates, and unaccounted tar volumes were developed by Dames and Moore under contract with NSP for the 1900 through 1947 time period.

Tar volumes for the Ashland MGP were estimated from gas production data, and based on typical tar waste generation and sales ratios. Production of approximately 590,000 gallons of tar was estimated for the period of 1900 through 1947. Of this, it is estimated that approximately 410,000 gallons were sold leaving 180,000 gallons unaccounted for. A portion of the unaccounted for tar may have been used for roofing, fuel, or other purposes. Plant records have not been reviewed for the years preceding 1900. No estimate of the volume or disposition of other coal gasification by-products has been made to-date for the years of operation preceding 1900.

2.1.3 Chequamegon Bay

Chequamegon Bay adjacent to the Ashland Lakefront Property is a 30,000 acre bay of Lake Superior. Historically the bay has been an important transportation route for boats and ships transporting materials manufactured or mined in the area to other Great Lakes ports. A dredged shipping channel has been maintained in the bay since the late 1800's. Volume of shipping on the bay has greatly diminished since the Upper Peninsula iron mining and lumbering industries have diminished.

The United States Army Corps of Engineers provided access to two volumes of the Wisconsin/Minnesota Ports and Lake Superior Series. The volumes were reviewed for the years 1945 and 1949. Both volumes indicate that the Port of Ashland included seven commercially available dock facilities. Three of these docks were used for receiving coal, three were ore shipping terminals, and one was used for handling pulpwood and saw logs. The pulpwood and saw logs dock was located at the west side of the Ashland Lakefront Property, and is now occupied by a marina. The docks associated with the lumber mills historically located on the east side of the subject property were dismantled by the time the Harbor Series documents were published.

Records indicate that for a five year period from 1944 to 1948, the following average tonnages of iron ore, coal and pulpwood were handled at the Ashland docks:

Iron Ore	2,677,472 short tons
Coal receipts	312,908 short tons
Pulpwood	69,154 short tons

Although the records reviewed cover only a short period of time, they indicate the type and volume of materials handled at the historically active port.

2.2 Site Investigation History

Environmental investigation of the Ashland Lakefront Property began in 1988 after subsurface contamination was discovered during construction activities at the City of Ashland WWTP. Investigations have since been conducted in the area of the former ravine, offshore sediments, and in a deep regional aquifer. The following is a list of investigation reports reviewed during preparation of this comprehensive document:

- **Northern Environmental** – Environmental Assessment, City of Ashland, Wisconsin Wastewater Treatment Plant Site, August 21, 1989

- **Northern Environmental** – Preliminary Laboratory Results, Ground Water and Soil/Wood Chip Samples from August 28, 1991 Test Pits, Ashland Wastewater Treatment Plant, Ashland, Wisconsin, September 28, 1991
- **SEH** – Remedial Investigation Interim Report, August 22, 1994
- **SEH** – Existing Conditions Report, February 27, 1995
- **Dames and Moore** – Final Report, Ashland Lake Front/Northern States Power Project, Ashland, Wisconsin, March 17, 1995
- **Dames and Moore** – Draft Site Investigation Report and Remedial Action Plan, June 27, 1995
- **SEH** – Draft Remedial Action Options Feasibility Study, February 16, 1996
- **Dames and Moore** – SEH Draft Remedial Action Options Feasibility Study Review Comments, May 28, 1996
- **SEH** – Sediment Investigation Report, July 22, 1996
- **Dames and Moore** – Supplemental Investigation Final Report, August 7, 1996
- **Dames and Moore** – Copper Falls Aquifer Groundwater Investigation, February 27, 1997

The data presented in this report is intended to be a summary of data from the previously listed investigations, along with field observations made by SEH on April 8, 1997. Data unavailable to SEH as of April 8, 1997 were not included in the Comprehensive Environmental Investigation Report.

2.2.1 Environmental Sampling Locations

A total of eight permanent groundwater monitoring wells and two piezometers are currently present on the Ashland Lakefront Property. An additional 9 monitoring wells and 11 piezometers are present in the upper bluff area. Two artesian wells are located on or near the Ashland Lakefront Property, and have been included in the site investigation.

A total of 12 test pits, 23 soil borings, and 8 temporary wells were historically used to collect environmental data at the Ashland Lakefront Property. Eighty sediment probes and six offshore soil borings were performed in Chequamegon Bay adjacent to the property during investigation of offshore sediments. Forty-two soil borings have been performed during investigation of the upper bluff area. Eight of these have been instrumented as monitoring wells, and 11 were instrumented as piezometers. Locations of historic wells, piezometers, soil borings, test pits, and sediment probes are depicted on Figure 3, "Sampling Location Map."

3.0 Physical Characteristics of the Area

The population of the City of Ashland is 9,115 based on 1990 census results. Residents are served by the city's municipal water supply, which is provided from Chequamegon Bay surface water. The surface water intake is located approximately 1,900 feet offshore at Longitude 90°50'29"E and Latitude 46°36'25"N. The intake is located in approximately 23 feet of water and is approximately one mile northeast of the Ashland Lakefront Property.

3.1 Topography

The Ashland area is located in the Lake Superior Lowland physiographic province characterized by flat to undulating topography underlain by red glacial clay. Uplands lie to the south of Ashland and are characterized by rolling hilly topography and underlain by sand and gravel soils. Elevations in the Ashland area range from 601 feet MSL datum (Lake Superior surface elevation) to approximately 700 feet MSL. Regional slope is generally to the north.

The Ashland Lakefront Property is a relatively flat terrace located below a 30 foot high lake bluff. Elevations of the terrace range from 601 MSL to approximately 610 MSL. The elevation of the upper bluff in the vicinity of the former ravine area is approximately 640 feet MSL.

3.2 Surface Water

The Ashland Lakefront Property is located on the shore of Chequamegon Bay. Regional surface water drainage flows to the north through Fish Creek and several small unnamed creeks and swales into Chequamegon Bay. Surface water at the site and in the upper bluff area flows either to the City of Ashland storm sewer system, or discharges directly to Chequamegon Bay.

3.3 Geology

Soils in the Ashland area generally consist of surficial deposits underlain by red clay and silt deposits of the Miller Creek Formation. Thickness of the Miller Creek soils in the Ashland area ranges from approximately 15 to 50 feet based on local well logs. Miller Creek soils are underlain by interbedded glacial clays, sands and gravels of the Copper Falls Formation. Thickness of the Copper Falls Formation is at least 130 feet based on local well logs.

Precambrian aged sandstone of the Oronto Group is likely the uppermost bedrock unit in the Ashland area. Thickness of the sandstone unit has not been determined. The Oronto sandstones are most likely underlain by Precambrian basalt.

Surficial soils at the Ashland Lakefront Property are underlain by a variety of fill materials, including wood waste (slabs and sawdust), solid waste (including concrete, bricks, bottles, glass, steel pieces, wire, and cinders), and earthen fill (including a buried clay berm along the shoreline on the northeast side of the site). Fill materials are underlain in places by a 0 to 5.5 foot thick layer of beach sand. Soils of the Miller Creek Formation are present below the fill and beach sand. The Miller Creek soils encountered at the Ashland Lakefront Property consist of clays and silts and range in thickness from 7 to 40 feet. Silty sand and gravel soils of the Copper Falls Formation are present beneath the Miller Creek soils. Thickness of the Copper Falls Formation at the site has not been determined. Bedrock has not been encountered to-date during investigation of the site.

Geology of the upper bluff area in the vicinity of the former ravine consists of earthen fill materials in the former ravine, with clay soils of the Miller Creek Formation on the flanks of the former ravine. Miller Creek clay soils are present at the base of the former ravine, however, the thickness of these soils has been measured at as little as four feet at one soil boring location. It is unknown whether the Miller Creek Formation exists along the entire base of the former ravine. Sand and gravel layers interbedded with silty clay lenses were encountered below the Miller Creek Formation.

Offshore geology adjacent to the site consists of a discontinuous layer of submerged wood chips on the lake bottom underlain by fine to medium grained sand sediments. The sand sediments are underlain by silts and clays of the Miller Creek Formation. The Copper Falls Formation was not encountered during investigation of offshore sediments. A geologic cross section as shown on Figure 4, "Geologic Cross Section" has been prepared to depict subsurface geologic conditions in the areas of investigation.

3.4 Hydrogeology

A shallow saturated zone is typically found above the contact of the Miller Creek Formation and the overlying surficial soils. Thickness of this shallow saturated zone can locally be up to ten feet, but it is not commonly used as a water supply source. Three aquifers occur in the Lake Superior Basin in the vicinity of Ashland; the Pleistocene sand and gravel aquifer (referred to herein as the Copper Falls aquifer), the Precambrian sandstone aquifer, and the Precambrian basalt aquifer.

The Copper Falls aquifer occurs at approximately 25 to 55 feet below ground surface in the Ashland area. Sandy till units within the aquifer yield low volumes of water (5 to 10 gpm), while sand and gravel lenses can yield up to 100 gpm. The Copper Falls aquifer is confined by the overlying cohesive Miller Creek soils. The Miller Creek Formation functions as an aquitard or confining unit hydraulically separating the shallow saturated zones and the Copper Falls aquifer. Wells screened in the Copper Falls aquifer frequently exhibit artesian conditions in the

Ashland area, particularly close to the Chequamegon Bay shoreline. Static heads of more than 30 feet above the surface of Lake Superior have been reported at some locations along the Ashland shoreline. Thickness of the Copper Falls aquifer is over 100 feet based on deep piezometer boring information from site investigation.

The Precambrian sandstone aquifer is utilized as a municipal water supply source in several nearby communities (e.g., Washburn, Bayfield). Moderate to low permeabilities exist within the sandstone aquifer. Sandstone wells in the Ashland area typically yield between 5 and 50 gpm.

The Precambrian basalt aquifer produces moderate to low yields of groundwater. Yields are typically controlled by fracture densities within the bedrock. The basalt aquifer is commonly used as a water supply source south of Ashland where the aquifer occurs closer to the surface.

A shallow saturated zone is present within the soils and fill materials overlying the Miller Creek Formation at the Ashland Lakefront Property. The hydraulic conductivity of the shallow soils and fill materials ranges from approximately 0.1 to 5×10^{-5} cm/sec. The higher hydraulic conductivity values are typically found in locations with saturated wood waste fill. The horizontal hydraulic gradient is very flat (0.001 ft/ft to the north) due to the high hydraulic conductivities at the Ashland Lakefront Property. Artesian conditions are present at the site in the Copper Falls aquifer. Head levels of approximately 17 feet above ground surface have historically been measured in an artesian well located on the Ashland Lakefront Property, indicating a strong upward gradient at this location.

Hydrogeology of the upper bluff includes low permeability conditions (3×10^{-6} to 4×10^{-8} cm/sec) in the Miller Creek clays comprising most of the shallow saturated soil in the area. Fill soils located in the former ravine exhibit hydraulic conductivities approximately 1,000 times higher than the surrounding Miller Creek soils. Horizontal hydraulic gradient in the fill soils of the former ravine is approximately 0.09 ft/ft. Direction of groundwater flow in this location is to the north (toward the mouth of the former ravine). Groundwater flows onto the ground surface at the base of the bluff in the proximity of the mouth of the former ravine in the form of a seep. The seep is likely caused either by contact of the ravine fill soils with an underlying less permeable layer (contact seep) or by an abrupt change in topography causing the land surface to intersect the shallow water table (depression seep). Artesian conditions have not been identified in the Copper Falls aquifer in the vicinity of the former ravine area or the upper bluff area. An upward hydraulic gradient is present in the Copper Falls aquifer in the northern portion of the upper bluff area, and diminishes and eventually changes to a downward gradient as you move south. The general direction of flow in the Copper Falls aquifer is to the north (toward Chequamegon Bay). A groundwater flow net as shown on Figure 5, "Groundwater Equipotential Contours" has been prepared from available data to depict the two dimensional groundwater flow regime. Groundwater elevation data was unavailable for all monitoring points depicted for a single point in time. Consequently, the flow regime depicted should be considered approximate.

4.0 Nature and Extent of Contamination

Soil, groundwater, and sediment sample analysis has historically been utilized by the consultants investigating the Ashland Lakefront Property to define the degree and extent of subsurface contamination. In addition, observations of the presence or absence of non-aqueous phase liquids (NAPLs) have been made by SEH in several monitoring wells and piezometers. The soils analytical results for the various environmental investigations conducted in the site vicinity are summarized on Table 1, "Soil Analytical Results." Analytical results from samples of various fill materials are included on Table 1. Groundwater analytical results from the historic investigations of the vicinity are summarized on Table 2, "Groundwater Analytical Results." Sediment analytical results from SEH's sediment investigation conducted adjacent to the site are presented on Table 3, "Sediment Analytical Results." Observation results from the NAPL evaluation are included in Table 4, "Non-Aqueous Phase Liquids Measurement and Observations."

Isoconcentration maps were prepared to depict approximate degree and extent of groundwater and sediment BETX (benzene, ethylbenzene, toluene, and xylenes) and polynuclear aromatic hydrocarbon (PAH) contamination in the vicinity of the Ashland Lakefront Property. These isoconcentration maps were developed from groundwater analytical data and sediment data, as well as field observations made during the site investigations. The observations were used to assist in defining extent of contamination between analytical data points. It should be noted that the presence or absence of NAPLs can significantly influence the groundwater concentrations of contaminants at a given location. Therefore, the apparent concentration and distribution of contamination depicted on the isoconcentration maps should be considered approximate.

Figure 6, "Total BETX Shallow Groundwater Isoconcentration Map" depicts groundwater total BETX concentrations in plan view. Figure 7, "Total PAH Shallow Groundwater Isoconcentration Map" depicts total PAH concentrations in plan view. Figure 8, "Groundwater Isoconcentration Contours, BETX" depicts total BETX concentrations in cross section. Figure 9, "Groundwater Isoconcentration Contours, Total PAHs" depicts total PAH concentrations in cross section.

4.1 Soils

As reflected in Table 1, soils at the Ashland Lakefront Property and in the former ravine area have been impacted by a variety of contaminants, including VOCs, PAHs, and metals. The VOCs detected are predominantly comprised of the BETX compounds and naphthalene. PAH compounds detected include most of the compounds analyzed on the EPA SW 846 8260 scan. Lead and arsenic were detected in some soil samples at elevated concentrations relative to background.

Delineation of soils impact is limited to the shallow soils and fill materials lying above the Miller Creek Formation. Due to shallow groundwater in certain areas investigated, many soil samples have been collected at or below the zone of saturation. These samples may exhibit matrix interference due to contaminated pore water within the soil. These results, although not representative of soil contaminant levels, are useful when considering potential remedial action for the soils.

Isoconcentration contours were not plotted for soils contaminants due to the highly variable matrices in the samples analyzed (e.g., soil, fill, wood waste). A detailed description of the soil contaminants identified to-date is presented in the following subsections.

4.1.1 VOC Soil Contamination

Widespread VOC contamination has been identified in the shallow soils at the Ashland Lakefront Property and in the former ravine area. The VOCs consist predominantly of the BETX compounds as well as naphthalene. However, since naphthalene is also included as a parameter in the PAH range, naphthalene contamination will be discussed only in the PAH subsections to avoid redundancy. In addition, several areas of apparent grossly contaminated soils (e.g., "coal tar saturated soils" in Dames and Moore borings B-19 and B-20) which were not analyzed for total concentrations of VOCs (TCLP analysis was performed) were identified during investigation of the former ravine area. No TCLP exceedances for VOCs were identified in the soils analyzed from the former ravine area. No TCLP analysis has been performed to-date on soils from the Ashland Lakefront Property. The extent of VOC-impacted soils approximates the area of shallow groundwater BETX contamination depicted on Figure 6.

4.1.2 PAH Soil Contamination

A wide range of PAH soil contaminants have been identified in shallow soil samples analyzed from the Ashland Lakefront Property and the former ravine area. PAH soil contamination generally begins near the shallow groundwater surface, and extends to the top of the Miller Creek Formation. The horizontal extent of shallow PAH impacted soils includes the soils in the former ravine area, and soils on the Ashland Lakefront Property extending north to the shoreline of Chequamegon Bay. The extent of PAH contaminated soils approximates the overall area of shallow groundwater PAH contamination depicted on Figure 7.

4.1.3 Metals Soil Contamination

Metals contamination identified in the vicinity of the Ashland Lakefront Property includes scattered, potentially isolated areas of elevated lead concentrations. In addition, one soil sample analyzed from the site contained elevated concentrations of arsenic. These concentrations appear to be elevated above the natural levels of metals in the soils of Wisconsin. The scattered areas of metals contamination appear to be most prevalent along the northern portion of the Ashland Lakefront Property. One soil sample collected from the former ravine area contained concentrations of TCLP lead exceeding the TCLP standard for lead. No TCLP metals analysis has been performed to-date on soil samples collected from the Ashland Lakefront Property.

4.2 Groundwater

As indicated on Table 2, groundwater at the Ashland Lakefront Property, in the former ravine area, and in the Copper Falls aquifer have been impacted by a variety of contaminants. A variety of VOCs (predominantly BETX compounds and naphthalene), PAHs, and metals (lead, iron, and manganese) were detected in groundwater samples collected during the investigation. Numerous exceedances of ch. NR 140 Wisconsin Administrative Code (NR 140) groundwater standards have been identified.

The areal extent of shallow groundwater contamination at the Ashland Lakefront Property and in the former ravine area is depicted on Figures 6 and 7. The approximate vertical extent of contamination in both the shallow groundwater and the Copper Falls aquifer is depicted on Figures 8 and 9. It appears the areal extent of groundwater contamination in the Copper Falls aquifer has not yet been fully identified along the northern boundary of the deep plume (based on FID readings at Dames and Moore boring MW-2A). In addition, there is most likely a connection of the shallow and Copper Falls aquifer contaminants through a breach in the Miller Creek Formation. The exact location of the connection between the shallow and deep areas of contamination has not been identified, and is not shown on the Figures. Investigation of the Copper Falls aquifer by Dames and Moore is currently ongoing.

In addition, it is apparent that the distribution and concentration of groundwater contaminants is influenced by the presence of NAPL in the subsurface. A detailed discussion of NAPL contamination is presented in Section 4.3 of this report.

4.2.1 VOC Groundwater Contamination

The groundwater analysis performed during investigation of the Ashland Lakefront Property and vicinity indicates the presence of widespread VOC groundwater contamination. Exceedances of NR 140 Enforcement Standards (ES) for BETX have been identified at widespread locations in the vicinity. The VOCs most commonly detected in the shallow groundwater at the Ashland Lakefront Property include benzene, ethylbenzene, and xylenes.

Significant variation in concentrations of VOC contaminants have been observed within the areas of investigation. The upper portion of the former ravine area, the upper portion of the Copper Falls aquifer, and the offshore sediments contain elevated concentrations of several VOCs, including benzene, ethylbenzene, toluene, 1,2,4- trimethylbenzene, 1,3,5-trimethylbenzene, and xylenes. The contaminants at the Ashland Lakefront Property contain significant concentrations of benzene, ethylbenzene, and xylenes, but significantly lower toluene, 1,2,4-trimethylbenzene, or 1,3,5-trimethylbenzene concentrations.

Concentrations of VOC contaminants in both the deep aquifer and the shallow saturated zone in the former ravine area are generally highest in the vicinity of the TW-13, MW-13A, MW-13B well nest. On the Ashland Lakefront Property, the highest concentrations of VOC groundwater contamination identified is in monitoring well TW-9. BETX isoconcentration maps were prepared both in plan view (Figure 6), and in cross section (Figure 8) to attempt to depict the distribution of VOC groundwater contaminants. No comprehensive analytical data is available for all the groundwater sampling points for a single sampling event. Consequently, the concentrations of BETX depicted on Figures 6 and 8 reflect the average BETX groundwater concentrations at each sampling point over time. The distribution of BETX concentrations shown should be considered approximate.

4.2.2 PAH Groundwater Contamination

A wide range of PAH contaminants has been identified during the groundwater investigations of the vicinity. Exceedances of NR 140 ESs for naphthalene and benzo-a-pyrene have been identified at widespread locations of the investigated area. Generally, the most prevalent PAH compound in the areas of impacted groundwater at the Ashland Lakefront Property, the former ravine area, and in the Copper Falls aquifer is naphthalene. The highest total PAH groundwater concentrations identified in the vicinity to-date were from well TW-9. High total PAH concentrations were also noted at the groundwater-surface water interface (seep) located near the mouth of the former ravine area. The highest PAH concentrations identified in the former ravine area and in the Copper Falls aquifer are located at the TW-13, MW-13A, MW-13B well nest. PAH isoconcentration maps were prepared both in plan view (Figure 7), and in cross section (Figure 9) to depict the approximate distribution of groundwater PAH contamination in the vicinity. No comprehensive round of groundwater analytical results is available to provide PAH groundwater data for all of the sampling points for one time interval. Consequently, the values indicated on Figure 7 and 9 represent the average total PAH concentration at each sampling point over time. The PAH distributions shown should be considered approximate.

4.2.3 Metals Groundwater Contamination

Several dissolved metals were detected at widespread locations during the groundwater investigations. Numerous NR 140 ES exceedances were identified for iron. In addition, NR 140 Preventive Action Limit (PAL) exceedances were identified in one or more groundwater samples for arsenic, cadmium, and lead. The distribution of dissolved metals in groundwater appears to be scattered, and does not appear to correlate with the distribution of groundwater VOC and PAH contaminants.

4.3 Non-Aqueous Phase Liquids

An evaluation was performed to determine the potential presence of NAPLs in the monitoring wells installed at the Ashland Lakefront Property and upper bluff area. The potential presence of Light Non-Aqueous Phase Liquids (LNAPLs) and Dense Non-Aqueous Phase Liquids (DNAPLs) in the subsurface was suspected based on data collected during previous investigations performed at these sites. These data include descriptions of contaminated materials on geologic logs obtained from borings and test pits, elevated concentrations of low solubility constituents in groundwater, and the temporal and spatial variability of contaminants across the investigation area.

4.3.1 Field Evaluation

A field evaluation of potential NAPL was conducted by SEH at the Ashland Lakefront Property and upper bluff area on April 8, 1997. Three methods were used to qualitatively and quantitatively evaluate the presence and volume of potential NAPL in site monitoring wells and piezometers. These methods included immersing a weighted cotton string, a clear bailer, and an interface probe in the wells to determine the presence, approximate thickness, and physical characteristics of NAPL at each location included in the evaluation. The methods used at each well or piezometer were based on the probability of detecting NAPL at a particular location and/or the observed thickness of NAPL within a given well casing. Results of the NAPL evaluation are summarized in Table 4.

Significant quantities of DNAPL were detected in piezometers MW-13A, MW-13B, and in monitoring wells TW-9 and MW-7. Piezometers MW-13A and MW-13B are located in the upper bluff area on St. Claire Street and are screened in the Copper Falls aquifer. Monitoring wells

TW-9 and MW-7 are located at the base of the bluff on the Ashland Lakefront Property and are screened in the shallow saturated zone.

Approximately 2.1 feet of DNAPL was measured in piezometer MW-13A. Piezometer MW-13A is screened 45 feet below ground surface (bgs). The borehole for MW-13A was advanced to a depth of 50 feet bgs. Approximately 26 feet of DNAPL was measured in piezometer MW-13B. The geologic and well construction logs for this well indicate the borehole was advanced and the well completed at a depth of 70 feet bgs.

The DNAPL was detected at the bottom of piezometers MW-13A and MW-13B. A distinct phase separation (i.e., water-product) was evident in these piezometers. The water column above the DNAPL was relatively clear and apparently free of product. The DNAPL sampled in each of these piezometers consisted of a black, oily, low to medium viscosity (thin), highly odorous hydrocarbon material. Considerable staining of the white PVC casing at piezometers MW-13A and MW-13B occurred during the NAPL evaluation. The lack of residual DNAPL on the inside of the well casings prior to SEH's evaluation indicates the presence of DNAPL in these piezometers may not have previously been identified.

The presence of DNAPL is suspected in well TW-13. However, SEH was unable to access this well because the top of the water column was frozen. In addition, the presence of DNAPL is also suspected in piezometer MW-5A, however, SEH was unable to access this well because drums of frozen purge water were stored over the well. Free product (DNAPL and LNAPL) was not observed in any of the other wells or piezometers located on the upper bluff area that were included in SEH's NAPL evaluation.

DNAPL was also measured in monitoring wells TW-9 and MW-7 located at the base of the former ravine area on the Ashland Lakefront Property. Approximately 2 feet of DNAPL was measured in well TW-9. This well is screened from 4 to 14 feet below ground surface. Approximately 5 feet of DNAPL was measured in well MW-7. Well MW-7 is located directly down gradient of the seep area and is screened from 5 to 15 feet below ground surface. The DNAPL measured in wells MW-7 and TW-9 was also found as a separate phase at the bottom of the wells. The apparent physical characteristics (i.e., color, viscosity) of the material observed in wells MW-7 and TW-9 was similar to the DNAPL observed in piezometers MW-13A and MW-13B.

A NAPL emulsion (a mixture of insoluble liquid-droplets and water) was detected in three of the monitoring wells evaluated at the Ashland Lakefront Property. A yellow, low viscosity emulsion was evident on the weighted cotton string and bailer immersed in wells MW-2, MW-3, and TW-6. The emulsion consists of brownish-yellow droplets of hydrocarbon material dispersed throughout the water column in the well. No phase separation was evident in these wells.

Free product (LNAPL or DNAPL) was not evident in the other wells or piezometers monitored during this evaluation. The groundwater observed at these points was generally clear, however, a significant hydrocarbon odor was apparent in several of these observation points. In addition, an LNAPL phase (floating product) was not evident in any of the wells or piezometers evaluated. The absence of NAPL in the wells or piezometers does not necessarily mean it is not present in the subsurface. Many factors including screen placement, well construction design and installation, and capillary forces will influence and determine whether DNAPL will enter a monitoring well or piezometer.

4.3.2 Non-Aqueous Phase Liquid Evaluation Results

The results of SEH's NAPL evaluation clearly indicate the presence of significant quantities of DNAPL in the subsurface of the upper bluff area and the Ashland Lakefront Property. Data collected during previous investigations, including geologic logs for borings advanced in the former ravine area and at the Ashland Lakefront Property, and observations of test pits excavated at the Ashland Lakefront Property, indicate the potential presence of NAPL across other areas of the two sites. It should be noted that several of the temporary wells at the Ashland Lakefront Property have been abandoned and consequently were not available for NAPL inspection.

The apparent low viscosity of the DNAPL and emulsified NAPL observed in the monitoring wells and piezometers indicates the potential for significant mobility of NAPLs within the subsurface. The presence or absence of NAPL in the monitoring wells observed during this evaluation (and the techniques used for sampling), likely accounts for much of the spatial and temporal variability evident in the groundwater analytical data throughout the investigation area. The presence of NAPL in a sample or well can significantly increase the concentration of contaminants detected in relation to samples or wells in which NAPL is absent.

4.4 Sediments

As reflected on Table 3, offshore sediments located immediately adjacent to the Ashland Lakefront Property have been impacted by VOCs (predominantly BETX compounds) and by PAH compounds.

Cleanup of offshore sediment contamination is not currently regulated by ch. NR 720, Wisconsin Administrative Code, for cleanup of contaminated soils. Sediment cleanup criteria is typically determined by developing sediment quality objectives (SQOs). SQOs are most commonly expressed as contaminant concentrations in the biologically or hydrologically active zone of sediment deposits. SQOs reflect levels of contamination that are protective of all present and reasonably anticipated prospective uses of the aquatic ecosystem at the site of contamination.

The prospective uses of aquatic ecosystems like Chequamegon Bay include:

- Consumption of fish by recreational and/or subsistence anglers;
- Propagation and health of aquatic life, including benthic macroinvertebrates and fish;
- Propagation and health of wildlife, including piscivorous birds and mammals; and
- Supply of water for consumptive uses, including drinking.

WDNR guidance on contaminated sediment cleanup decisions, including development of SQOs to protect various beneficial uses is currently under development. In the interim, the WDNR water resources group recommends utilizing guidelines prepared by the Province of Ontario and by the National Oceanic and Atmospheric Administration (NOAA) for initial screening of the site to assess whether the offshore contaminants identified potentially pose an environmental risk. Ecological risk posed by contaminated sediment and the need for remediation at the site was assessed based on review of these guidelines.

The concentrations of sediment contaminants identified adjacent to the Ashland Lakefront Property were compared to the Province of Ontario and NOAA guidelines for several PAHs and metals. Exceedances of Ontario and/or NOAA guidelines for one or more PAH compound were measured in sediment samples collected as far as 700 feet offshore. Exceedances of Ontario or NOAA guidelines were generally not identified for metals. Details regarding the exceedances of these guidelines is presented in the Sediment Investigation Report (SEH, 1996). The extent of sediment contamination is depicted on Figures 6 and 7.

4.4.1 VOC Sediment Contamination

Several VOCs were detected in sediment and soil samples collected during offshore investigation adjacent to the Ashland Lakefront Property. The VOCs most consistently detected in the offshore samples included benzene, ethylbenzene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and xylenes. Generally, the extent of offshore VOC contamination is contiguous with the north shoreline of the Ashland Lakefront Property, forming three undulating lobes that extend up to 700 feet offshore. The areal extent of offshore contamination is depicted on Figure 6. Vertically the offshore VOC contaminants are generally concentrated in the upper four feet of lake bottom, at or near the interface of a layer of submerged wood chips and the underlying granular sediments. Offshore VOC concentrations generally decrease with depth below lake bottom. Downward movement of offshore contamination is limited by the Miller Creek Formation soils. VOCs were generally not detected in offshore samples collected east of the Kreher Park boat landing or west of Ellis Avenue.

No regulatory criteria for VOC contamination of sediments has been identified at this time. No Province of Ontario or NOAA Guidelines for these compounds were developed at the time of this report.

4.4.2 PAH Sediment Contamination

A wide range of PAH contaminants were identified in the offshore sediment and soil samples analyzed from adjacent to the Ashland Lakefront Property. The horizontal extent of offshore PAH impacts is approximately the same as that indicated for offshore VOC contamination. Vertically, the offshore PAH contamination is generally most concentrated within the upper four feet of sediments at the interface of the wood chips layer and the underlying sand. Downward movement of offshore PAH contaminants is limited by the Miller Creek Formation soils. Approximate extent of offshore PAH contamination is depicted on Figure 7.

Numerous exceedances of both the Ontario Sediment Quality guidelines and the NOAA guidelines for PAHs were identified in sediments collected from adjacent to the Ashland Lakefront Property. It appears likely that benthic biota are being adversely affected by the PAH-impacted sediments based on the PAH sediment concentrations identified to-date.

4.4.3 Metals Sediment Contamination

Offshore sediment and soil samples were analyzed for a variety of metals and select parameters, including arsenic, cadmium, chromium, copper, lead, nickel, zinc, and cyanide. The concentrations of metals analyzed were generally below background concentrations identified during previous investigations of pre-colonial Great Lakes sediments. No significant offshore metals contamination has been identified adjacent to the Ashland Lakefront Property.

5.0 Contaminant Fate and Transport

This section addresses the release of contaminants from potential source areas in the vicinity of the Ashland Lakefront Property and their subsequent transport and fate in the environment. Environmental fate and transport is dependant on the physical and chemical properties of the contaminants, the environmental transformation processes affecting them, and the properties of the matrix through which they migrate.

5.1 Potential Source Areas

Several potential sources of subsurface contamination have been identified in the vicinity of the Ashland Lakefront Property. Historical documents and anecdotal information provide insufficient evidence regarding which potential sources are conclusively responsible for the contamination of the Ashland Lakefront Property and sediments. The initial site investigation performed by Northern Environmental concluded the Ashland Lakefront Property contamination was the result of wood treatment with creosote. SEH identified three potential sources of contamination on the Ashland Lakefront Property; possible wood treatment activities, potential contamination from the upgradient MGP, and historic filling activities at the site. Dames and Moore identified several potential sources of contamination at the Ashland Lakefront Property including, potential onsite wood treatment activities, historic filling activities, spills from possible wood treatment along the railroad right of way, use of the historical open sewer, an unidentified source in the vicinity of the seep, and groundwater contamination migrating onto the property from the former ravine area.

SEH and Dames and Moore are in agreement that the probable source of contamination in the former ravine area and in the Copper Falls aquifer is from waste disposal activities at the historic MGP. The source of sediment contamination adjacent to the Ashland Lakefront Property is most likely attributable to one or more of the aforementioned potential source areas. The following subsections provide a summary of information regarding potential sources of contamination.

5.1.1 Onsite Wood Treatment

Lumber processing activities took place at the site from the late 1800's until approximately 1930. Historic documents observed to-date pertaining to lumber yard operations do not indicate whether or not treatment of lumber took place at the site. However, some anecdotal information obtained from long-time Ashland residents indicates that wood treatment may have occurred at the site. Numerous long-time residents recall an area of black tarry material some of whom recall as a wood treatment pit or structure located in the approximate location of the "Coal Tar Dump" shown on a 1951 Greeley and Hanson site plan. Other individuals contributing anecdotal information indicate the black tarry substance was from disposal of MGP wastes at the Ashland Lakefront Property. It has not been determined whether the source of the "Coal Tar Dump" was in fact the dumping of MGP waste materials at this location, the use of wood treatment compounds at this location, some combination of these potential contaminant sources, or if the "Coal Tar Dump" ever really existed.

Research on the history of wood treating indicates that wood treating processes for preservation changed a number of times during the late 1800's and early 1900's. Wood treatment at this time was unregulated with regard to specific material and treatment procedures.

In general, the early wood preservative methods included dipping or direct application of metallic salts and coal tar materials. The coal tar materials used were often by-products generated from the manufacturing of coal gas, and were generally not processed further prior to use. Many facilities used coal tar/kerosene mixture as a wood preservative. For many years, wood preservation chemicals were produced by distilling wood. This was found to be an inferior preservative compared to coal tar creosote.

By 1930, true creosote was being actively distilled from coal tar to remove the volatile fraction (<210 degrees Celsius boiling point) and heavy oils (>450 degrees Celsius boiling point). The resulting true creosote is comprised primarily of 18 PAH compounds. A majority of these have been identified at the Ashland Lakefront Property. Since creosote is a distillate of coal tar, the two products are very similar.

5.1.2 Manufactured Gas Plant Operations

A MGP operated at the southeast corner of St. Claire Street and 3rd Avenue from the late 1800's until approximately 1947. The MGP initially utilized coal carbonization methods and was later converted to carburetted water gas process methods. Several waste streams are generated from operation of MGPs. Organic wastes include coal tar, light oils, and oil/water emulsions. These wastes generally consist of PAH (naphthalene rich) and BETX compounds similar to those found throughout the area of investigation. Inorganic wastes generated during purification of the gas include several metals, ammonia, cyanide, nitrates, sulfates, and thiocyanides. The organic wastes vary significantly based on process, feed stock, and residual material reuse. Inorganic wastes vary based on process and feedstock.

Contamination of the former ravine area and the Copper Falls aquifer apparently occurred due to release of waste products created during operations of the MGP. Some contaminated groundwater is migrating from the former ravine area onto the Ashland Lakefront Property. The proportion of contamination at the Ashland Lakefront Property and potentially in offshore sediments that is attributable to MGP activities has not been determined at this time.

5.1.3 Historic Filling Activities

Various waste materials have reportedly been disposed onsite by historical owners of the property and potentially by unauthorized individuals. The Ashland Lakefront Property was created through the placement of fill materials at the base of the former lakeshore bluff from the 1870's (or earlier) until approximately 1970's. The majority of the fill materials observed at the Ashland Lakefront Property consists of slabwood and sawdust. However, it appears disposal of municipal solid wastes, fly ash, dredge spoils, and earthen fill materials have occurred in various locations on the Ashland Lakefront Property. The fill materials reportedly disposed on the property do not appear to be the source of the widespread VOC and PAH contamination identified at the site to-date. However, the fill materials may be responsible for some of the metals contamination identified at the Ashland Lakefront Property.

The fill material identified in the former ravine area generally consists of earthen fill materials. The earthen fill in the former ravine area is not likely to be the source of the VOC or PAH contamination identified at this location. However, fill materials within the former ravine area may be the source of some or all of the metals contamination identified at this location.

5.1.4 Open Sewer

An open sewer is depicted on historic Sanborn Fire Insurance maps dating from 1901 to 1951. It is not clear whether the open sewer was used for stormwater or sanitary water discharge to Chequamegon Bay. The potential exists that contaminants within the open sewer effluent may be responsible for subsurface contamination in the vicinity of the open sewer as well as in the offshore sediments. The source of possible VOC and PAH contaminants within the open sewer discharge (if different from the source of other onsite and upgradient subsurface VOCs and PAHs) has not been identified.

5.1.5 Area South of Seep

Dames and Moore has indicated that an unidentified source of contamination may exist just to the south of the seep area on the Wisconsin Central Railroad property. The nature of this potential unidentified source of contamination has not been determined.

5.2 Persistence, Fate, and Transport of Contaminants

This section provides a general overview of the persistence, fate, and transport mechanisms for the contaminants of interest for the Ashland Lakefront Property. This information is included as a reference to qualitatively assess the potential for these constituents to persist and migrate in the environment. Due to the number and diversity of individual constituents detected during the investigations performed at the Ashland Lakefront Property and in the upper bluff area, this section will focus on the two major classes of constituents (organic compounds and metals) detected in the various media sampled at these sites.

5.2.1 Contaminant Transport in the Vadose (Unsaturated) Zone

Contaminants are transported through the soil or unsaturated zone above the water table as dissolved constituents. Contaminants may also move through the unsaturated zone as non-aqueous phase liquids or migrate in the gaseous phase. The movement of contaminants in the vadose zone is greatly affected by soil hydraulic conductivity, soil moisture content, pore pressures, and the physical-chemical properties of the contaminants.

Contaminants in the dissolved phase will generally move vertically down through the unsaturated zone until the capillary zone, water table, or low hydraulic conductivity layers are encountered. The soil moisture will infiltrate through the unsaturated soil in response to matric potential (capillary pressures) and gravity. The dissolved contaminants will move through the soil by advection with the soil moisture and through diffusion. Water and dissolved solutes may not move as a uniform front as they infiltrate through the soil. Preferential pathways due to changes in soil structure, texture, permeability or other soil heterogeneities may allow water or contaminants to migrate at a rate greater than expected.

5.2.2 Contaminant Transport in Groundwater

Advection and diffusion are the two primary processes by which contaminants dissolved in groundwater are transported. Advection is the transport of a non-reactive solute (dissolved ions) at the same speed as the average linear velocity at which groundwater flows through an aquifer.

Diffusion is the process by which solutes in the groundwater move from areas of higher concentration to areas of lower concentration. In materials with very low permeability (e.g., clays), groundwater may move very slowly. Under these conditions, diffusion may be more important than advection, and a solute may travel faster than the rate of groundwater flow.

In addition to these two transport processes, a third influencing mechanism is dispersion. As contaminated groundwater flows through an aquifer, dispersion will cause mixing and dilution of solutes in water. Dispersion is caused primarily by heterogeneities (i.e. physical characteristics of the soil materials) in the subsurface materials. Heterogeneities in the aquifer may cause solutes in the groundwater to spread more quickly or slowly than expected. Constituents dissolved in groundwater will always follow the most permeable pathways.

Predicting the rate of contaminant movement in soil or groundwater is complicated by chemical and biological processes which may retard the movement of solutes, causing them to flow more slowly than the advective rate of groundwater.

5.2.3 Multi Phase Flow

Contaminant movement through soil or groundwater is further complicated by the presence of immiscible liquids such as LNAPLs (less dense than water) or DNAPLs (more dense than water). If NAPLs are released on the ground surface they will migrate vertically down through the vadose zone in response to gravity and capillary pressures. As the NAPLs are infiltrating through the soil, a portion of the volatile fraction may partition into the air as a vapor phase and migrate through the vadose zone. If LNAPLs are present in the soil in sufficient quantity, they may migrate until they intersect the capillary fringe above the water table and begin to pool. The pooling LNAPL will eventually displace the capillary fringe and rest directly on the water table. Soluble LNAPL components in contact with groundwater will eventually dissolve and move by advection with groundwater. Undissolved LNAPLs may flow due to gravity along the slope formed by the shallow groundwater surface.

If DNAPL is present in sufficient quantity, it will continue to migrate vertically downward through the saturated zone until it reaches a low permeability layer (aquitard) where capillary pressures cannot be overcome. The DNAPL will then begin to accumulate. Mobile DNAPL can migrate laterally on top of the aquitard following the direction of downward slope. This migration can be independent of the direction of groundwater flow. The more soluble components in the DNAPL will dissolve and move by advection with groundwater.

5.2.4 Organic Compounds

The basic elements of transport and fate of organic compounds include:

- Physiochemical properties of the chemicals;
- Transport processes in the environment; and
- Transformation processes.

The major chemical or biological processes currently recognized as having a significant effect on attenuation of organic contaminants include sorption, chemical reaction, and biological transformation.

Sorption of organic constituents in solution onto sediment and soil is most effective for solutes that are non-polar and relatively insoluble (i.e., PAHs). An increase in organic matter in the soil or sediment increases the degree of sorption.

The major mechanisms of chemical transformations of organic compounds in water are photolysis, oxidation, hydrolysis, and reduction. Biodegradation of organic constituents by microbes is probably the most important transformation mechanism.

The physical and chemical properties for select VOC and PAH constituents detected in groundwater and sediment samples collected during this investigation are presented in Table 5, "Physical and Chemical Properties of Select Volatile Organic Compounds and Polynuclear Aromatic Hydrocarbons." Because of the number and diversity of organic constituents detected, and the availability of data for select constituents, the data in the table are not inclusive of the constituents that may be present at the site. These data represent two major classes of hydrocarbon constituents (VOCs and PAHs) detected at the Ashland Lakefront Property and help to qualitatively assess how constituents with different physical-chemical properties are likely to behave in the environment.

The solubility of chemicals in water gives an indication of the relative mobility of chemicals in the environment. Chemicals with high water solubility tend to remain dissolved in the water column rather than partition to soil or sediment, are less likely to volatilize from water and bioaccumulate in aquatic organisms, and are more likely to biodegrade. As shown in Table 5, the solubilities of VOCs are significantly greater than the PAH compounds detected at the site.

The specific gravity of a substance is the ratio of the weight of a given volume of that substance to the weight of the same volume of water. Pure substances that have a specific gravity less than 1.0 will float on water, while substances with specific gravities greater than 1.0 will sink in water. The aromatic VOC compounds (BETX) listed in Table 5 have specific gravities less than 1.0 while the chlorinated hydrocarbon 1,1,1-trichloroethane and the PAHs have specific gravities greater than 1.0.

The vapor pressure and Henry's Law constants give an indication of a chemicals volatility. The greater the vapor pressure and Henry's Law constant of the chemical, the more likely the chemical will volatilize from soil/sediment and or water (depending on vapor pressure and solubility). The data in Table 5 show that the majority of PAH compounds have significantly lower vapor pressures and Henry's Law constants than the VOCs.

The octanol/water partition coefficient (Log K_{ow}) and the soil adsorption coefficient (Log K_{oc}) are useful for determining the potential for leaching and/or adsorption to soil and sediment. Pure chemicals with high Log K_{ow} and Log K_{oc} values are generally less mobile and more likely to adsorb to soil/sediment. PAHs have significantly higher K_{ow} and K_{oc} values than VOCs.

Based on the data presented in Table 5, it is apparent that most PAH compounds are expected to be less mobile relative to the VOCs. The low water solubility, vapor pressure, and Henry's Law constant's for the PAH compounds suggest that PAHs are more likely to partition (adsorb) to soil or sediment and bioaccumulate in aquatic organisms, and less likely to volatilize from water compared to the VOCs. The greater Log K_{ow} and Log K_{oc} values for the PAHs also suggest a greater affinity for adsorption to soil and sediment than the VOCs. The high specific gravity values for the PAHs (and chlorinated hydrocarbons) indicate that PAHs would have a tendency to sink in the water column while the aromatic VOCs would have a tendency to rise or float in water.

5.2.5 Metals

The primary attenuation processes controlling metal ion concentrations in soil/sediment and groundwater include adsorption-desorption and solution precipitation reactions. Metal ions are relatively immobile in normal groundwater and surface water conditions due to their limited solubility and their affinity for adsorption to soil/sediment particles. Metal ions are generally more mobile in water with low pH, where metals occur as a charged metal ion. As pH increases, metal mobility generally declines as metal precipitates form. The mobility of metals can also increase if attached to mobile colloids.

5.3 Fate and Transport Summary

Based on the results of the investigations performed to-date, NSP and Kreher Park, it is apparent that widespread contamination exists in the project area. The media affected by the contamination includes soil, sediment, surface water, and groundwater. Contaminant releases to air near the site have not been measured to-date, but are likely occurring to a limited extent under existing conditions. Volatile compounds are likely migrating in the vadose zone and venting to the atmosphere. Limited volatilization may also occur from impacted surface water (i.e., Chequamegon Bay and the seep).

VOC and PAH contaminants are found in the ravine fill, shallow groundwater, and the deeper Copper Falls aquifer in the dissolved phase, as an emulsion, and as immiscible liquids (DNAPL). The DNAPL measured in the Copper Falls aquifer may have migrated vertically downward through natural or man-made breaches in the clay aquitard (Miller Creek Formation) in the vicinity of the former ravine area. The extent and migration of DNAPL in the Copper Falls aquifer has not been determined. DNAPL migration in the ravine fill likely occurred along the base of the former ravine area under the influence of gravity. The apparent low viscosity of the DNAPL observed in the piezometers screened in the Copper Falls aquifer and monitoring wells screened in the shallow saturated zone indicates the potential for significant mobility within the subsurface.

Significant VOC and PAH concentrations are present in the dissolved phase in the shallow groundwater as well as in the Copper Falls aquifer. The soluble contaminants in the DNAPL in the deep aquifer will dissolve in groundwaters. The dissolved phase contaminants will continue to migrate by advection in groundwater toward the north.

The presence of DNAPL in the shallow unconfined aquifer and ravine fill provide a continuous source of contaminants to groundwater. Dissolved phase contaminants migrate in the ravine fill and shallow unconfined aquifer by advection in groundwater. However, the degree of advective flow in the fill materials below the Ashland Lakefront Property is unknown. Water elevations measured in monitoring wells screened in the fill indicate a very low hydraulic gradient across the site due in part to the open or porous nature of the fill material. It is possible that movement of water within the fill is partially affected by water level fluctuations and water movement in the bay.

The presence of DNAPL was also detected at the base of the shallow aquifer in areas below the Ashland Lakefront Property. In addition, an emulsion consisting of hydrocarbon droplets dispersed in water was detected in several of the wells and test pits at the Ashland Lakefront

Property. Constituents in the DNAPL and emulsion will continue to dissolve and contaminate the groundwater below this site.

LNAPLs were not detected in monitoring wells at these sites. However, it is possible that some of the elevated VOC concentrations measured at the site are related to the presence of LNAPLs. If present, LNAPLs would move in the direction of groundwater flow. It should be noted that the presence or absence of NAPL in the aquifer, and the techniques used to sample the groundwater, significantly affect the concentration of contamination detected in the samples as well as the consistency of concentrations from one round of sampling to the next at individual sampling points.

The extent of VOC and PAH contaminated sediment in Chequamegon Bay appears to be confined to the nearshore (within 700 feet) environment north of the Ashland Lakefront Property. The mapped horizontal extent of PAH and VOC contaminated sediment roughly follows the configuration of the north shoreline of the Ashland Lakefront Property. Visual observation sampling and analysis of sediment to the west of the Ashland Lakefront Property and beyond 700 feet north of the north shoreline did not indicate the presence of PAH and VOC contaminated sediment. The mapped distribution of contaminated sediment in the bay is possibly due to periodic resuspension of the sediment caused by bioturbation, wave action, and seiche effect and the lateral transport of contaminants and sediment by longshore or littoral currents.

The surface water quality in Chequamagon Bay has not been assessed. However, the physical-chemical characteristics of the constituents of interest detected during the sediment study suggest that concentrations of contaminants in sediments would be higher than the concentrations in the overlying water column. The high specific gravity, low solubility, and affinity for adsorption to sediment will tend to concentrate these contaminants in the sediment. The PAH and VOC contaminated sediment is concentrated at the wood debris/sediment-water interface and concentrations generally decrease with depth. The presence of contaminated sediment and NAPLs across the surface of the lake bed is consistent with the physical-chemical characteristics of the contaminants. The distribution pattern of contaminants in the bay, and the absence of sedimentation above the wood or NAPL contaminated sediment, is consistent with periodic resuspension and redeposition physical processes likely occurring in the bay.

The physical-chemical characteristics described above are based on pure chemicals. The mobility and bioavailability (toxicity) of the contaminants will be significantly greater if the original waste products were "cut" with solvents (i.e., kerosene or benzol). In addition, the physical characteristics for pure chemicals do not account for co-solvency or multi-solute effects.

The mixing of numerous chemical constituents would tend to decrease the viscosity and increase the solubility of the heavier distillates, thereby increasing their mobility and bioavailability.

6.0 Discussion

The results of environmental investigation activities performed at the Ashland Lakefront Property indicate widespread contamination is present in the vicinity of the site. Vertically, contaminants are located in the soils and groundwater overlying the Miller Creek Formation, and in the Copper Falls aquifer directly beneath the Miller Creek Formation. The Miller Creek Formation acts as an aquitard limiting vertical movement of groundwater and contaminants from the shallow and deep areas of contamination.

The areal extent of shallow subsurface contamination identified to-date at the Ashland Lakefront Property includes approximately ten impacted acres on the Kreher Park property, one impacted acre upgradient from the site in the former ravine area, and ten acres of impacted offshore sediments. Contamination has also been identified in the Copper Falls aquifer, however, the extent of contamination in this aquifer may require further delineation.

NAPLs are present at several locations throughout the area investigated. Significant quantities of DNAPLs appear to be present in the Copper Falls aquifer below the upper bluff area. DNAPLs are also present in the shallow saturated zone within the former ravine area. DNAPLs have been observed in the monitoring wells located on the Ashland Lakefront Property downgradient of the former ravine area. The DNAPLs appear in these areas as a black low viscosity liquid. Emulsified NAPLs of lighter color occur in the shallow aquifer in many wells at the Ashland Lakefront Property. Observations made during sediment sampling also indicate the presence of NAPLs similar in characteristics to the DNAPLs in areas adjacent to the Ashland Lakefront Property.

The apparent low viscosity of the DNAPL observed in the monitoring wells indicates the potential for significant NAPL migration within the subsurface. These observations contrast with statements in previous Dames and Moore reports which suggest the coal tar (DNAPL) is immobile in the subsurface. These statements include the following: "This material is highly viscous, and cannot easily migrate" and "The migration rate (i.e., potential flow rate through fill and unconsolidated, silty sand) of the coal tar is assumed to be zero. This is based on evidence suggesting the viscosity of coal tar dictates its inability to flow horizontally" (Dames and Moore, 1995).

The organic chemistry of contaminants located in the Copper Falls aquifer, former ravine area, Ashland Lakefront Property, and offshore sediments is similar in that the contaminants consist a naphthalene-rich liquid containing a wide spectrum of PAH and VOC compounds. The variations in concentration and distribution of individual PAHs or VOCs are possibly attributable to different waste sources (e.g., MPG wastes vs. wood treatment wastes), historic changes in production processes or waste disposal practices (e.g., MGP switching from coal carbonization to carburetted water gas process), or geochemical or biodegradation processes. In addition, the presence or absence of NAPL along with the well sampling and analytical techniques used likely accounts for some of the temporal and spacial variability observed in groundwater concentration data.

Contamination in the Copper Falls aquifer appears to have originated from operation of the former MGP. Contaminants apparently entered the aquifer through a breach in the Miller Creek Formation. The location of the connection between the shallow contamination and the Copper Falls aquifer contamination has not been determined. However, it appears the breach in the Miller Creek Formation most likely exists somewhere in the vicinity of the TW-13, MW-13A, MW-13B well nest. The vertical extent of contamination indicates DNAPL are migrating downward through the Copper Falls aquifer. Concentrations of contaminants appear to diminish with depth, although exceedances of NR 140 ESs have been identified in the deepest piezometer installed in the former ravine area (134.5 feet bgs). The horizontal extent of contamination in the Copper Falls aquifer does not appear to be defined to the north based on field observations (strong odors, elevated FID readings) made in the northernmost deep environmental boring (MW-2A) performed to-date. This piezometer appears to be screened below the area of impact.

The sources of shallow contamination and offshore contamination in the vicinity of the property have not been definitively identified to-date. The source of shallow contamination (except metals) in the former ravine area appears to be operations of the former MGP. It also appears that contaminated groundwater is migrating onto the Ashland Lakefront Property in the vicinity of the seep near the mouth of the former ravine area. It appears most likely that these contaminants are from MGP wastes historically placed in the ravine. However, an additional unidentified source of contamination located beneath the Wisconsin Central railroad right of way may be present. The presence, absence, or nature of this potential source of contamination has not been identified to-date.

A potential additional source of contamination on the Ashland Lakefront Property is the material comprising the "Coal Tar Dump" depicted on a 1953 site drawing prepared by Greeley and Hanson. Whether the material located in this area is in fact coal tar, wood treatment residuals, or some combination of these wastes has not been determined. The potential also exists that wood treatment may have historically occurred at other locations on the Ashland Lakefront Property. However, conclusive evidence of this has not been found to-date.

The sediment contamination appears to be chemically and physically similar to the contaminants at the Ashland Lakefront Property and in the former ravine area. The source(s) of offshore organic contaminants are almost certainly one or more of the same source(s) as identified at the Ashland Lakefront Property. The mode of contaminant transport to the sediments was likely through subsurface seeps, historic surface water runoff, or possible discharge of contaminants from one or more of the aforementioned source areas through the historic open sewer. The offshore distribution of sediment contamination may be caused by various physical forces, including offshore and littoral currents, longshore drift, and sediment resuspension and settlement during periods of high energy.

7.0 Conclusions

Based on SEH's review of the environmental investigations performed in the vicinity of the Ashland Lakefront Property to-date, a number of issues of consensus have been reached between consultants regarding the existing site conditions. However, there is disagreement between consultants on some issues due to varying professional interpretations of a very complex subsurface environment. The following is SEH's interpretation of the important areas of consensus, major areas of disagreement, and important unknowns presented by the consultants involved in the project. Apparently minor areas of consensus or non consensus were not included for the sake of brevity.

7.1 Issues of Consensus

Based on review of project documents, SEH believes the consultants currently involved in investigation of the vicinity are in general consensus on the following points.

- The general site conditions and industrial history of the Ashland Lakefront Property and former ravine area have been defined.
- The degree and extent of shallow contamination (above the Miller Creek Formation) has been adequately defined to consider remedial options.
- A majority of the subsurface contamination consists of various phases of naphthalene-rich organic liquids impacting soil, groundwater, and sediment.
- Sporadic inorganic contamination (primarily lead) exists on the Ashland Lakefront Property and in the former ravine area, which appears to occur independent of the organic contamination.
- Free phase DNAPLs, DNAPL emulsions, and potentially LNAPLs, are present within the areas of investigation.

- Organic contamination in the former ravine area and in the Copper Falls aquifer appears to have originated from the former MGP.
- At least some contaminated groundwater is migrating from the former ravine area onto the Ashland Lakefront Property.

7.2 Issues of Non-Consensus

The following are issues where the consultants currently involved in the project disagree based on differing professional interpretation of complex site data.

- Shallow aquifer hydrogeology in the vicinity of the seep. Dames and Moore believes the shallow groundwater within the former ravine area is hydraulically separate from the shallow groundwater at the Ashland Lakefront Property. SEH believes there most likely is a subsurface connection of shallow groundwater flowing from the former ravine area to the Ashland Lakefront Property. Additional investigation of the seep area may be required to determine which interpretation of shallow hydrogeology at this location is correct.
- Degree and extent of deep aquifer contamination. Dames and Moore believes the degree and extent of deep aquifer contamination has been defined, and that the contaminant plume is in steady state or equilibrium conditions. This opinion is based on the estimated time since contaminant migration from the source area (as much as 100 years), together with the estimated horizontal advective groundwater flow velocity within the portion of the aquifer where the plume is located (45 ft/yr), and the lack of significant contamination reported in the Northern Environmental borings located downgradient from piezometer MW-2A. SEH believes extent of deep contamination to the north may not be defined. This opinion is based on the Northern Environmental borings being geotechnical rather than environmental borings, and that a note on one of the boring logs indicates that photoionization detector used for field screening may have been defective during drilling of some of the deep Northern Environmental borings. Field instrumentation readings and field observations at the northernmost deep environmental borings installed by Dames and Moore (MW-2A NET) indicate probable contamination directly beneath the Miller Creek Formation. SEH believes the northern extent of this contamination may not be defined as yet.
- Conclusive evidence of former wood treatment activities at the Ashland Lakefront Property. Dames and Moore states it is a fact that much of the Ashland Lakefront Property was contaminated with coal tar creosote and other wastes. SEH believes that former wood treatment activities may have occurred at the Ashland Lakefront Property, and that at least a portion of the subsurface contamination may have resulted from wood treatment activities, However, the evidence to-date on the presence or absence of wood treatment at the

site is often conflicting. Numerous affidavits state wood treatment activities occurred at the Ashland Lakefront Property or approximately three blocks to the east. However, several long-term Ashland residents indicated wood treatment activities did not occur at the Ashland Lakefront Property. A "Coal Tar Dump" is depicted on a historic site drawing. However, no maps or drawings depicting wood treatment areas or structures on the Ashland Lakefront Property have been identified to date. SEH does not believe conclusive evidence of the presence or absence of historic wood treatment at the Ashland Lakefront Property has been identified to-date.

- The likelihood that wastes from the MGP may be a significant contributor to the organic contaminants identified at the Ashland Lakefront Property and potentially in the offshore sediments. Dames and Moore believes low levels of contaminated groundwater are migrating from the former ravine area onto the Ashland Lakefront Property. However, Dames and Moore believes downgradient migration of NAPLs from the former ravine area is unlikely due to their estimated high viscosity (5,660 cp) for coal tar. Dames and Moore believes a more likely source of NAPLs within the wood waste at the Ashland Lakefront Property is coal tar/creosote wastes associated with lumber treatment.

  Based on SEH's April 8, 1997 field observations, it appears, the NAPLs identified in several monitoring wells and piezometers located in the former ravine area and on the Ashland Lakefront Property are far less viscous (and thus much more mobile) than Dames and Moore has estimated. SEH believes it is likely that NAPL contaminants have historically migrated from the former ravine area onto the Ashland Lakefront Property and potentially to the offshore sediment. Based on investigation results, ongoing migration of NAPLs may be occurring.

- The presence or absence of a separation of contaminants between the vicinity of monitoring wells TW-6 and TW-9 at the Ashland Lakefront Property. Dames and Moore believes that the contamination identified at TW-6 is separate from contaminants at TW-9, and that these areas of contamination are from two separate source areas. This is based on the relatively clean groundwater analytical results from well TW-4, a soil sample analyzed from TP-3 containing only low concentrations of contaminants, and an apparent clay ridge present between TW-6 and TW-9 that may limit migration of DNAPLs between these two points.

  SEH believes the organic contamination between TW-6 and TW-9 is most likely connected. This is based on similar contaminants at the two locations in question, and apparent NAPLs observed during excavation of TP-3. This appears to indicate the contaminant migration pathway between TW-6 and TW-9 (if present) is to the south of former temporary well TW-4.

7.3 Unknowns

The following are unknown issues which may require additional investigation.

- Presence and nature of additional potential sources of contamination (open sewer discharges, unidentified source south of seep).
- Define whether a contiguous contaminated zone exists between wells TW-6 and TW-9.
- Identify the viscosity of NAPL contamination in the former ravine area and at the Ashland Lakefront Property.
- Presence and location of potential wood treatment or creosote pits at the Ashland Lakefront Property.
- Determination of whether the "Coal Tar Dump" is in fact dumped MGP wastes or wood preservative material.
- Impacts to offshore biota and potential human health risks from exposure to offshore contaminants.
- Remedial alternatives for addressing the various areas of contamination.

8.0 Standard of Care

The conclusions contained in this report were arrived at in accordance with generally accepted professional practice at this time and location. Other than this, no warranty is implied or intended. As part of this report, SEH has made interpretations of conclusions provided by other consultants involved in the project. Any misinterpretation of another consultant's professional opinion made by SEH in this report was inadvertent.

JEG/jeg/ls/CWI

Tables

Table 1
Soil Analytical Results

Analytical Parameters	ch. NR 720 soil cleanup standards	Site Location/Boring or Test Pit No./Depth (ft)/Date																													
		Ashland Lakefront Property																													
		88-2/88-5	88-4	TW-1		TW-2		TW-3	TW-4	TW-5			TW-6			TW-7	TW-8	TW-10		TW-11	TW-12	TP-1	TP-2		TP-3	TP-4	TP-5	TP-6	TP-7	TP-8	T-9
		Composite*	*	4.5-6.5	12-14	9.5-11.5	14.5-16.5	7-9	7-9	9.5-11.5	12-14	14.5-16.5	7-9	9.5-11.5	14.5-16.5	12-14	4.5-6.5	4.5-6.5	12-14	12-14	4.5-6.5	5-7	2-4	6-8	2-4	4-6	6-8	5-7	2-4	5-7	2-4
		1/17-18/89	1/24/89	9/6/94					9/7/94									9/8/94				9/7/94									
Metals (μg/g)																															
Arsenic	0.39	--	**100**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	8	--	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**24.8**	BDL	BDL	BDL	0.465	0.394	0.846	0.432	0.981	1.94	BDL	BDL	2.99	BDL	BDL
Chromium (+3)	16,000	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copper	NSE	--	46.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	50	--	--	**180**	BDL	BDL	BDL	BDL	43.9	22.2	BDL	BDL	42.7	14.9	6.52	BDL	**1,321**	**129**	BDL	12	**204**	**78.1**	**682**	**358**	**177**	**354**	28.5	**54.9**	**344**	**202**	**101**
Selenium	NSE	--	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	15.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	16.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	NSE	--	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PAHs^1 (μg/g)																															
Acenaphthene	NSE	4.4	**	BDL	0.11	14.8	BDL	1.71	BDL	349	0.041	BDL	836	35.2	1.12	BDL	4.38	4.68	1.73	46.4	0.106	6.64	0.098	0.0488	BDL	241	782	BDL	1.15	1	4.91
Acenaphthylene	NSE	BDL	**	12.4	BDL	1.81	BDL	0.233	BDL	BDL	BDL	BDL	27.3	1.32	0.397	BDL	0.827	0.275	0.386	1.26	BDL	1.01	0.292	0.0835	6.24	1,875	27.3	BDL	3.26	BDL	4.22
Anthracene	NSE	7.1	**	3.47	0.048	4.94	BDL	1.16	BDL	83.6	0.047	0.024	295	16.5	1.09	BDL	4.27	0.9	1.23	15.1	BDL	3.13	0.52	0.313	1.66	640	324	BDL	1.54	BDL	2.82
Benzo(a)Anthracene	NSE	10	**	0.271	BDL	16.9	BDL	1.09	BDL	34.3	BDL	BDL	186	10	2.75	BDL	8.31	1.29	0.794	8.23	0.203	4.7	2.78	1.39	5.65	323	204	BDL	6.06	0.535	8.08
Benzo(a)Pyrene	NSE	8.9	**	20.1	BDL	9.77	BDL	0.862	BDL	21.4	BDL	BDL	126	6.34	1.89	BDL	6.06	1.1	0.657	4.81	0.172	6.66	2.03	0.845	20.9	205	206	BDL	14.7	BDL	12.5
Benzo(b)Fluoranthene	NSE	8	**	12.6	BDL	8.14	BDL	0.641	BDL	19.7	BDL	BDL	110	4.6	1.78	BDL	5.02	1.28	0.509	3.85	0.247	5.83	3.14	1.43	11.3	191	118	BDL	10	BDL	11.2
Benzo(k)Fluoranthene	NSE	BDL	**	2.61	BDL	2.62	BDL	0.188	BDL	4.09	BDL	BDL	17.1	2.15	1.14	BDL	3.05	BDL	BDL	2.31	BDL	BDL	0.972	0.33	4.53	BDL	74	BDL	3.65	BDL	2.52
Benzo(ghi)Perylene	NSE	4.7	**	86	BDL	3.98	BDL	0.492	BDL	10.1	BDL	BDL	65.7	BDL	1.04	BDL	3.02	BDL	BDL	BDL	0.179	4.96	2.44	0.772	24.7	BDL	79	BDL	26.3	BDL	25.1
Chrysene	NSE	10	**	5.03	BDL	13.4	BDL	0.959	BDL	27.6	BDL	BDL	118	8.53	2.35	BDL	8.13	0.94	0.691	6.94	0.151	5.32	1.92	1	5.9	313	208	BDL	5.8	0.449	6.69
Dibenzo(a,h)Anthracene	NSE	1.4	**	3.03	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.513	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,6-Dinitrotoluene	NSE	1.6	**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NSE	15	**	2.33	0.111	29.6	BDL	1.73	0.616	66.5	0.057	0.035	276	14.9	4.23	BDL	13.5	1.87	1.59	13.2	0.18	5.33	5.7	3.11	4.67	605	366	0.049	4.45	0.887	5.65
Fluorene	NSE	4.9	**	1.74	0.038	4.48	BDL	1.15	BDL	113	BDL	BDL	306	10.1	0.725	BDL	3	1.25	1.4	19.4	BDL	2.7	0.187	0.099	1.31	1,003	279	BDL	0.898	BDL	2.01
Indeno(1,2,3-cd)Pyrene	NSE	3.5	**	42.8	BDL	3.53	BDL	BDL	BDL	8.7	BDL	BDL	58.5	BDL	1.15	BDL	3.22	1.05	BDL	BDL	BDL	4.35	2.21	0.788	19.4	BDL	65.6	BDL	22	BDL	17.4
2-Methyl Naphthalene	NSE	BDL	**	BDL	0.092	1.08	BDL	1.6	BDL	711	0.033	0.025	1,064	55.4	0.51	BDL	1.37	1.05	1.38	82.4	0.24	6.4	0.071	0.036	BDL	8,745	706	BDL	BDL	BDL	3.1
Naphthalene	NSE	3.3	**	BDL	0.149	4.09	BDL	0.975	BDL	924	0.052	BDL	1,583	118	1.48	BDL	3.38	6.21	0.504	50.7	0.204	4.93	0.169	0.0591	BDL	10,225	1,077	BDL	1.11	BDL	5.26
Phenanthrene	NSE	11	**	BDL	0.148	5.37	BDL	3.79	0.469	426	0.192	0.103	1,308	56.8	3.75	BDL	13.8	3.37	5.9	64.6	0.237	10.1	2.98	1.75	1.94	2,690	1,254	0.049	1.67	1.69	7
Pyrene	NSE	35	**	5.39	0.195	50.5	BDL	3.13	0.75	124	0.108	0.061	616	32.7	5.78	BDL	20.6	3.49	2.65	24.2	0.286	13.8	3.42	1.91	10.8	945	759	0.063	14.2	1.61	17.8
VOCs^2 (μg/g)																															
Benzene	0.0055	--	BDL	**2.6**	BDL	BDL	BDL	BDL	BDL	**8.38**	BDL	BDL	BDL	BDL	**0.018**	BDL	**1.92**	**0.011**	BDL	BDL	BDL	**2.1**	BDL	0.005	BDL	**645**	**5.62**	**0.068**	**1.01**	**0.337**	**0.675**
n-Butylbenzene	NSE	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	25.1	BDL	0.009	BDL	5.52	0.022	BDL	BDL	0.343	BDL	3.74	BDL	3.48	BDL	0.02	BDL	648	54.9	BDL	0.14	0.058	0.415
sec-Butylbenzene	NSE	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.065	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2,688	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	2.9	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**38.2**	BDL	BDL	**276**	**7.91**	0.014	BDL	BDL	BDL	BDL	2.45	BDL	0.469	BDL	BDL	BDL	**2,973**	**51.1**	BDL	0.147	0.149	0.323
Isopropylbenzene	NSE	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.79	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	190	6.2	BDL	0.029	BDL	0.056
p-Isopropyltoluene	NSE	--	BDL	BDL	BDL	1.51	BDL	2.81	0.49	BDL	BDL	BDL	BDL	20.2	BDL	BDL	2.34	0.066	BDL	BDL	0.019	1.16	BDL	BDL	BDL	95.1	21.3	BDL	BDL	0.283	0.104
Naphthalene	NSE	--	BDL	3.86	0.293	BDL	0.125	1.63	2.81	666	0.254	0.342	2,260	375	1.58	0.137	19.2	0.064	BDL	83.6	0.07	10.2	BDL	0.019	29	28,469	1,122	0.008	1.23	1.57	2
n-Propylbenzene	NSE	--	BDL	BDL	BDL	1.85	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.142	BDL	BDL	BDL	0.85	BDL	BDL	BDL	101	4.89	BDL	BDL	0.053	0.056
Toluene	1.5	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.053	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.029	0.027	BDL	**2,007**	BDL	BDL	BDL	BDL	BDL
1,2,4-Trimethylbenzene	NSE	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21.4	BDL	BDL	157	5.24	0.053	BDL	BDL	0.079	BDL	2.93	BDL	1.81	BDL	BDL	BDL	2,994	6.15	BDL	0.187	0.042	0.282
1,3,5-Trimethylbenzene	NSE	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.025	BDL	BDL	0.173	BDL	BDL	BDL	1.36	BDL	BDL	BDL	742	17.4	BDL	0.068	0.112	0.154
Total Xylenes	4.1	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**41.3**	BDL	BDL	**197**	**9.37**	0.179	BDL	BDL	0.031	BDL	BDL	BDL	2.75	BDL	BDL	BDL	**4,981**	**68.8**	BDL	0.375	0.232	0.499

* = Sample collected by Northern Environmental Technologies, Inc.; no depth interval documented

** = Analytical results not readily available

BDL = Below laboratory detection limits

-- = Not analyzed for

▨ = Exceeds ch. NR 720 soil cleanup standards

NSE = No standard established

[1] = PAH list is not complete; PAHs not listed are BDL

[2] = VOC list is not complete; VOCs not listed are BDL

Compiled by: TJB Checked by: KEA

Table 1 (Continued)
Soil Analytical Results

Analytical Parameters	ch. NR 720 soil cleanup standards	Site Location/Boring No./Depth (ft)/Date									
		Upper Bluff Area									
		B-2	B-6	B-9	B-11	B-13	B-19	B-20	TW-9	TW-13	
		**	**	**	**	**	**	**	9.5-11.5	14-16	18-20
		4/28/95		4/26/95			5/16/95		9/8/94	11/21/94	
Metals (μg/g)											
Arsenic	0.39	--	--	--	--	--	--	--	--	--	--
Cadmium	8	--	--	--	--	--	--	--	BDL	--	--
Chromium	16,000	--	--	--	--	--	--	--	--	--	--
Copper	NSE	--	--	--	--	--	--	--	--	--	--
Lead	50	--	--	--	--	--	--	--	BDL	--	--
Selenium	NSE	--	--	--	--	--	--	--	BDL	--	--
Zinc	NSE	--	--	--	--	--	--	--	--	--	--
PAHs[1] (μg/g)											
Acenaphthene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	148	77.2	93.6
Acenaphthylene	NSE	BDL	BDL	BDL	1.3	BDL	--	--	5.54	40.7	354
Anthracene	NSE	BDL	BDL	0.36	1.3	BDL	--	--	42.9	42.5	163
Benzo(a)Anthracene	NSE	BDL	BDL	2.1	4.7	BDL	--	--	33.4	36.4	106
Benzo(a)Pyrene	NSE	BDL	BDL	2.6	5.3	0.13	--	--	27.6	44.1	111
Benzo(b)Fluoranthene	NSE	BDL	BDL	2.8	4.1	BDL	--	--	20.2	36	89.6
Benzo(k)Fluoranthene	NSE	BDL	BDL	0.28	1.5	BDL	--	--	10.8	16.3	42.8
Benzo(ghi)Perylene	NSE	BDL	BDL	1.4	2.9	BDL	--	--	BDL	28.8	67.6
Chrysene	NSE	BDL	BDL	2.3	5.6	BDL	--	--	25.4	37	101
Dibenzo(a,h)Anthracene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	BDL	4.27	10.6
2,6-Dinitrotoluene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	--	--	--
Fluoranthene	NSE	BDL	BDL	2.1	6	0.18	--	--	54.7	54.7	200
Fluorene	NSE	BDL	BDL	0.13	BDL	BDL	--	--	48.3	46.4	184
Indeno(1,2,3-cd)Pyrene	NSE	BDL	BDL	1.1	2.4	BDL	--	--	BDL	24	56
2-Methyl Naphthalene	NSE	BDL	BDL	BDL	BDL	1.4	--	--	162	168	1,209
Naphthalene	NSE	BDL	BDL	BDL	BDL	0.47	--	--	466	93.5	292
Phenanthrene	NSE	BDL	BDL	0.65	3.7	0.17	--	--	270	247	2,256
Pyrene	NSE	BDL	BDL	5	12	0.42	--	--	136	159	545
VOCs[2] (μg/g)											
Benzene	0.0055	BDL	0.0044	BDL	0.0043	0.016	--	--	3.05	11.2	19.8
n-Butylbenzene	NSE	BDL	BDL	BDL	BDL	0.0094	--	--	30.1	4.43	16.8
sec-Butylbenzene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	BDL	2.45	BDL
Ethylbenzene	2.9	BDL	BDL	BDL	BDL	0.014	--	--	49.5	12.2	75.8
Isopropylbenzene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	6.46	BDL	6.67
p-Isopropyltoluene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	29.7	35.9	BDL
Naphthalene	NSE	BDL	BDL	BDL	0.016	0.14	--	--	863	--	--
n-Propylbenzene	NSE	BDL	BDL	BDL	BDL	BDL	--	--	6.69	1.66	6.5
Toluene	1.5	0.004	0.012	BDL	0.0057	0.02	--	--	BDL	6.97	43.2
1,2,4-Trimethylbenzene	NSE	BDL	BDL	BDL	BDL	0.0097	--	--	24.6	8.56	62.9
1,3,5-Trimethylbenzene	NSE	BDL	BDL	BDL	BDL	0.0079	--	--	15.8	3.18	22.6
Total Xylenes	4.1	BDL	BDL	BDL	BDL	0.046	--	--	52.9	13.48	94.1

Table 1 (Continued)
Soil Analytical Results

Analytical Parameters	ch. NR 720 soil cleanup standards	Site Location/Boring No./Depth (ft)/Date									
		Upper Bluff Area									
		B-2	B-6	B-9	B-11	B-13	B-19	B-20	TW-9	TW-13	
		**	**	**	**	**	**	**	9.5-11.5	14-16	18-20
		4/28/95		4/26/95			5/16/95		9/8/94	11/21/94	
TCLP-PAHs	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--
TCLP-VOCs[2] (µg/l)											
Benzene	N/A	0.14	0.24	0.27	0.92	34	16	6	--	--	--
Chloroform	N/A	0.32	BDL	BDL	0.3	0.29	BDL	9.2	--	--	--
2-Butanone	N/A	7.4	3.1	7.8	4.3	4.5	170	110	--	--	--
TCLP-Metals (mg/l)											
Arsenic	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--
Barium	N/A	1.3	1.1	2.1	1.1	0.85	3.5	1.6	--	--	--
Cadmium	N/A	BDL	BDL	BDL	BDL	BDL	BDL	0.021	--	--	--
Chromium	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--
Lead	N/A	0.06	0.24	BDL	0.091	BDL	7.5	1.4	--	--	--
Mercury	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--
Selenium	N/A	0.017	BDL	BDL	BDL	0.019	BDL	BDL	--	--	--
Silver	N/A	BDL	BDL	0.026	BDL	BDL	BDL	BDL	--	--	--

** = Samples collected by Dames & Moore; no depth interval documented
BDL = Below laboratory detection limits
-- = Not analyzed for
▨ = Exceeds ch. NR 720 soil cleanup standards
NSE = No standard established
N/A = Not applicable
[1] = PAH list is not complete; PAHs not listed are BDL
[2] = VOC list is not complete; VOCs not listed are BDL
Compiled by: TJB Checked by: KEA

Table 3 (Continued)
Summary of Offshore Soil and Sediment Analytical Results

Analytical Parameters	Grid Location/Depth (ft)/Date																									
	2100N 1000E	2300N 800E	2300N 1000E	2300N 1300E		2300N 1400E		2300N 1500E		2300N 1600E	2300N 1700E	2400N 1200E	2400N 1300E	2400N 1400E	2400N 1600E	2400N 1700E	2400N 2000E	2400N 2100E		2500N 1300E	2500N 1400E	2500N 1500E		2500N 1600E	2500N 1700E	
	4-6	0-4	4-8	0-4	4-6	0-4	6-8	0-4	8-10	0-4	0-4	4-6	0-4	0-4	0-4	0-4	6-8	0-4	4-6	0-4	0-4	0-4	6-8		0-4	6-8
	3/12/96	3/6/96	3/6/96	3/8/96	3/8/96	3/7/96	3/7/96	3/6/96	3/6/96	3/12/96	3/8/96	3/12/96	3/8/96	3/7/96	3/12/96	3/8/96	3/12/96	3/9/96	3/9/96	3/8/96	3/7/96	3/7/96	3/7/96	3/12/96	3/8/96	3/8/96
PAHs[1] (mg/kg)																										
Acenaphthene	BDL	BDL	BDL	23	1.13	23	8.84	120	0.35	82	27	BDL	47	71	21	76	220	BDL	41	53	23	29	0.36	BDL	23	BDL
Acenaphthylene	BDL	BDL	BDL	3.73	BDL	BDL	0.77	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7.27	130	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene	BDL	BDL	BDL	14	0.35	9.93	3.96	49	BDL	35	10	BDL	16	30	9.03	37	140	BDL	18	19	7.72	9.12	BDL	BDL	7.86	BDL
Benzo(a)Anthracene	BDL	BDL	BDL	15	BDL	4.92	2.02	BDL	BDL	13	BDL	BDL	6.41	BDL	3.36	18	67	1.46	7.66	BDL	4.54	5.04	BDL	BDL	3.89	BDL
Benzo(a)Pyrene	BDL	BDL	BDL	12	BDL	4.24	1.79	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13	49	1.41	BDL	BDL	4.15	4.69	BDL	BDL	3.32	BDL
Benzo(b)Fluoranthene	BDL	BDL	BDL	10	BDL	BDL	1.39	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10	36	1.54	BDL	BDL	2.93	3.41	BDL	BDL	BDL	BDL
Benzo(ghi)Perylene	BDL	BDL	BDL	5.76	BDL	BDL	0.84	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene	BDL	BDL	BDL	15	BDL	4.9	1.88	BDL	BDL	12	BDL	BDL	6.71	BDL	3.32	17	62	1.69	7.41	BDL	4.42	5.04	BDL	BDL	3.98	BDL
Fluoranthene	BDL	BDL	BDL	6.73	0.31	13	4.81	45	0.45	31	9.01	BDL	17	30	8.15	36	160	3.97	19	21	11	14	BDL	BDL	11	BDL
Fluorene	BDL	BDL	BDL	13	0.46	11	4.83	55	BDL	43	13	BDL	20	32	11	45	180	BDL	24	23	11	12	BDL	BDL	11	BDL
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	5.5	BDL	BDL	0.82	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.98	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methyl Naphthalene	BDL	BDL	BDL	24	1.31	21	7.81	140	BDL	110	26	BDL	54	79	30	96	460	BDL	57	61	20	23	0.48	BDL	20	BDL
2-Methyl Naphthalene	BDL	BDL	BDL	32	1.81	29	10	180	0.34	140	54	BDL	73	110	35	110	520	BDL	65	84	28	32	0.73	BDL	27	BDL
Naphthalene	BDL	BDL	BDL	38	2.69	48	9.2	240	BDL	150	73	BDL	100	200	35	130	600	1.57	76	130	36	45	1.39	0.44	41	0.3
Phenanthrene	BDL	BDL	BDL	39	1.19	30	12	140	0.75	98	31	BDL	52	90	25	89	420	3.69	54	65	28	35	BDL	BDL	30	BDL
Pyrene	BDL	BDL	BDL	34	0.44	16	6	57	0.59	33	11	BDL	25	36	8.08	37	160	3.23	22	28	16	19	BDL	BDL	14	BDL
2,6-Dimethnaphthalene	BDL	BDL	BDL	13	0.47	9.8	4.51	62	BDL	51	13	BDL	20	32	13	42	160	BDL	15	23	8.97	9.87	BDL	BDL	7.75	BDL
Benzo(e)Pyrene	BDL	BDL	BDL	8.32	BDL	BDL	1.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8.02	34	1.58	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Ethylnaphthalene	BDL	BDL	BDL	16	0.64	13	5.69	79	BDL	64	18	BDL	29	43	15	53	220	BDL	29	32	12	14	BDL	BDL	12	BDL
1-Methylphenanthrene	BDL	BDL	BDL	9.09	BDL	4.69	2.12	23	BDL	21	BDL	BDL	6.42	14	6.15	23	69	BDL	10	BDL	3.68	4.31	BDL	BDL	4.31	BDL

Analytical Parameters	Grid Location/Depth (ft)/Date																												
	2500N 1800E			2500N 1900E	2500N 2000E	2500N 2100E		2500N 2200E	2500N 2300E		2500N 2600E		2600N 1200E	2600N 1300E	2600N 1400E		2600N 1500E	2600N 1600E	2600N 1700E	2600N 1800E	2600N 1900E		2600N 2000E	2600N 2100E	2600N 2300E	2600N 2500E	2600N 2700E	2700N 1300E	2700N 1500E
	0-4	6-8	8-10	0-4	0-4	0-4	6-8	4-6	6-8	8-10	0-4	6-8	0-4	0-4	0-4	6-8	0-4	0-4	0-4	0-4	0-4	6-8	4-6	0-4	6-8	0-4	0-4	0-4	0-4
	3/11/96	3/11/96	3/11/96	3/8/96	3/11/96	3/9/96	3/9/96	3/9/96	3/10/96	3/10/96	3/11/96	3/11/96	3/8/96	3/7/96	3/7/96	3/7/96	3/12/96	3/12/96	3/8/96	3/11/96	3/9/96	3/9/96	3/11/96	3/9/96	3/10/96	3/11/96	3/11/96	3/7/96	3/7/96
PAHs[1] (mg/kg)																													
Acenaphthene	0.85	2.25	BDL	31	BDL	BDL	BDL	BDL	19	0.53	BDL	BDL	BDL	79	21	BDL	BDL	BDL	BDL	0.56	9.37	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthylene	BDL	0.31	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene	BDL	1.2	BDL	13	BDL	BDL	BDL	BDL	9.13	BDL	BDL	BDL	BDL	30	8.31	BDL	BDL	BDL	BDL	BDL	4.04	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)Anthracene	BDL	0.44	BDL	BDL	BDL	BDL	BDL	BDL	4.14	BDL	BDL	BDL	BDL	21	4.4	BDL	BDL	BDL	BDL	BDL	1.63	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)Pyrene	BDL	0.33	BDL	BDL	BDL	BDL	BDL	BDL	3.14	BDL	BDL	BDL	BDL	19	4.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	14	2.81	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(ghi)Perylene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene	BDL	0.41	BDL	BDL	BDL	BDL	BDL	BDL	3.74	BDL	BDL	BDL	BDL	20	4.35	BDL	BDL	BDL	BDL	BDL	1.53	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene	BDL	1.14	BDL	10	BDL	BDL	BDL	BDL	9.76	BDL	BDL	BDL	BDL	46	12	BDL	BDL	BDL	BDL	BDL	4.1	BDL	BDL	BDL	BDL	BDL	BDL	0.54	BDL
Fluorene	0.42	1.41	BDL	15	BDL	BDL	BDL	BDL	12	BDL	BDL	BDL	BDL	38	9.96	BDL	BDL	BDL	BDL	BDL	5.33	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8.77	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methyl Naphthalene	0.97	2.29	BDL	41	BDL	0.32	BDL	0.37	27	1.39	BDL	BDL	BDL	63	19	BDL	BDL	BDL	BDL	0.98	11	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Methyl Naphthalene	1.1	2.68	BDL	51	0.32	0.47	BDL	0.46	31	1.6	BDL	BDL	BDL	85	26	BDL	BDL	BDL	BDL	1.01	14	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalene	1.3	2.4	BDL	58	0.41	1.06	BDL	0.83	36	2.14	BDL	BDL	BDL	79	37	BDL	BDL	BDL	BDL	2.19	16	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene	0.96	3.22	BDL	35	BDL	BDL	BDL	BDL	27	BDL	BDL	BDL	0.34	100	29	BDL	BDL	BDL	BDL	BDL	11	0.5	BDL	BDL	BDL	BDL	BDL	0.52	BDL
Pyrene	BDL	1.28	BDL	13	BDL	BDL	BDL	BDL	12	BDL	BDL	BDL	BDL	59	15	BDL	BDL	BDL	BDL	BDL	4.55	BDL	BDL	BDL	BDL	BDL	BDL	0.62	BDL
2,6-Dimethnaphthalene	0.33	1.08	BDL	14	BDL	BDL	BDL	BDL	6.85	BDL	BDL	BDL	BDL	33	8.52	BDL	BDL	BDL	BDL	BDL	4.58	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(e)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Ethylnaphthalene	0.43	1.32	BDL	20	BDL	BDL	BDL	BDL	14	0.51	BDL	BDL	BDL	46	12	BDL	BDL	BDL	BDL	BDL	6.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methylphenanthrene	BDL	0.66	BDL	6.43	BDL	BDL	BDL	BDL	5.05	BDL	BDL	BDL	BDL	14	3.81	BDL	BDL	BDL	BDL	BDL	2.15	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL = Below laboratory detection limit
-- = Not analyzed for
[1] = PAH list is not complete; PAHs not listed are BDL
Compiled by: JJT Checked by: KEA

Table 3 (Continued)
Summary of Offshore Soil and Sediment Analytical Results

Analytical Parameters	Grid Location/Depth (ft)/Date																							
	2700N 1600E	2700N 1700E	2700N 1800E		2700N 1900E	2700N 2000E	2700N 2100E	2700N 2200E		2700N 2300E	2700N 2500E	2800N 1300E	2800N 1400E	2800N 1500E	2800N 1600E	2800N 1700E	2800N 1800E	2800N 1900E	2800N 2000E	2800N 2100E	2800N 2200E	2800N 2300E	2800N 2400E	2800N 2500E
	0-4	0-4	0-4	4-6	0-4	4-6	0-4	4-6	6-8	4-6	8-10	0-4	6-8	0-4	0-4	0-4	0-4	0-4	0-4	0-4	4-6	0-4	0-4	0-4
	3/12/96	3/8/96	3/11/96	3/11/96	3/9/96	3/11/96	3/9/96	3/11/96	3/11/96	3/10/96	3/12/96	3/7/96	3/7/96	3/7/96	3/12/96	3/8/96	3/11/96	3/9/96	3/11/96	3/9/96	3/11/96	3/10/96	3/10/96	3/10/96
PAHs[1] (mg/kg)																								
Acenaphthene	BDL	BDL	0.41	7.63	9.81	220	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.41	2.25	BDL	BDL	BDL	11	BDL	BDL
Acenaphthylene	BDL	BDL	BDL	BDL	BDL	22	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene	BDL	BDL	BDL	4.54	4.02	99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.26	BDL	BDL	BDL	5.79	BDL	BDL
Benzo(a)Anthracene	BDL	BDL	BDL	2.14	BDL	37	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.63	BDL	BDL	BDL	3.24	BDL	BDL
Benzo(a)Pyrene	BDL	BDL	BDL	1.6	BDL	26	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.42	BDL	BDL	BDL	2.72	BDL	BDL
Benzo(b)Fluoranthene	BDL	BDL	BDL	1.23	BDL	19	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.36	BDL	BDL	BDL	2.03	BDL	BDL
Benzo(ghi)Perylene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.35	BDL	BDL
Chrysene	BDL	BDL	BDL	1.91	BDL	36	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.57	BDL	BDL	BDL	3.23	BDL	BDL
Fluoranthene	BDL	BDL	BDL	4.82	3.52	90	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.37	BDL	BDL	BDL	7.17	BDL	BDL
Fluorene	BDL	BDL	BDL	4.76	5.27	130	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.42	BDL	BDL	BDL	6.85	BDL	BDL
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methyl Naphthalene	BDL	BDL	0.86	6.37	12	290	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.9	2.52	BDL	BDL	BDL	13	BDL	BDL
2-Methyl Naphthalene	BDL	BDL	0.83	7.58	15	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.89	3.09	BDL	BDL	BDL	15	BDL	BDL
Naphthalene	BDL	BDL	1.89	4.05	18	350	BDL	BDL	BDL	0.42	BDL	BDL	BDL	BDL	BDL	BDL	3.1	3.25	BDL	BDL	BDL	15	BDL	BDL
Phenanthrene	BDL	BDL	BDL	12	12	250	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.39	3.32	BDL	BDL	BDL	17	BDL	BDL
Pyrene	BDL	BDL	BDL	5.07	3.85	100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.56	BDL	BDL	BDL	8.08	BDL	BDL
2,6-Dimethnaphthalene	BDL	BDL	BDL	3.81	4.24	120	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.13	BDL	BDL	BDL	3.92	BDL	BDL
Benzo(e)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.76	BDL	BDL
2-Ethylnaphthalene	BDL	BDL	BDL	4.77	5.57	150	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.48	BDL	BDL	BDL	7.52	BDL	BDL
1-Methylphenanthrene	BDL	BDL	BDL	2.78	2.13	59	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.72	BDL	BDL	BDL	2.85	BDL	BDL

Analytical Parameters	Grid Location/Depth (ft)/Date																										
	2900N 1400E	2900N 1500E	2900N 1600E	2900N 1700E	2900N 1800E	2900N 1900E	2900N 2000E	2900N 2100E	2900N 2200E	2900N 2300E		2900N 2400E	2900N 2500E	3100N 1300E	3100N 1500E		3100N 1700E		3100N 1900E		3100N 2100E		3100N 2300E		3500N 1500E		3500N 2000E
	0-4	2-4	0-4	0-4	4-6	0-4	0-2	0-4	0-4	0-4	10-12	4-6	0-4	8-10	0-4	6-8	0-4	6-8	0-4	6-8	0-4	8-10	0-4	12-14	6-8	16-18	4-6
	3/7/96	3/12/96	3/12/96	3/8/96	3/11/96	3/9/96	3/11/96	3/9/96	3/11/96	3/10/96	3/10/96	3/10/96	3/10/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	2/27/96	2/28/96	3/11/96
PAHs[1] (mg/kg)																											
Acenaphthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthylene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(ghi)Perylene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methyl Naphthalene	0.89	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Methyl Naphthalene	1.24	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalene	2.34	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene	0.48	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,6-Dimethnaphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(e)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Ethylnaphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1-Methylphenanthrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL = Below laboratory detection limit

-- = Not analyzed for

[1] = PAH list is not complete; PAHs not listed are BDL

Compiled by: JJT Checked by: KEA

Table 2
Groundwater Analytical Results

Analytical Parameters	NR 140 Standards		Site Name/Well No./Sampling Date																													
			Ashland Lakefront Property																													
	ES	PAL	MW-1					MW-2						MW-3					MW-3 (Dup.)	TW-1		TW-2		TW-3		TW-4		TW-5		TW-6		
			1/25/89	6/28/94	9/15/94	10/20/94	6/95	1/25/89	6/28/94	9/15/94	10/20/94	5/18/95	6/95	1/25/89	6/28/94	9/15/94	10/20/94	6/95	6/28/94	9/15/94	10/20/94	9/19/94	10/20/94	9/15/94	10/20/94	9/19/94	10/20/94	9/19/94	10/20/94	9/19/94	10/20/94	6/95
Metals (µg/l)																																
Aluminum	NSE	NSE	--	66	--	--	*	--	66	--	--	--	*	--	37	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Arsenic	50	5	BDL	BDL	BDL	1.16	*	BDL	1.4	BDL	2.96	1.3	*	BDL	BDL	BDL	1.18	*	--	BDL	2.94	BDL	1.33	24.6	1.42	BDL	1.77	BDL	2.79	BDL	2.05	*
Cadmium	5	0.5	--	--	--	--	*	--	--	--	--	BDL	*	--	--	--	--	*	--	--	--	--	--	--	--	--	0.2	BDL	BDL	BDL	BDL	*
Chromium	100	10	BDL	--	BDL	4.37	*	BDL	--	BDL	BDL	BDL	*	BDL	--	BDL	BDL	*	--	BDL	BDL	BDL	BDL	15.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*
Copper	1,300	130	23	--	BDL	BDL	*	BDL	--	30	BDL	1.1	*	BDL	--	BDL	BDL	*	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	27	BDL	BDL	16	BDL	*
Iron	300	150	--	1,210	1,540	2,020	*	--	3,650	429	5,020	2,000	*	--	959	1,180	844	*	--	3,140	5,880	1,230	5,060	63,100	855	99	520	2,150	2,600	1,720	1,340	*
Lead	15	1.5	--	--	2.72	BDL	*	--	--	3.02	BDL	1.6	*	--	--	3.83	BDL	*	--	BDL	BDL	2.65	2.85	3.19	3.46	3.72	3.49	BDL	2.61	2.08	BDL	*
Selenium	50	10	--	--	--	--	*	--	--	--	--	BDL	*	--	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Zinc	5,000	2,500	12	--	BDL	BDL	*	4	--	68	BDL	46	*	16	--	77	BDL	*	--	25	BDL	43	59	44	BDL	35	BDL	26	BDL	BDL	20	*
Indicators (mg/l)																																
BOD	NSE	NSE	14	--	--	--	*	14	--	--	--	--	*	42	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Chloride	250	125	54.8	--	--	--	*	64.6	--	--	--	--	*	64.1	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
COD	NSE	NSE	330	--	--	--	*	224	--	--	--	--	*	1,870	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Sulfate	250	125	3.6	--	--	--	*	5.5	--	--	--	--	*	4.6	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
TOC	NSE	NSE	29	8.28	8.89	10.2	*	25.2	10.2	17.4	14.2	--	*	27.1	12.3	17.1	9.59	*	--	37.7	18.2	23.9	13.5	19.7	12.6	22.5	5.36	19.4	8.75	14.9	16.2	*
PAHs[1] (µg/l)																																
Acenaphthene	NSE	NSE	330	253	185	182	*	300	42.8	7.85	43.3	55	*	88	11.9	24.9	BDL	*	--	75.2	121	23.4	33.3	194	164	38.9	37.2	1,631	243	2,301	1,691	*
Acenaphthylene	NSE	NSE	38	465	5.16	7.93	*	33	98.5	BDL	3.53	3	*	BDL	BDL	13.2	BDL	*	--	6.7	13.4	3.08	3.65	31.5	36.5	6.34	8.03	95.6	17.3	142	144	*
Anthracene	NSE	NSE	110	9.35	8.25	20.4	*	320	1.6	BDL	2.92	34	*	100	39	25.9	BDL	*	--	21.7	29	8.71	7.03	107	83.7	21.7	19.7	700	91.6	1,131	866	*
Benzo(a)Anthracene	NSE	NSE	59	0.473	4.37	10.4	*	93	0.522	BDL	2.61	8.8	*	180	56.4	142	37.5	*	--	49.8	37	31.7	17	172	80.4	41.8	18.9	481	42.2	685	366	*
Benzo(a)Pyrene	0.2	0.02	51	0.539	3.39	10.6	*	79	0.691	BDL	4.29	11	*	170	69.3	163	49.4	*	--	48.3	45.7	31.8	17.1	206	115	45.2	22.3	386	46.6	507	335	*
Benzo(b)Fluoranthene	NSE	NSE	53	BDL	2.69	8.5	*	77	0.387	BDL	2.92	5.1	*	150	28.1	97.4	31	*	--	37.7	32.1	21.9	13.6	142	72.9	32.5	15.7	282	31.3	375	236	*
Benzo(k)Fluoranthene	NSE	NSE	BDL	BDL	BDL	2.1	*	BDL	BDL	BDL	1.53	7.8	*	BDL	19.8	59.8	14.9	*	--	18	17.5	12	5.97	81.5	37	10.2	9.53	BDL	14.9	BDL	123	*
Benzo(ghi)Perylene	NSE	NSE	27	BDL	BDL	4.97	*	45	BDL	BDL	3.26	5.2	*	110	BDL	63	26.3	*	--	29.1	29.2	12.1	7.48	103	67.8	BDL	13.6	192	26.1	182	153	*
bis(2-Ethylhexyl)phthalate	NSE	NSE	18	--	--	--	*	28	--	--	--	--	*	58	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Chrysene	NSE	NSE	60	BDL	BDL	9.03	*	92	BDL	BDL	2.89	9.6	*	180	BDL	125	39	*	--	48.8	44	29	17.8	158	89.1	36.9	20.7	427	43.7	540	377	*
Dibenzo(a,h)Anthracene	NSE	NSE	BDL	BDL	BDL	BDL	*	14	BDL	BDL	BDL	--	*	26	BDL	BDL	BDL	*	--	BDL	BDL	BDL	1.45	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*
Di-n-Butylphthalate	NSE	NSE	BDL	--	--	--	*	BDL	--	--	--	BDL	*	BDL	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Fluoranthene	NSE	NSE	110	BDL	9.39	25	*	140	BDL	1.81	4.85	15	*	260	210	169	65.7	*	--	78.9	80.8	51	37	215	148	51.6	38.1	768	92.1	1,107	775	*
Fluorene	400	80	180	51.3	44.4	59.9	*	150	4.05	1.34	9.54	16	*	83	6.29	BDL	BDL	*	--	24.2	38.3	8.5	10.8	112	95.3	16.2	16.8	839	110	1,005	671	*
Indeno(1,2,3-cd)Pyrene	NSE	NSE	22	BDL	BDL	4.84	*	33	BDL	BDL	2.75	4.3	*	80	BDL	53.7	24.6	*	--	24.1	24.2	10.9	6.57	85.9	57.4	BDL	12.6	165	25.1	153	136	*
1-Methyl Naphthalene	NSE	NSE	--	575	--	--	*	--	59.2	--	--	--	*	--	BDL	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
2-Methyl Naphthalene	NSE	NSE	BDL	344	268	353	*	BDL	20.1	BDL	91.4	BDL	*	BDL	BDL	BDL	BDL	*	--	7.56	55	BDL	BDL	87.4	151	8.13	5.67	2,376	372	2,693	2,034	*
Naphthalene	40	8	150	702	470	228	*	1,800	90.1	0.894	857	280	*	16	BDL	BDL	BDL	*	--	12	58.7	20.6	48.5	47.8	75.1	10.7	BDL	2,634	678	5,907	5,500	*
Phenanthrene	NSE	NSE	370	53.2	52.4	93.9	*	300	BDL	0.812	11.2	34	*	170	19.2	33.8	BDL	*	--	28.5	53.4	7.45	6.88	298	219	37.5	25.8	2,829	339	3,751	2,482	*
Phenol	6,000	1,200	BDL	--	--	--	*	14	--	--	--	BDL	*	BDL	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Pyrene	NSE	NSE	230	BDL	14.6	28.9	*	370	BDL	3.4	6.79	28	*	790	317	502	127	*	--	188	125	120	51.5	529	220	146	59.9	1,362	132	2,192	1,152	*
VOCs[2] (µg/l)																																
Benzene	5	0.5	190	4,240	2,440	3,340	4,100	390	1,090	236	659	370	950	51.4	0.8	1.2	2.55	4.4	0.8	513	450	379	578	813	546	BDL	1.29	738	601	3,150	3,400	1,500
n-Butylbenzene	NSE	NSE	--	BDL	652	BDL	*	--	BDL	279	BDL	73	*	--	BDL	1.5	BDL	*	BDL	BDL	BDL	BDL	BDL	7.2	17.9	BDL	BDL	615	BDL	BDL	BDL	*
tert-Butylbenzene	NSE	NSE	--	BDL	202	BDL	*	--	BDL	66.6	BDL	--	*	--	BDL	1.0	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	296	BDL	*
Ethylbenzene	700	140	BDL	413	292	353	*	190	113	124	178	310	*	BDL	BDL	BDL	BDL	*	BDL	46.6	95.4	BDL	71.1	11.4	43	BDL	5	459	308	1,290	1,370	*
Isopropylbenzene	NSE	NSE	--	BDL	BDL	BDL	*	--	BDL	BDL	BDL	24	*	--	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	16.3	BDL	BDL	BDL	*
p-Isopropyltoluene	NSE	NSE	--	BDL	BDL	BDL	*	--	BDL	BDL	BDL	58	*	--	BDL	BDL	BDL	*	BDL	BDL	38.7	BDL	134	18	23	BDL	9.18	BDL	BDL	BDL	BDL	*
Naphthalene	40	8	--	1,490	2,360	1,930	1,700	--	607	1,000	1,020	1,300	210	--	BDL	1.4	1.15	52	BDL	455	749	98.2	111	311	701	29.9	52.2	392	3,120	3,600	4,050	1,200
n-Propylbenzene	NSE	NSE	--	BDL	BDL	BDL	*	--	BDL	BDL	BDL	BDL	*	--	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7.5	BDL	BDL	BDL	*
Toluene	343	68.6	27.1	651	BDL	BDL	*	31.7	BDL	BDL	BDL	29	*	BDL	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	34.9	BDL	BDL	35.1	BDL	BDL	BDL	*
1,2,4-Trimethylbenzene	NSE	NSE	--	107	BDL	BDL	*	--	BDL	BDL	BDL	79	*	--	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	12.2	33.9	BDL	BDL	67.5	67.9	BDL	219	*
1,3,5-Trimethylbenzene	NSE	NSE	--	BDL	BDL	BDL	*	--	BDL	BDL	BDL	67	*	--	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	8.17	BDL	BDL	12.2	BDL	BDL	BDL	*
Total Xylenes	620	124	223.8	449	BDL	443	*	350	BDL	104	207.7	430	*	BDL	BDL	BDL	BDL	*	BDL	104.2	99.9	BDL	52.4	33.7	52	BDL	BDL	366	251	1,285	1,331	*

Table 2 (Continued)
Groundwater Analytical Results

Analytical Parameters	NR 140 Standards		Site Name/Well No./Sampling Date																										
			Ashland Lakefront Property																										
	ES	PAL	TW-7		TW-8		TW-9				TW-10		TW-10 (Dup.)	TW-11		TW-11 (Dup.)	TW-12		Supply Well	AW-1			AW-2		TP-2	Seep Sample			
			9/19/94	10/20/94	9/15/94	10/20/94	9/19/94	10/20/94	5/18/95	6/95	9/19/94	10/20/94	10/20/94	9/19/94	10/20/94	9/19/94	9/19/94	10/20/94	1/25/89	6/28/94	9/19/94	10/20/94	9/19/94	10/20/94	8/28/91	9/19/94	10/20/94	5/17/95	6/95
Metals (µg/l)																													
Aluminum	NSE	NSE	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	*
Arsenic	50	5	--	--	--	2.46	BDL	BDL	7.4	*	--	--	--	--	--	--	BDL	BDL	BDL	2.1	BDL	5.07	BDL	1.45	--	--	--	9.5	*
Cadmium	5	0.5	--	--	--	BDL	--	--	BDL	*	--	--	--	--	--	--	BDL	BDL	--	--	--	--	--	--	--	--	--	9.4	*
Chromium	100	10	--	--	--	BDL	BDL	BDL	17	*	--	--	--	--	--	--	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	--	--	--	BDL	*
Copper	1,300	130	--	--	--	BDL	BDL	BDL	44	*	--	--	--	--	--	--	BDL	BDL	BDL	--	BDL	26	BDL	15	--	--	--	89	*
Iron	300	150	--	--	--	11,300	3,200	3,670	22,000	*	--	--	--	--	--	--	2,910	8,080	----	BDL	10	15	BDL	18	--	--	--	30,000	*
Lead	15	1.5	--	--	--	BDL	2.07	BDL	59	*	--	--	--	--	--	--	BDL	BDL	--	--	4.72	BDL	BDL	BDL	--	--	--	75	*
Selenium	50	10	--	--	--	--	--	--	BDL	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	790	*
Zinc	5,000	2,500	--	--	--	BDL	23	BDL	180	*	--	--	--	--	--	--	23	BDL	8	--	58	BDL	BDL	BDL	--	--	--	3,600	*
Indicators (mg/l)																													
BOD	NSE	NSE	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*
Chloride	250	125	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*
COD	NSE	NSE	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,200	--	--	--	*
Sulfate	250	125	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*
TOC	NSE	NSE	19.3	3.9	4.82	9.83	20.1	22.4	--	*	22.1	15.2	--	24.4	5.93	--	18.2	12.6	--	BDL	12.6	BDL	4.81	BDL	--	--	--	--	*
PAHs[1] (µg/l)																													
Acenaphthene	NSE	NSE	BDL	BDL	32.1	73.2	14,460	6,544	750	*	523	216	--	447	375	--	39.3	68.1	BDL	BDL	--	BDL	BDL	BDL	--	26,429	19,625	12,000	*
Acenaphthylene	NSE	NSE	BDL	BDL	BDL	BDL	587	480	BDL	*	77.4	40.6	--	7.25	17.1	--	2.47	BDL	BDL	BDL	--	BDL	BDL	BDL	--	2,130	3,823	1,500	*
Anthracene	NSE	NSE	BDL	BDL	2.02	6.61	4,373	2,689	240	*	164	69.3	--	60.2	113	--	1.09	BDL	BDL	BDL	--	BDL	BDL	BDL	--	8,056	8,842	6,500	*
Benzo(a)Anthracene	NSE	NSE	BDL	BDL	2.64	5.22	3,465	1,344	150	*	116	30	--	27.1	36.2	--	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	--	6,764	6,800	4,800	*
Benzo(a)Pyrene	0.2	0.02	BDL	BDL	BDL	BDL	3,278	1,434	160	*	104	29.2	--	14.5	27.5	--	7.59	5.37	BDL	BDL	--	BDL	BDL	BDL	--	5,866	7,754	4,300	*
Benzo(b)Fluoranthene	NSE	NSE	BDL	BDL	BDL	4.04	2,136	921	160	*	74.1	20.7	--	12.6	20.5	--	5.46	BDL	BDL	BDL	--	BDL	BDL	BDL	--	4,753	6,260	4,300	*
Benzo(k)Fluoranthene	NSE	NSE	BDL	BDL	BDL	BDL	1,272	428	41	*	43.6	11.6	--	9.36	14.5	--	2.33	BDL	BDL	BDL	--	BDL	BDL	BDL	--	2,201	3,066	1,300	*
Benzo(ghi)Perylene	NSE	NSE	BDL	BDL	BDL	BDL	1,090	695	57	*	40.1	14.9	--	BDL	12.4	--	14.4	7.45	BDL	BDL	--	BDL	BDL	BDL	--	2,891	4,022	1,800	*
bis(2-Ethylhexyl)phthalate	NSE	NSE	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	*
Chrysene	NSE	NSE	BDL	BDL	1.75	4.94	2,597	1,363	150	*	102	30.9	--	19.7	34.9	--	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	--	5,626	7,298	4,600	*
Dibenzo(a,h)Anthracene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	--	*	BDL	BDL	--	BDL	BDL	--	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	--	BDL	624	--	*
Di-n-Butylphthalate	NSE	NSE	--	--	--	--	--	--	BDL	*	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	BDL	*
Fluoranthene	NSE	NSE	BDL	BDL	4.22	11.4	5,615	3,215	310	*	176	70.2	--	47.8	88.2	--	2.19	BDL	BDL	BDL	--	BDL	BDL	BDL	--	13,235	15,725	8,200	*
Fluorene	400	80	BDL	BDL	6.8	16.9	4,644	2,663	250	*	223	101	--	122	159	--	6.11	11.9	BDL	BDL	--	BDL	BDL	BDL	--	11,009	11,437	5,700	*
Indeno(1,2,3-cd)Pyrene	NSE	NSE	BDL	BDL	BDL	BDL	1,044	571	53	*	36.5	13.8	--	BDL	11.6	--	10.2	5.76	BDL	BDL	--	BDL	BDL	BDL	--	2,522	3,578	1,600	*
1-Methyl Naphthalene	NSE	NSE	--	--	--	--	--	--	--	*	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	BDL	BDL	--	*
2-Methyl Naphthalene	NSE	NSE	BDL	BDL	3.59	BDL	16,465	7,252	BDL	*	977	149	--	732	518	--	5.18	9.44	BDL	BDL	--	BDL	BDL	BDL	--	38,120	24,594	18,000	*
Naphthalene	40	8	BDL	BDL	62.6	140	39,749	19,267	4,600	*	1,005	23.1	--	2,794	656	--	459	563	BDL	BDL	--	BDL	BDL	BDL	--	18,776	30,250	21,000	*
Phenanthrene	NSE	NSE	BDL	BDL	8.84	22.5	24,186	8,925	1,100	*	864	229	--	280	282	--	4.42	6.81	BDL	BDL	--	BDL	BDL	BDL	--	62,103	38,293	24,000	*
Phenol	6,000	1,200	--	--	--	--	--	--	BDL	*	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	BDL	*
Pyrene	NSE	NSE	BDL	BDL	6.14	12.4	13,911	4,241	630	*	420	89.2	--	85.5	109	--	4.85	BDL	BDL	BDL	--	BDL	BDL	BDL	--	39,877	22,136	19,000	*
VOCs[2] (µg/l)																													
Benzene	5	0.5	BDL	BDL	1,150	1,590	833	1,590	600	710	509	479	434	BDL	BDL	BDL	141	253	BDL	BDL	BDL	BDL	BDL	BDL	2,000	1,640	3,250	3,500	3,200
n-Butylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	150	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*
tert-Butylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*	73.6	BDL	BDL	127	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*
Ethylbenzene	700	140	BDL	BDL	56.4	82.3	1,170	2,300	830	*	78	BDL	BDL	200	BDL	186	53.3	70	BDL	BDL	BDL	BDL	BDL	BDL	240	BDL	378	670	*
Isopropylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	63	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	80	*
p-Isopropyltoluene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	130	*	BDL	BDL	BDL	BDL	BDL	BDL	73.3	75.1	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	34	*
Naphthalene	40	8	BDL	BDL	89.8	151	8,740	18,600	12,000	9,300	919	540	529	2,290	1,270	2,210	530	634	--	BDL	BDL	BDL	BDL	BDL	150	1,300	2,590	6,700	5,100
n-Propylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	*
Toluene	343	68.6	BDL	BDL	BDL	BDL	BDL	BDL	47	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	650	*
1,2,4-Trimethylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	190	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	170	BDL	BDL	240	*
1,3,5-Trimethylbenzene	NSE	NSE	BDL	BDL	BDL	BDL	BDL	BDL	190	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	86	*
Total Xylenes	620	124	BDL	BDL	BDL	BDL	BDL	2,430	1,010	*	BDL	BDL	BDL	134	BDL	125	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	290	BDL	483	390	*

Table 2 (Continued)
Groundwater Analytical Results

Analytical Parameters	NR 140 Standards		Site Name/Well No./Sampling Date																											
			Upper Bluff Area																											
	ES	PAL	MW-1		MW-2		MW-3		MW-4		MW-4A	MW-4B	MW-5	MW-5A	MW-5B	MW-5C	MW-6	MW-6A	MW-7	MW-7A	MW-8	MW-8A	MW-9A	MW-10	MW-10A	TW-13		TW-13 (Dup.)	MW-13A	MW-13B
			5/17/95	6/95	5/17/95	6/95	5/17/95	6/95	5/17/95	6/95	6/4/96	6/4/96	10/19/95	10/19/95	10/19/95	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	11/96	11/96	11/96	12/2/94	5/17/95	5/17/95	6/4/96	6/4/96
Metals (μg/l)																														
Aluminum	NSE	NSE	--	*	--	*	--	*	--	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	50	5	BDL	*	3.5	*	1.9	*	4.2	*	4.4	BDL	BDL	1.9	2.5	BDL	BDL	2.2	BDL	BDL	BDL	BDL	5.3	BDL	2.6	--	2.6	2.2	BDL	BDL
Cadmium	5	0.5	BDL	*	BDL	*	BDL	*	BDL	*	0.69	BDL	BDL	BDL	BDL	BDL	0.31	BDL	0.19	0.14	BDL	BDL	0.49	BDL	BDL	--	BDL	BDL	BDL	BDL
Chromium	100	10	BDL	*	BDL	*	BDL	*	BDL	*	1.4	BDL	BDL	BDL	BDL	BDL	0.41	0.87	0.5	BDL	8.3	BDL	0.9	0.38	BDL	--	BDL	BDL	BDL	BDL
Copper	1300	130	1.5	*	BDL	*	1.1	*	4	*	3.3	3.1	1.4	1.7	BDL	BDL	6.8	3.9	0.88	BDL	3.9	0.91	4.2	3.1	1.6	--	BDL	BDL	1.5	1
Iron	300	150	8.4	*	26,000	*	4,400	*	50	*	2,300	11	2,500	83	46	43	46	4.6	220	24	86	27	130	13	53	--	3,800	3,600	110	11
Lead	15	1.5	1.3	*	1.4	*	1.7	*	BDL	*	BDL	BDL	1.3	2.2	3.3	BDL	1.8	1.8	1.5	BDL	BDL	BDL	BDL	BDL	BDL	--	1.2	BDL	BDL	3.1
Selenium	50	10	5.9	*	2.4	*	2.9	*	2.2	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	2.4	1.7	BDL	BDL
Zinc	5000	2500	BDL	*	BDL	*	23	*	BDL	*	BDL	BDL	840	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	14	BDL	BDL	--	BDL	BDL	BDL	BDL
Indicators (mg/l)																														
BOD	NSE	NSE	--	*	--	*	--	*	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	*	*
Chloride	250	125	--	*	--	*	--	*	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	*	*
COD	NSE	NSE	--	*	--	*	--	*	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	*	*
Sulfate	250	125	--	*	--	*	--	*	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	*	*
TOC	NSE	NSE	--	*	--	*	--	*	--	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	--	--	--	*	*
PAHs[1] (μg/l)																														
Acenaphthene	NSE	NSE	BDL	*	BDL	*	BDL	*	38	*	17	11	340	BDL	BDL	BDL	BDL	BDL	180	14	BDL	BDL	BDL	BDL	BDL	914	270	100	9.9	13
Acenaphthylene	NSE	NSE	BDL	*	BDL	*	BDL	*	210	*	BDL	BDL	BDL	13	200	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	48	BDL	3,570	950	270	BDL	BDL
Aniline	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	BDL	15	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	89	BDL
Anthracene	NSE	NSE	BDL	*	4.7	*	BDL	*	BDL	*	18	4.5	84	8.7	54	BDL	BDL	BDL	29	BDL	BDL	BDL	BDL	4	BDL	1,685	290	130	BDL	12
Benzo(a)Anthracene	NSE	NSE	BDL	*	3.6	*	BDL	*	BDL	*	3.1	BDL	41	BDL	23	BDL	BDL	BDL	9.4	BDL	BDL	BDL	BDL	BDL	BDL	921	160	72	BDL	BDL
Benzo(a)Pyrene	0.2	0.02	BDL	*	4.5	*	BDL	*	BDL	*	3.4	BDL	36	BDL	BDL	BDL	BDL	BDL	11	BDL	BDL	BDL	BDL	BDL	BDL	898	130	58	BDL	BDL
Benzo(b)Fluoranthene	NSE	NSE	BDL	*	4	*	BDL	*	BDL	*	5.4	BDL	25	BDL	BDL	BDL	BDL	BDL	8.8	BDL	BDL	BDL	BDL	BDL	BDL	715	140	89	BDL	3.7
Benzo(k)Fluoranthene	NSE	NSE	BDL	*	5.2	*	BDL	*	BDL	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	339	BDL	BDL	--	--
Benzo(ghi)Perylene	NSE	NSE	BDL	*	4.9	*	BDL	*	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.2	BDL	BDL	BDL	BDL	BDL	BDL	389	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate	6	0.6	--	*	--	*	--	*	--	*	BDL	20	BDL	BDL	BDL	13	BDL	BDL	BDL	BDL	BDL	BDL	18	7	2.6	--	--	--	40	17
1-Chloronaphthalene	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	--	--	--	BDL	BDL	BDL	BDL	2.4	BDL	BDL	BDL	BDL	BDL	--	--	--	BDL	BDL
Chrysene	NSE	NSE	BDL	*	4	*	BDL	*	BDL	*	3	BDL	37	BDL	20	BDL	BDL	BDL	9.6	BDL	BDL	BDL	BDL	BDL	BDL	843	170	70	BDL	BDL
Dibenzofuran	NSE	NSE	BDL	*	BDL	*	BDL	*	24	*	26	20	BDL	BDL	BDL	BDL	BDL	BDL	7.2	15	BDL	BDL	BDL	4.3	BDL	--	BDL	BDL	15	20
2,4-Dichlorophenol	NSE	NSE	--	*	--	*	--	*	--	*	BDL	370	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	BDL	BDL
2,4-Dimethylphenol	NSE	NSE	BDL	*	BDL	*	BDL	*	120	*	BDL	BDL	BDL	180	1,100	BDL	BDL	BDL	160	110	BDL	570	BDL	BDL	BDL	--	240	59	3,400	3,400
Dimethylphthalate	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	BDL	BDL
Fluoranthene	NSE	NSE	BDL	*	3.9	*	BDL	*	BDL	*	12	BDL	100	BDL	41	BDL	BDL	BDL	29	BDL	BDL	BDL	BDL	BDL	BDL	1,862	290	140	BDL	3.1
Fluorene	400	80	BDL	*	BDL	*	BDL	*	40	*	52	46	110	4	72	BDL	BDL	BDL	74	33	BDL	BDL	BDL	17	BDL	1,879	350	130	32	43
Indeno(1,2,3-cd)Pyrene	NSE	NSE	BDL	*	4.1	*	BDL	*	BDL	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	362	BDL	BDL	--	--
2-Methyl Naphthalene	NSE	NSE	BDL	*	BDL	*	29	*	1,100	*	1,500	1,300	350	79	770	BDL	BDL	BDL	500	1,200	BDL	BDL	BDL	33	BDL	9,780	3,600	1,200	930	990
2-Methylphenol	NSE	NSE	BDL	*	BDL	*	BDL	*	190	*	BDL	BDL	BDL	160	450	BDL	BDL	BDL	100	39	BDL	600	BDL	BDL	BDL	--	170	BDL	2,800	1,700
3 & 4-Methylphenol	NSE	NSE	BDL	*	BDL	*	BDL	*	190	*	820	530	BDL	59	750	BDL	BDL	BDL	400	150	BDL	1,200	BDL	BDL	BDL	--	BDL	BDL	6,300	3,100
Naphthalene	40	8	BDL	*	4.5	*	490	*	3,500	*	8,800	7,200	1,100	650	2,200	BDL	BDL	BDL	3,100	3,900	BDL	560	BDL	44	BDL	24,769	14,000	4,700	7,000	7,600
1-Naphthylamine	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	--	--	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	16	22
2-Naphthylamine	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	--	--	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	9.3	18
Phenanthrene	NSE	NSE	BDL	*	4.8	*	BDL	*	60	*	74	55	350	8.3	180	BDL	BDL	BDL	130	16	BDL	BDL	BDL	37	BDL	6,072	1,100	470	23	54
Phenol	6000	1200	BDL	*	BDL	*	BDL	*	180	*	240	BDL	BDL	BDL	270	BDL	BDL	BDL	36	14	BDL	390	BDL	BDL	BDL	--	BDL	BDL	1,900	150
Pyrene	NSE	NSE	BDL	*	10	*	BDL	*	30	*	19	7.9	150	BDL	58	BDL	BDL	BDL	49	BDL	BDL	BDL	BDL	BDL	BDL	3,380	670	330	BDL	8.1
Pyridine	NSE	NSE	--	*	--	*	--	*		*	24	18	--	--	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	20	19

Table 2 (Continued)
Groundwater Analytical Results

Analytical Parameters	NR 140 Standards		Site Name/Well No./Sampling Date																											
			Upper Bluff Area																											
	ES	PAL	MW-1		MW-2		MW-3		MW-4		MW-4A	MW-4B	MW-5	MW-5A	MW-5B	MW-5C	MW-6	MW-6A	MW-7	MW-7A	MW-8	MW-8A	MW-9A	MW-10	MW-10A	TW-13		TW-13 (Dup.)	MW-13A	MW-13B
			5/17/95	6/95	5/17/95	6/95	5/17/95	6/95	5/17/95	6/95	6/4/96	6/4/96	10/19/95	10/19/95	10/19/95	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	6/4/96	11/96	11/96	11/96	12/2/94	5/17/95	5/17/95	6/4/96	6/4/96
VOCs[2] (µg/l)																														
Benzene	5	0.5	0.34	0.43	0.3	34	6.2	7.8	490	430	12,000	430	24	13,000	31,000	8.3	BDL	BDL	1,500	6,600	38	25,000	5.6	7.1	1.6	20,500	16,000	16,000	79,000	62,000
Bromodichloromethane	0.6	0.06	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.2	BDL	BDL	1.3	BDL	BDL	BDL	BDL	BDL	--	--	BDL	BDL
n-Butylbenzene	NSE	NSE	BDL	*	BDL	*	1.5	*	56	*	BDL	770	22	14	38	19	BDL	BDL	200	2,900	30	BDL	1.9	24	0.29	BDL	BDL	BDL	440	450
sec-Butylbenzene	NSE	NSE	BDL	*	BDL	*	0.4	*	BDL	*	1,400	150	BDL	BDL	BDL	5.6	BDL	BDL	BDL	610	7.6	230	BDL	BDL	BDL	BDL	490	BDL	970	980
tert-Butylbenzene	NSE	NSE	BDL	*	BDL	*	0.37	*	BDL	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	600	600
Chloroform	6	0.6	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	9.3	BDL	BDL	4.7	BDL	0.66	BDL	BDL	BDL	--	--	BDL	BDL
Ethylbenzene	700	140	BDL	*	0.36	*	17	*	440	*	2,100	110	140	1,600	500	BDL	BDL	BDL	930	970	BDL	340	0.61	BDL	BDL	3,180	2,800	2,800	970	950
Isopropylbenzene	NSE	NSE	0.21	*	5	*	1.8	*	76	*	BDL	96	36	38	12	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	330	120	BDL	BDL
Isopropyl ether	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	BDL	16	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--	BDL	BDL
p-Isopropyltoluene	NSE	NSE	BDL	*	0.21	*	2.6	*	BDL	*	--	--	--	--	--	--	--	--	--	--	--	--	BDL	0.19	BDL	BDL	BDL	--	--	--
Methyl tert Butyl Ether	60	12	BDL	*	BDL	*	0.36	*	3.5	*	BDL	BDL	BDL	BDL	16	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	BDL
Naphthalene	40	8	0.41	1.6	BDL	20	74	840	BDL	1,100	10,000	1,800	6,700	1,900	3,800	53	0.86	BDL	3,800	5,500	93	7,500	14	77	4.1	8,760	13,000	12,000	21,000	13,000
n-Propylbenzene	NSE	NSE	BDL	*	BDL	*	0.87	*	30	*	BDL	BDL	BDL	BDL	30	5.3	BDL	BDL	BDL	2,200	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene	NSE	NSE	--	*	--	*	--	*	--	*	--	--	--	--	--	--	--	--	--	--	--	--	2.2	8	BDL	--	--	--	--	--
Tetrachloroethylene	5	0.5	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	BDL	BDL
Toluene	343	68.6	0.45	*	0.82	*	9.3	*	4,100	*	8,800	580	120	1,600	18,000	13	BDL	BDL	290	4,600	22	8,000	11	14	0.73	10,000	9,800	9,700	36,000	30,000
1,2,3-Trichlorobenzene	NSE	NSE	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.9	BDL	BDL	BDL	BDL	BDL	--	--	BDL	BDL
Trichloroethylene	5	0.5	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	BDL	BDL
Trichlorofluoromethane	3,490	698	--	*	--	*	--	*	--	*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.21	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--	BDL	BDL
1,2,4-Trimethylbenzene	NSE	NSE	BDL	*	0.36	*	14	*	480	*	1,500	190	62	130	460	7.4	BDL	BDL	260	720	7	250	0.66	5.1	BDL	BDL	460	BDL	860	870
1,3,5-Trimethylbenzene	NSE	NSE	BDL	*	BDL	*	5	*	200	*	2,400	170	30	44	140	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1,100	1,100
Total Xylenes	620	124	BDL	*	0.61	*	27	*	3,600	*	9,700	970	380	1,300	9,700	29	2.2	2.3	800	3,800	32	1,600	5.4	7.7	BDL	5,180	4,100	4,000	11,500	8,050

NSE = No standard established
BDL = Below laboratory detection limits
-- = Not analyzed for
▨ = Exceeds ch. NR 140 Enforcement Standard (ES)
24.6 = Exceeds ch. NR 140 Preventive Action Limit (PAL)
[1] = PAH list is not complete; PAHs not listed are BDL
[2] = VOC list is not complete; VOCs not listed are BDL
* = Sample collected by Dames and Moore; complete analytical results not readily available; indicated results based on Dames and Moore reported values
Compiled by: TJB   Checked by: JJT

Table 3
Summary of Offshore Soil and Sediment Analytical Results

Analytical Parameters	Grid Location/Depth (ft)/Date									
	2300N 800E	2400N 1600E	2500N 1500E	2500N 1800E	2500N 1900E	2600N 1500E	2700N 1500E	2700N 1700E	2800N 1800E	2900N 1400E
	0-4	0-4	0-4	0-4	0-4	0-4	0-4	0-4	0-4	0-4
	3/6/96	3/12/96	3/7/96	3/11/96	3/8/96	3/12/96	3/7/96	3/8/96	3/11/96	3/7/96
Metals (mg/kg)										
Arsenic	1.2	1.1	1.0	1.0	0.5	1.2	–	1.3	0.9	1.0
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	–	0.1	BDL	BDL
Chromium	3.7	3.3	4.6	4.5	2.6	7.3	–	5.9	3.4	5.2
Copper	2.0	1.9	2.8	2.6	1.2	3.9	–	3.2	1.4	3.0
Lead	1.2	1.4	1.5	3.3	0.8	2.5	–	2.2	1.0	2.4
Nickel	3.9	2.6	3.9	3.1	2.1	5.5	–	4.1	2.3	4.2
Zinc	5.7	5.7	9.7	7.8	3.5	12.0	–	8.7	6.8	9.3
Indicators (mg/kg)										
Total Organic Carbon	BDL	1,200	–	>16,000	1,700	1,100	9,100	2,600	2,700	2,500
Total Cyanide	BDL	19.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sulfide	BDL	BDL	–	–	BDL	BDL	BDL	BDL	BDL	44.0

BDL = Below laboratory detection limit
-- = Not analyzed for
Compiled by: JJT Checked by: KEA

Table 3 (Continued)
Summary of Offshore Soil and Sediment Analytical Results

Analytical Parameters	Grid Location/Depth (ft)/Date																									
	2100N 1000E	2300N 800E	2300N 1000E	2300N 1300E		2300N 1400E		2300N 1500E		2300N 1600E	2300N 1700E	2400N 1200E	2400N 1300E	2400N 1400E	2400N 1600E	2400N 1700E	2400N 2000E	2400N 2100E		2500N 1300E	2500N 1400E	2500N 1500E		2500N 1600E	2500N 1700E	
	4-6	0-4	4-8	0-4	4-6	0-4	6-8	0-4	8-10	0-4	0-4	4-6	0-4	0-4	0-4	0-4	6-8	0-4	4-6	0-4	0-4	0-4	6-8		0-4	6-8
	3/12/96	3/6/96	3/6/96	3/8/96	3/8/96	3/7/96	3/7/96	3/6/96	3/6/96	3/12/96	3/8/96	3/12/96	3/8/96	3/7/96	3/12/96	3/8/96	3/12/96	3/9/96	3/9/96	3/8/96	3/7/96	3/7/96	3/7/96	3/12/96	3/8/96	3/8/96
VOCs[1] (µg/kg)																										
Benzene	BDL	BDL	BDL	6,900	440	1,100	120	1,900	BDL	1,300	3,000	BDL	520	5,900	2,700	55,000	4,300	96	220	5,100	BDL	BDL	BDL	BDL	BDL	BDL
n-Butylbenzene	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	640	--	--	--	--	--	--	BDL	--	--	--	--
Ethylbenzene	BDL	BDL	BDL	47,000	750	8,800	200	5,500	35	3,300	16,000	BDL	15,000	29,000	14,000	510,000	140,000	470	19,000	88,000	270	1,100	BDL	250	38,000	BDL
Isopropylbenzene	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	1,500	--	--	--	--	--	--	BDL	--	--	--	--
p-Isopropyltoluene	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	450	--	--	--	--
Naphthalene	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	160,000	--	--	--	--	--	--	43,000	--	--	--	--
n-Propylbenzene	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	600	--	--	--	--	--	--	BDL	--	--	--	--
Toluene	BDL	BDL	BDL	2,800	BDL	1,900	39	1,200	BDL	2,000	5,000	BDL	2,100	13,000	4,700	220,000	37,000	300	1,700	18,000	48	BDL	39	BDL	4,100	BDL
1,1,1-Trichloroethane	--	760	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	BDL	--	--	--	--
1,2,4-Trimethylbenzene	BDL	BDL	BDL	17,000	160	4,300	64	4,000	BDL	1,800	8,600	BDL	7,800	11,000	8,800	290,000	120,000	410	20,000	37,000	240	930	BDL	84	24,000	BDL
1,3,5-Trimethylbenzene	BDL	BDL	BDL	5,900	53	1,500	BDL	1,500	BDL	590	2,700	BDL	2,600	4,000	2,900	91,000	40,000	160	6,700	12,000	94	460	BDL	34	8,000	BDL
Total Xylenes	BDL	BDL	BDL	44,000	580	7,800	172	5,700	BDL	3,600	17,600	BDL	14,900	24,300	16,200	590,000	180,000	700	27,000	81,000	237	1,050	BDL	184	38,000	BDL

Analytical Parameters	Grid Location/Depth (ft)/Date																									
	2500N 1800E		2500N 1900E	2500N 2000E	2500N 2100E		2500N 2200E	2500N 2300E		2500N 2600E		2600N 1200E	2600N 1300E	2600N 1400E		2600N 1500E	2600N 1600E	2600N 1700E	2600N 1900E		2600N 2000E	2600N 2100E	2600N 2300E	2600N 2500E	2600N 2700E	2700N 1300E
	6-8	8-10	0-4	0-4	0-4	6-8	4-6	6-8	8-10	0-4	6-8	0-4	0-4	0-4	6-8	0-4	0-4	0-4	0-4	6-8	4-6	0-4	6-8	0-4	0-4	0-4
	3/11/96	3/11/96	3/8/96	3/11/96	3/9/96	3/9/96	3/9/96	3/10/96	3/10/96	3/11/96	3/11/96	3/8/96	3/7/96	3/7/96	3/7/96	3/12/96	3/12/96	3/8/96	3/9/96	3/9/96	3/11/96	3/9/96	3/10/96	3/11/96	3/11/96	3/7/96
VOCs[1] (µg/kg)																										
Benzene	8,900	74	BDL	BDL	BDL	BDL	BDL	140	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	750	57	BDL	BDL	BDL	BDL	BDL	BDL
n-Butylbenzene	--	--	1,000	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	120,000	77	9,300	BDL	BDL	BDL	84	8,700	120	BDL	BDL	BDL	660	890	BDL	BDL	BDL	BDL	13,000	65	BDL	BDL	BDL	BDL	BDL	BDL
Isopropylbenzene	--	--	1,600	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	--	--	2,300	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	81,000	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	--	230	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
Toluene	42,000	BDL	300	BDL	BDL	BDL	BDL	1,300	BDL	BDL	BDL	BDL	BDL	84	BDL	BDL	BDL	BDL	3,200	51	BDL	BDL	BDL	BDL	BDL	220
1,1,1-Trichloroethane	--	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	73,000	BDL	6,800	BDL	BDL	BDL	92	10,000	52	BDL	BDL	BDL	2,700	730	BDL	BDL	BDL	BDL	7,900	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3,5-Trimethylbenzene	22,000	BDL	2,200	BDL	BDL	BDL	34	3,600	BDL	BDL	BDL	BDL	1,300	320	BDL	BDL	BDL	BDL	2,400	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Xylenes	130,000	50	11,200	BDL	BDL	BDL	143	12,700	155	BDL	BDL	BDL	1,140	920	BDL	BDL	BDL	BDL	15,000	43	BDL	BDL	BDL	BDL	BDL	BDL

BDL = Below laboratory detection limit
-- = Not analyzed for
[1] = VOC list is not complete; VOCs not listed are BDL
Compiled by: JJT Checked by: KEA

Table 3 (Continued)
Summary of Offshore Soil and Sediment Analytical Results

Analytical Parameters	Grid Location/Depth (ft)/Date																									
	2700N 1400E	2700N 1500E	2700N 1600E	2700N 1700E	2700N 1800E		2700N 1900E	2700N 2000E	2700N 2100E	2700N 2200E		2700N 2300E	2700N 2500E	2800N 1300E	2800N 1400E		2800N 1500E	2800N 1600E	2800N 1700E	2800N 1900E	2800N 2000E	2800N 2100E	2800N 2200E	2800N 2300E	2800N 2400E	2800N 2500E
	0-4	0-4	0-4	0-4	0-4	4-6	0-4	4-6	0-4	4-6	6-8	4-6	8-10	0-4	0-4	6-8	0-4	0-4	0-4	0-4	0-4	0-4	4-6	0-4	0-4	0-4
	3/7/96	3/7/96	3/12/96	3/8/96	3/11/96	3/11/96	3/9/96	3/11/96	3/9/96	3/11/96	3/11/96	3/10/96	3/12/96	3/7/96	3/6/96	3/7/96	3/12/96	3/12/96	3/8/96	3/9/96	3/11/96	3/9/96	3/11/96	3/10/96	3/10/96	3/10/96
VOCs^1 (μg/kg)																										
Benzene	BDL	BDL	BDL	BDL	BDL	BDL	390	2,700	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
n-Butylbenzene	--	BDL	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	35	BDL	BDL	BDL	480	180	24,000	180,000	BDL	BDL	BDL	410	BDL	BDL	BDL	BDL	BDL	BDL	BDL	590	BDL	BDL	BDL	950	BDL	BDL
Isopropylbenzene	--	BDL	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	--	BDL	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	BDL	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	BDL	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	88	96	BDL	38	BDL	BDL	2,400	17,000	54	BDL	BDL	53	BDL	200	94	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane	--	200	--	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	280	BDL	BDL	BDL	250	89	13,000	130,000	BDL	BDL	BDL	280	BDL	BDL	BDL	BDL	BDL	BDL	BDL	590	BDL	BDL	BDL	1,300	BDL	BDL
1,3,5-Trimethylbenzene	130	BDL	BDL	BDL	77	BDL	4,500	38,000	BDL	BDL	BDL	100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	200	BDL	BDL	BDL	530	BDL	BDL
Total Xylenes	80	BDL	BDL	BDL	560	192	28,100	192,000	BDL	BDL	BDL	520	BDL	BDL	BDL	BDL	BDL	BDL	BDL	760	BDL	BDL	BDL	1,410	BDL	BDL

Analytical Parameters	Grid Location/Depth (ft)/Date																												
	2900N 1400E	2900N 1500E		2900N 1600E	2900N 1700E	2900N 1800E	2900N 1900E	2900N 2000E	2900N 2100E	2900N 2200E	2900N 2300E		2900N 2400E	2900N 2500E	3100N 1300E		3100N 1500E		3100N 1700E		3100N 1900E		3100N 2100E		3100N 2300E		3500N 1500E		3500N 2000E
	0-4	2-4	6-8	0-4	0-4	4-6	0-4	0-2	0-4	0-4	0-4	10-12	4-6	0-4	0-4	8-10	0-4	6-8	0-4	6-8	0-4	6-8	0-4	8-10	0-4	12-14	6-8	16-18	4-6
	3/7/96	3/12/96	3/12/96	3/12/96	3/8/96	3/11/96	3/9/96	3/11/96	3/9/96	3/11/96	3/10/96	3/10/96	3/10/96	3/10/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	3/12/96	2/27/96	2/28/96	3/11/96
VOCs^1 (μg/kg)																													
Benzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
n-Butylbenzene	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
Ethylbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Isopropylbenzene	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
p-Isopropyltoluene	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
Naphthalene	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
n-Propylbenzene	BDL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
Toluene	130	BDL	BDL	76	BDL	BDL	74	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane	250	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	BDL	--	--
1,2,4-Trimethylbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3,5-Trimethylbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Xylenes	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL = Below laboratory detection limit
-- = Not analyzed for
[1] = VOC list is not complete; VOCs not listed are BDL
Compiled by: JJT Checked by: KEA

Table 4
Non-Aqueous Phase Liquids Measurement and Observations

Well Number	Borehole Depth (ft)	Well Depth (ft)	NAPL Detected	Comments
Ashland Lakefront Property Monitoring Wells				
MW-1	16	14	No detect	Clear water, no indication of free product.
MW-2	16	13.5	Emulsion	Yellow color on string and bailer. Some emulsion throughout water column.
MW-3	16	15	Emulsion	Emulsion throughout water column. Yellow staining on string and bailer.
MW-7	15	15	5 feet of DNAPL	Heavy black staining on string and bailer. DNAPL in bottom of well.
TW-6	16.5	14	Emulsion	Some yellow staining on bailer and rope.
TW-9	16.5	14	1-2 feet DNAPL	Heavy black staining on string and bailer. DNAPL in bottom of well.
TW-12	16.5	14	No detect	Slight yellow staining on string and bailer.
Upper Bluff Area Monitoring Wells and Piezometers				
MW-1	21.5	21	No detect	No visual indication of free product.
MW-2	21	20	No detect	No visual indication of free product.
MW-3	16	15	No detect	No visual indication of free product.
MW-4	15.5	15	No detect	No visual indication of free product.
MW-4A	35	26	No detect	No visual indication of free product.
MW-4B	55.5	55	No detect	No visual indication of free product.
MW-5	28.5	28	No detect	No visual indication of free product.
MW-5A	34	33.5	--	Not able to access well. Presence of DNAPL is suspected in this well.
MW-5B	51	49	No detect	No visual indication of free product.
MW-5C	76	76	No detect	No visual indication of free product.
MW-8	16	16	No detect	Clear water. No indication of free product.
MW-8A	50	50	No detect	Clear water. No indication of free product.
TW-13	22	19	--	Unable to evaluate. Top of water column frozen. DNAPL suspected in this well.
MW-13A	50	45	2.1 feet of DNAPL	Heavy black oil staining on string and bailer. DNAPL in bottom of well.
MW-13B	70	70	26 feet of DNAPL	Heavy black oil staining on string and bailer. DNAPL in bottom of well.

Notes:
* = Depth are in feet from ground surface.
Observations and measurements made by SEH on April 8, 1997
Compiled by: JS Checked by: ____

Table 5
Physical and Chemical Properties of Select Volatile Organic Compounds and Polynuclear Aromatic Hydrocarbons

Constituent	Water Solubility (mg/l)	Specific Gravity	Henry's Law Constant (atm·m^3/mol) at 25°C	Vapor Pressure (mm Hg at 25°C)	Octanol/Water Partitioning Coefficient: (Log K_{ow} at 20 or 25°C)	Soil Adsorption Coefficient (Log K_{oc})
VOCs[1]						
Benzene	1791	0.876	5.43E-03	95.2	2.13	1.99
Ethylbenzene	161	0.867	8.44E-03	9.53	3.15	2.94
Toluene	535	0.867	5.94E-03	28.4	2.73	2.0
Xylenes (Mixed)	198	0.880	7.0E-03	6.6	3.26	2.38
1,1,1-Trichloroethane	1495	1.325	8.0E-03	123.7	2.49	2.26
Vinyl Chloride	2763	0.912	1.07E-02	2660	1.75	1.7
PAHs[2,3]						
Acenaphthene	3.42	1.024	9.20E-05	0.0015	4.0	3.66
Acenaphthylene	3.93	--	1.48E-03	0.029	3.70	3.40
Anthracene	0.045	1.25	1.02E-03	1.90E-04	4.45	4.15
Benzo(a)anthracene	5.70E-03	--	1.16E-06	2.20E-08	5.60	6.14
Benzo(a)pyrene	1.20E-03	--	1.55E-06	5.60E-09	6.06	6.74
Benzo(b)fluoranthene	1.40E-02	--	1.19E-05	5.00E-07	6.06	5.74
Benzo(ghi)perylene	7.00E-04	--	5.34E-08	1.03E-10	6.51	6.20
Chrysene	1.80E-03	1.274	1.05E-06	6.30E-09	5.61	5.30
Fluoranthene	0.206	--	6.46E-06	5.00E-06	4.90	4.58
Fluorene	1.69	--	6.42E-05	7.10E-04	4.20	3.86
Indeno(123-cd)pyrene	5.30E-04	--	6.86E-08	1.00E-10	6.50	6.20
2-Methylnaphthalene	25.4	--	--	--	4.10	3.93
Naphthalene	31.7	1.14	1.15E-03	2.30E-01	3.44	3.11
Phenanthrene	1.00	1.063	1.59E-04	6.80E-04	4.46	4.15
Pyrene	0.132	1.271	5.04E-06	2.50E-06	4.88	4.58

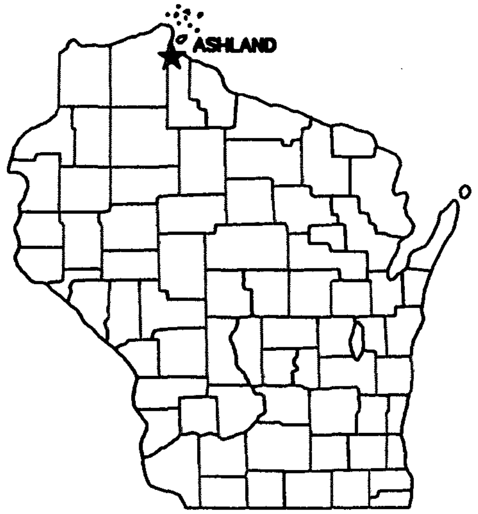
[1] = Howard, Phillip H., 1990, *Fate and Exposure Data for Organic Chemicals, Volume I-IV,* Lewis publishers, Chelsea, MI

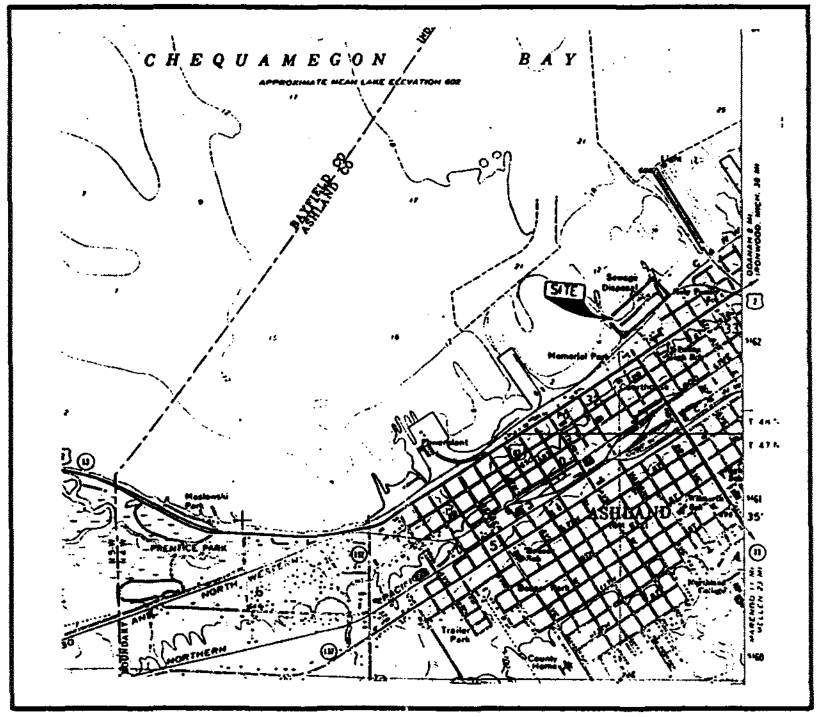
[2] = CONCAWE, 4/79, Protection of Groundwater from Oil Pollution

[3] = Lewis, Richard J., 1993, *Hawleys Condensed Chemical Dictionary,* Twelfth Addition, Van Nostrand Reinhold Company New York

Figures

ASHLAND LAKEFRONT PROPERTY
COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT
FIGURE SET
ASHLAND, WISCONSIN





REPRODUCED FROM

USGS ASHLAND WEST AND EAST QUADRANGLES

WISCONSIN – ASHLAND CO. 7.5 MINUTE SERIES

1964, PHOTO REVISED 1975

SCALE IN FEET

0 1000 2000 4000

INDEX

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

SEH
ENGINEERS ARCHITECTS PLANNERS

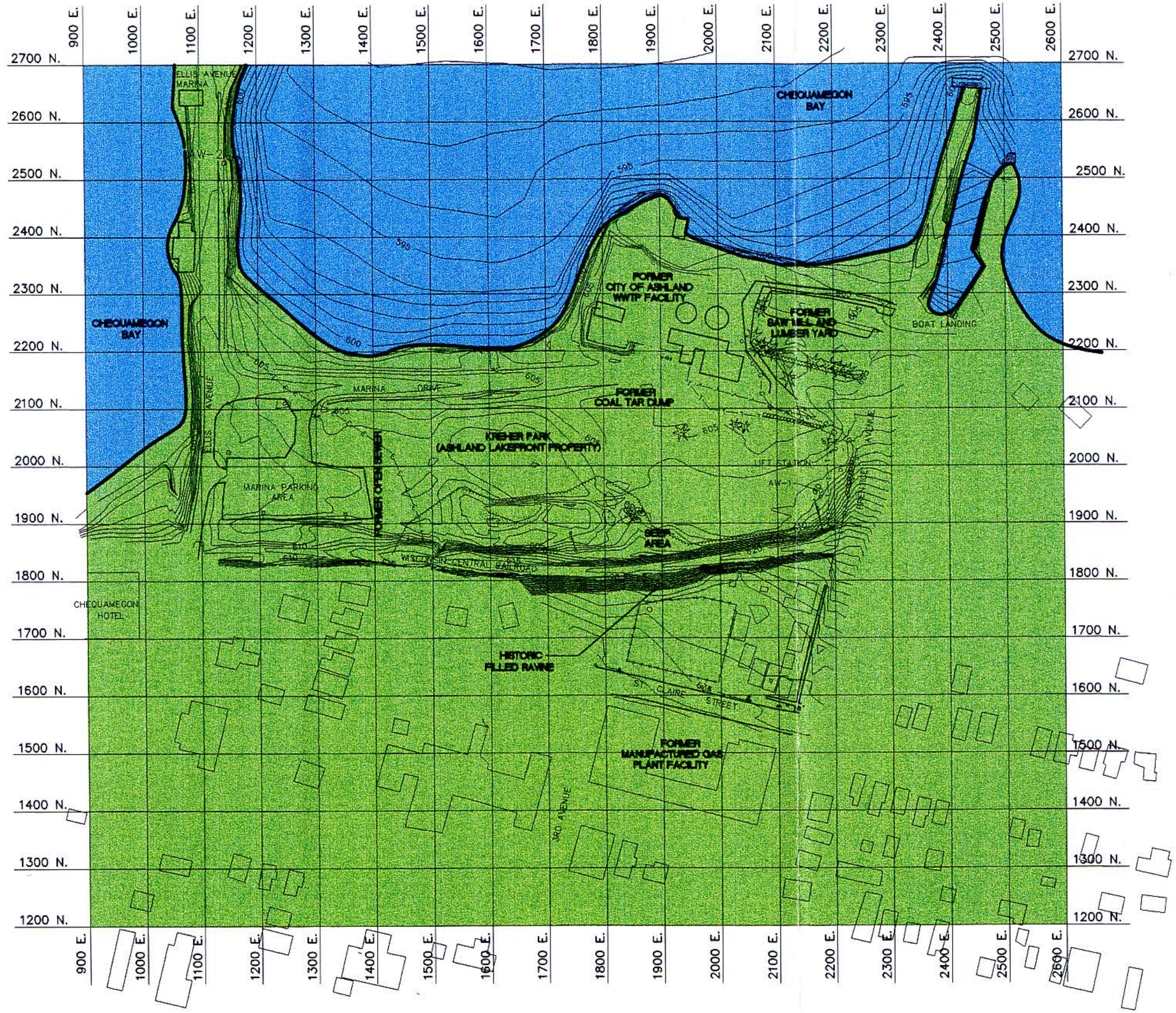
ASHLAND LAKEFRONT PROPERTY

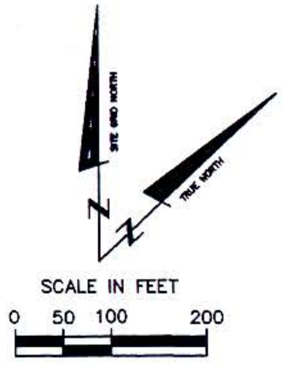
FIGURE 1
SITE LOCATION AND INDEX

PROJ. NO.
WDNR9401
DATE
5/1/97

1/9

S:\ASTE\WDNR\9401FRT1 05-13-97 10:41 am





LEGEND

— 605 —	TOPOGRAPHIC CONTOUR (1' INTERVAL)
⊙	HYDRANT
○	SANITARY OR STORM SEWER MANHOLE
⊠	TELEPHONE PEDISTAL
⊡	POWER POLE
←	GUY ANCHOR
⊏—●	LIGHT POLE
⊏—⊡	POWER POLE WITH LIGHT
—G—G—G—	UNDERGROUND GAS LINE
—E—E—E—	UNDERGROUND ELECTRIC LINE
—T—T—T—	UNDERGROUND TELEPHONE LINE
—x—x—x—	FENCE
⟼	CULVERT
✳	PINE TREE
⊙	TREE
○○○○○○	SHRUB / HEDGE
∴	SWAMP
AW-1 ○	EXISTING ARTESIAN WELL
🟦	= SURFACE WATER
🟩	= LAND

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

ENGINEERS ■ ARCHITECTS ■ PLANNERS

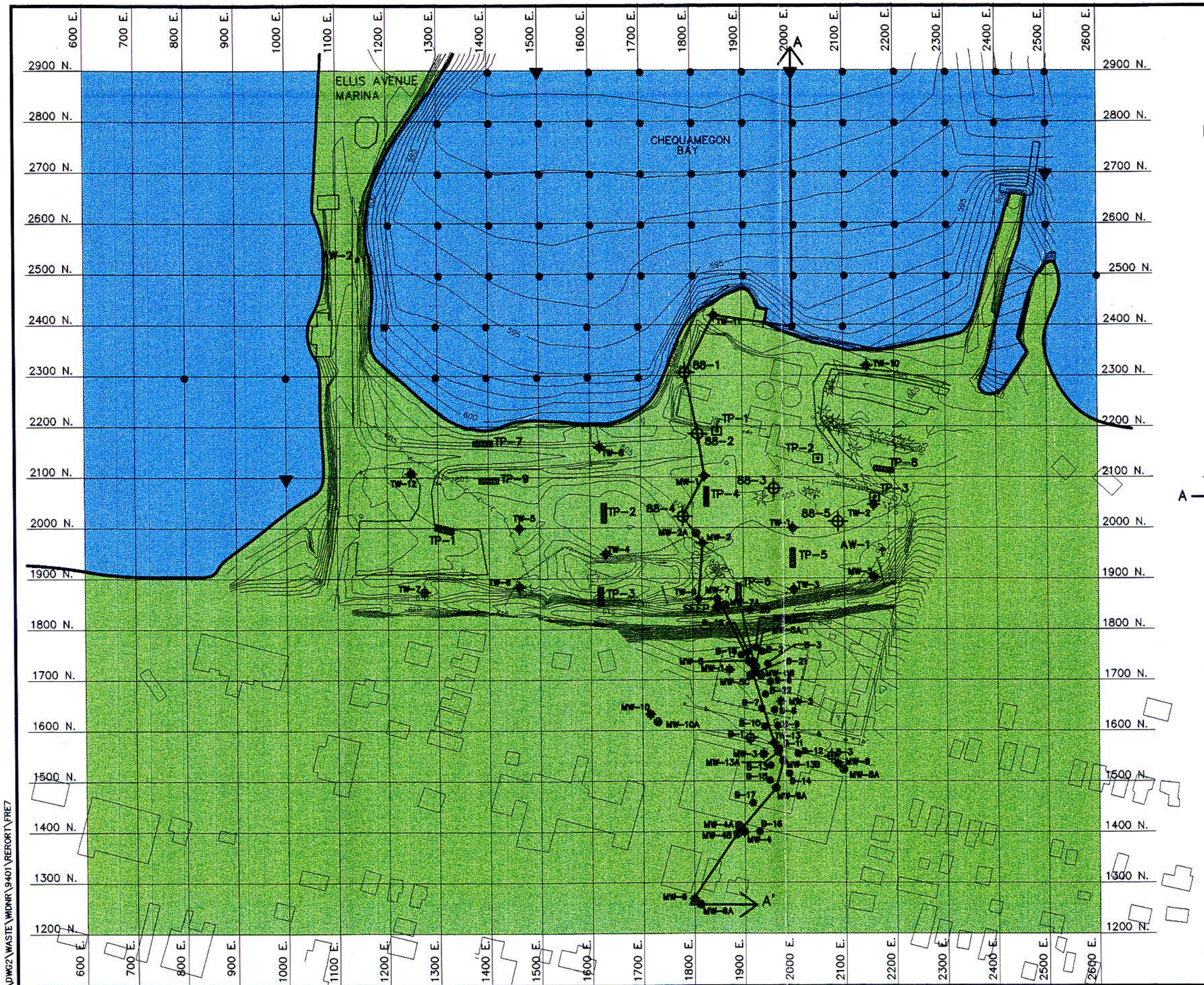
ASHLAND LAKEFRONT PROPERTY

FIGURE 2
EXISTING CONDITIONS

PROJ. NO.
WIDNR9401
DATE
5/1/97

2
9

F:\WASTE\DWG2\WASTE\WIDNR\9401\REPORT\FRE2



LEGEND

●	SEH SEDIMENT SAMPLING LOCATION
▼	SEH SOIL BORING LOCATION
▨ TP-6	SEH TEST PIT APPROXIMATE LOCATION AND NUMBER
TW-6 ⊕	EXISTING SEH GROUNDWATER MONITORING WELL LOCATION AND NUMBER
TW-1 ⊕	FORMER SEH TEMPORARY GROUNDWATER MONITORING WELL LOCATION AND NUMBER (ABANDONED 11-22-94)
B-1 ⊕	SEH SOIL BORING LOCATION AND NUMBER
88-5 ⊕	NORTHERN ENVIRONMENTAL TECHNOLOGIES, INC. SOIL BORING LOCATION AND NUMBER
MW-1 ⊕	NORTHERN ENVIRONMENTAL TECHNOLOGIES, INC. GROUNDWATER MONITORING WELL LOCATION AND NUMBER
TP-1 ▣	NORTHERN ENVIRONMENTAL TECHNOLOGIES, INC. TEST PIT LOCATION AND NUMBER
MW-3 ⊕	DAMES AND MOORE GROUNDWATER MONITORING WELL LOCATION AND NUMBER
MW-4A ⊗	DAMES AND MOORE PIEZOMETER LOCATION AND NUMBER
B-1 ●	DAMES AND MOORE SOIL BORING LOCATION AND NUMBER
◆	GROUNDWATER SEEP
AW-1 ▫	EXISTING ARTESIAN WELL LOCATION AND NUMBER
—605—	TOPOGRAPHIC CONTOUR (1' INTERVAL)
A ——— A'	CROSS SECTION LINE
⊙	HYDRANT
○	SANITARY OR STORM SEWER MANHOLE
⊠	TELEPHONE PEDISTAL
⊡	POWER POLE
←	GUY ANCHOR
☐—○	LIGHT POLE
☐—⊡	POWER POLE WITH LIGHT
G—G—G—	UNDERGROUND GAS LINE
E—E—E—	UNDERGROUND ELECTRIC LINE
T—T—T—	UNDERGROUND TELEPHONE LINE
X—X—X—	FENCE
⟩——⟨	CULVERT
✱	PINE TREE
○	TREE
⁚ ⁚ ⁚	SWAMP
🟦	= SURFACE WATER
🟩	= LAND

NOTE: 1. DUE TO SCALE CONSTRAINT, SEDIMENT SAMPLING POINTS BEYOND 2900 N ARE NOT SHOWN. SEDIMENT SAMPLES WERE COLLECTED AT POINTS AS FAR AS 4000 N.

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

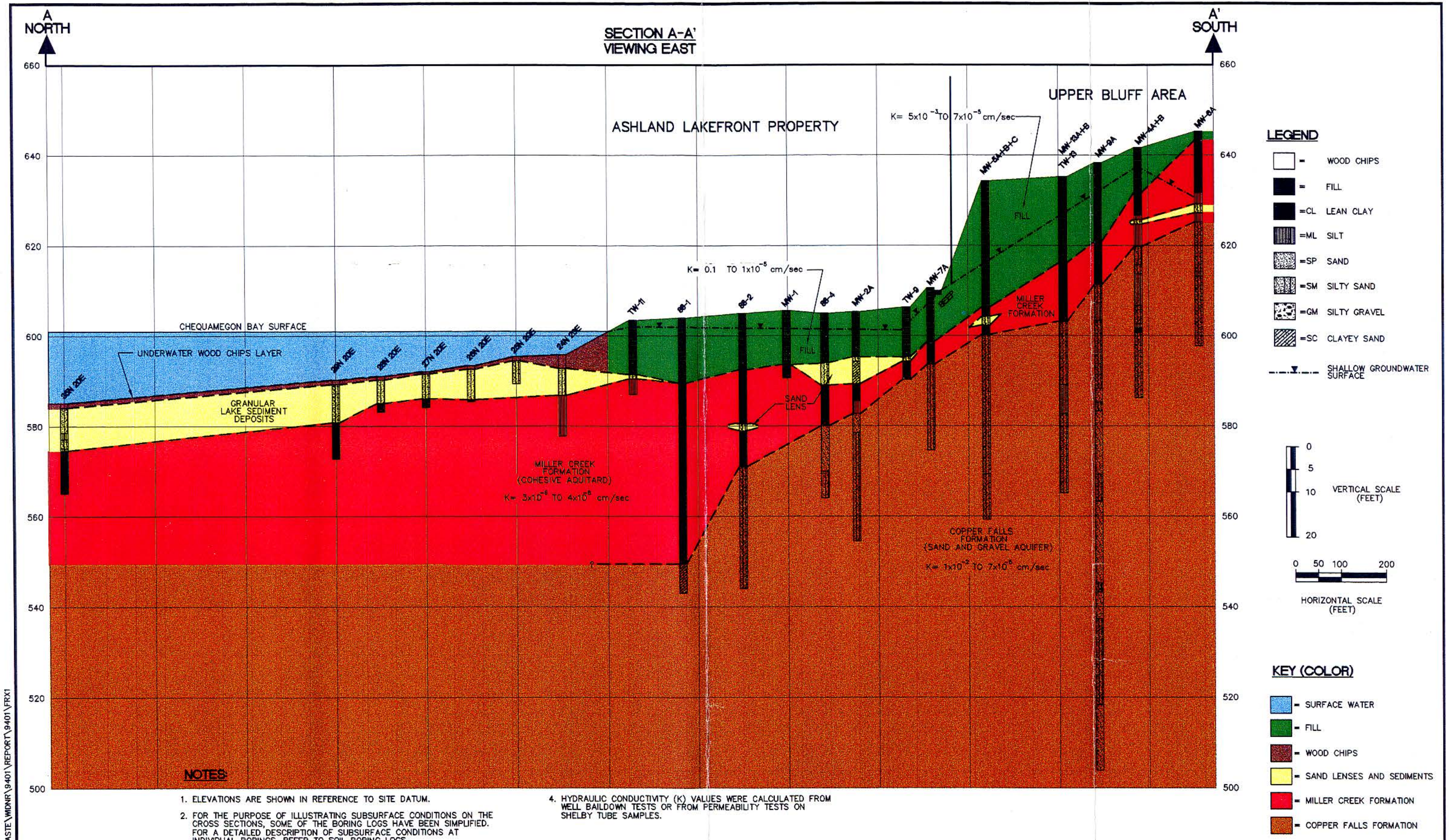
ASHLAND LAKEFRONT PROPERTY

FIGURE 3
SAMPLING
LOCATION MAP

PROJ. NO. WDNR9401
DATE 5/1/97

3/9

F:\WASTE\DWG2\WASTE\WDNR\9401\REPORT\FRE7



NOTES:

1. ELEVATIONS ARE SHOWN IN REFERENCE TO SITE DATUM.
2. FOR THE PURPOSE OF ILLUSTRATING SUBSURFACE CONDITIONS ON THE CROSS SECTIONS, SOME OF THE BORING LOGS HAVE BEEN SIMPLIFIED. FOR A DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT INDIVIDUAL BORINGS, REFER TO SOIL BORING LOGS.
3. HORIZONTAL DISTANCES ARE MEASURED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION.
4. HYDRAULIC CONDUCTIVITY (K) VALUES WERE CALCULATED FROM WELL BAILDOWN TESTS OR FROM PERMEABILITY TESTS ON SHELBY TUBE SAMPLES.

F:\WASTE\DWG2\WASTE\WDNR\9401\REPORT\9401\FRX1

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

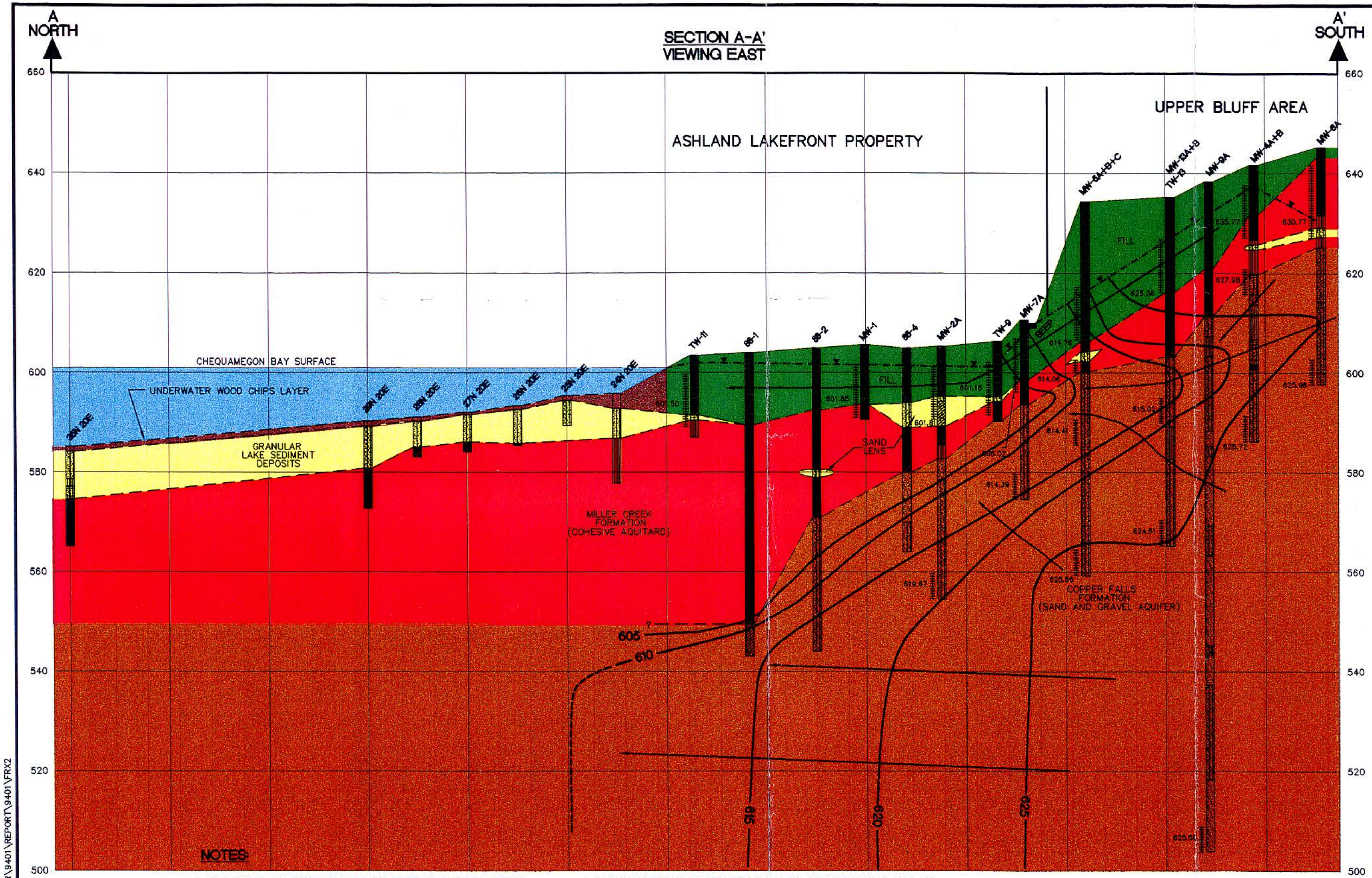
SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

ASHLAND LAKEFRONT PROPERTY

FIGURE 4
GEOLOGIC CROSS SECTION
A-A'

PROJ. NO.
WDNR9401
DATE
5/1/97

4
9



NOTES:

1. ELEVATIONS ARE SHOWN IN FEET AND REFERENCED TO SITE DATUM.
2. FOR THE PURPOSE OF ILLUSTRATING SUBSURFACE CONDITIONS ON THE CROSS SECTIONS, SOME OF THE BORING LOGS HAVE BEEN SIMPLIFIED. FOR A DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT INDIVIDUAL BORINGS, REFER TO SOIL BORING LOGS.
3. HORIZONTAL DISTANCES ARE MEASURED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION.
4. GROUNDWATER ELEVATIONS WERE MEASURED ON NOVEMBER 7, 1996 BY DAMES AND MOORE, EXCEPT FOR MONITORING WELLS TW-9, AND TW-11 WHICH WERE MEASURED BY SEH ON DECEMBER 13, 1994.
5. GROUNDWATER FLOW LINES WERE NOT DRAWN THROUGH MILLER CREEK FORMATION BECAUSE GROUNDWATER VELOCITIES IN MILLER CREEK FORMATION ARE VERY LOW.

LEGEND

☐ = WOOD CHIPS
■ = FILL
■ =CL LEAN CLAY
▥ =ML SILT
▨ =SP SAND
▨ =SM SILTY SAND
▨ =GM SILTY GRAVEL
▨ =SC CLAYEY SAND
—·—▼—·— SHALLOW GROUNDWATER SURFACE
—625— GROUNDWATER EQUIPOTENTIAL CONTOURS
619.67 SCREENED INTERVAL AND STATIC WATER LEVEL
← DIRECTION OF GROUNDWATER FLOW

0 5 10 20 VERTICAL SCALE (FEET)

0 50 100 200 HORIZONTAL SCALE (FEET)

KEY (COLOR)

🟦 = SURFACE WATER
🟩 = FILL
🟫 = WOOD CHIPS
🟨 = SAND LENSES AND SEDIMENTS
🟥 = MILLER CREEK FORMATION
🟧 = COPPER FALLS FORMATION

F:\WASTE\DWG2\WASTE\WDNR\9401\REPORT\9401\FRX2

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

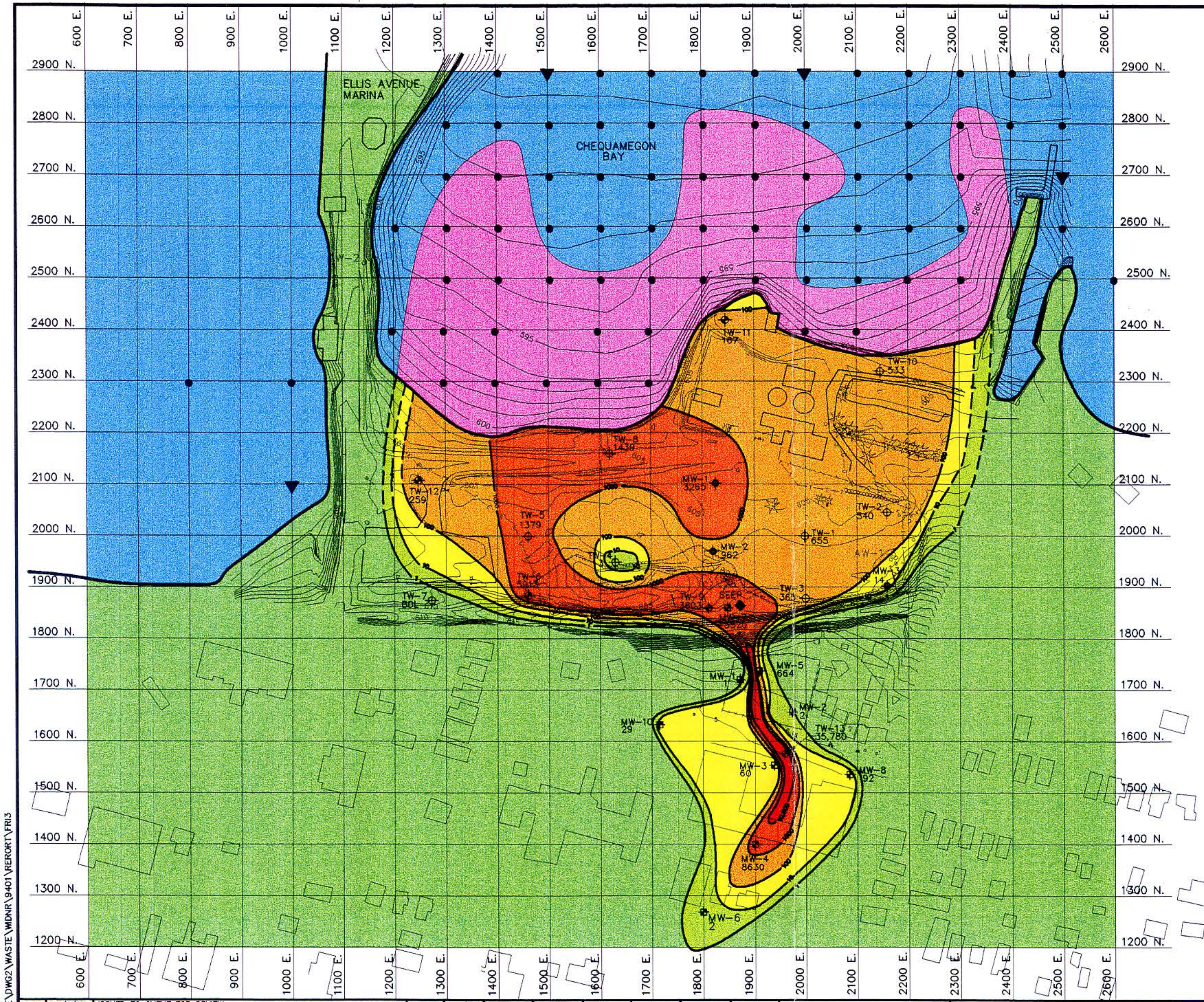
SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

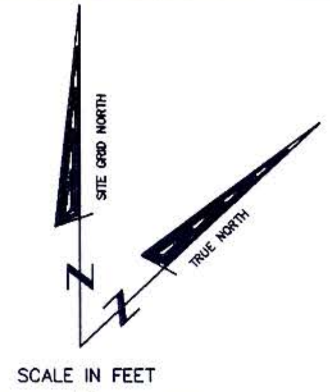
ASHLAND LAKEFRONT PROPERTY

FIGURE 5
GROUNDWATER EQUIPOTENTIAL CONTOURS

PROJ. NO.
WDNR9401
DATE
5/1/97

5/9





SCALE IN FEET

0 50 100 200

LEGEND

—— 10 ——	TOTAL BETX ISOCONCENTRATION CONTOUR (ug/l)
– – ? – –	SUFFICIENT GROUNDWATER DATA NOT AVAILABLE TO PROVIDE ISOCONCENTRATION CONTOUR DEFINITION
●	SEH SEDIMENT SAMPLING LOCATION
▼	SEH SOIL BORING LOCATION
◆	GROUNDWATER SEEP
MW-1 3265 ⯁	NORTHERN ENVIRONMENTAL TECHNOLOGIES, INC. GROUNDWATER MONITORING WELL AND TOTAL BETX CONCENTRATION IN ug/l.
MW-1 1 ⌗	DAMES AND MOORE GROUNDWATER MONITORING WELL AND TOTAL BETX CONCENTRATION IN ug/l.
TW-12 259 ⊕	EXISTING SEH GROUNDWATER MONITORING WELL AND TOTAL BETX CONCENTRATION IN ug/l.
TW-8 1439 ⊕	FORMER SEH TEMPORARY GROUNDWATER MONITORING WELL AND TOTAL BETX CONCENTRATION IN ug/l.
—— 605 ——	TOPOGRAPHIC CONTOUR (1' INTERVAL)

KEY (COLOR)

GROUNDWATER BETX CONCENTRATIONS

🟥	= 10,000 TO 100,000 ug/l
🟧	= 1,000 to 10,000 ug/l
🟧	= 100 TO 1,000 ug/l
🟨	= 10 to 100 ug/l
🟩	= 1 TO 10 ug/l
🟩	= NO DEFINED IMPACT TO SHALLOW GROUNDWATER

SEDIMENT INVESTIGATION RESULTS

🟪	= SEDIMENTS IMPACTED BY BETX CONTAMINANTS
🟦	= SEDIMENTS NOT IMPACTED BY BETX CONTAMINANTS

NOTES:

1. GROUNDWATER ISOCONCENTRATION INTERVALS ARE LABELED WITH THE TOTAL BETX CONCENTRATIONS (ug/l).
2. WHERE DATA FROM A SAMPLING EVENT IS AVAILABLE FOR EACH BETX COMPOUND, TOTAL BETX CONCENTRATIONS ARE REPRESENTED AS AVERAGE CONCENTRATIONS OF ALL AVAILABLE ANALYTICAL DATA QUANTIFIED FROM EACH SHALLOW GROUNDWATER MONITORING WELL.
3. NO GROUNDWATER DATA AVAILABLE IN OFFSHORE SEDIMENTS.
4. SEDIMENT IMPACTS SHOWN ARE BASED ON ANALYTICAL DATA FOR SEDIMENT SAMPLES

F:\WASTE\DWG2\WASTE\WDNR\9401\RERORT\FRI3

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE - COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

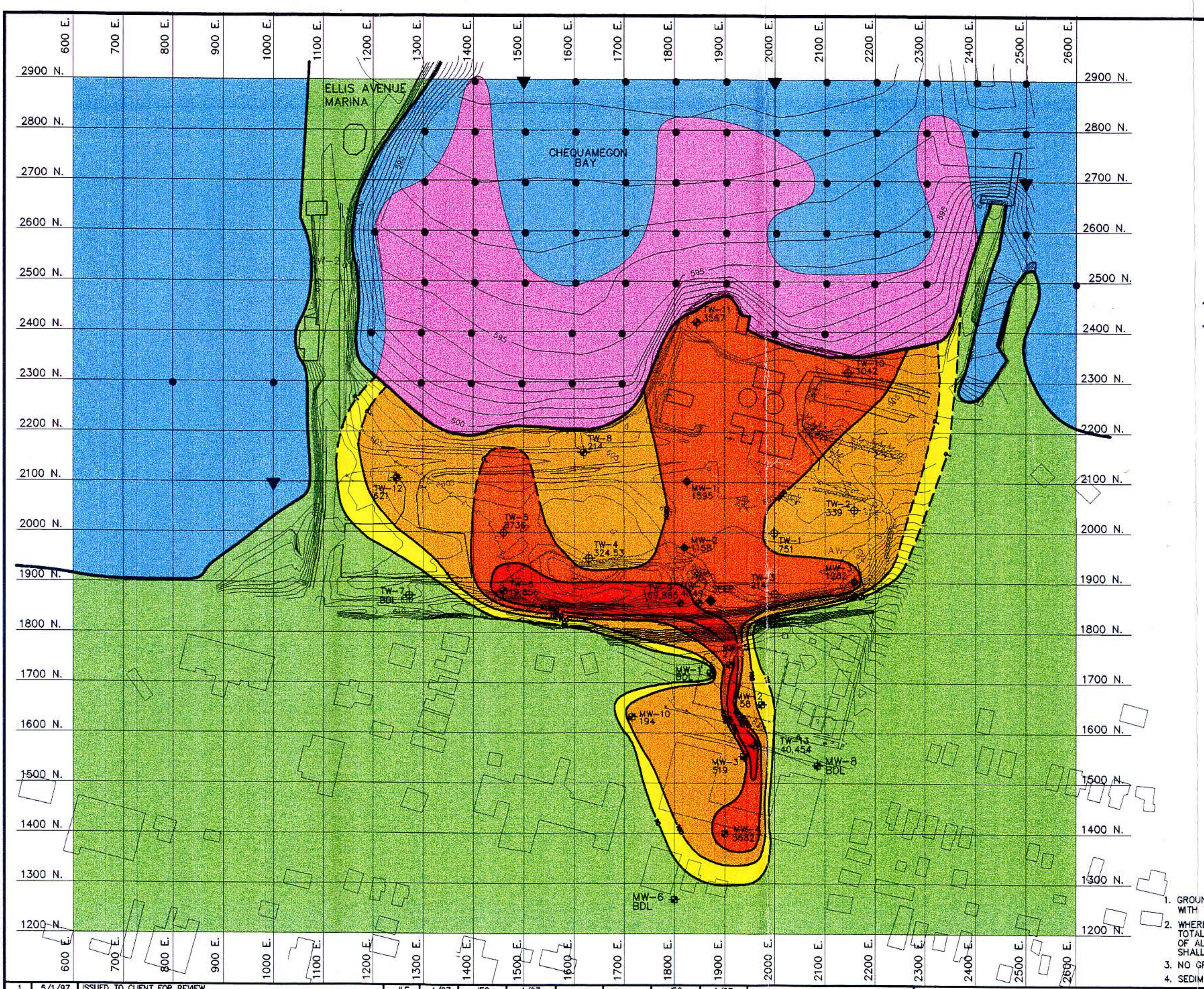
SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

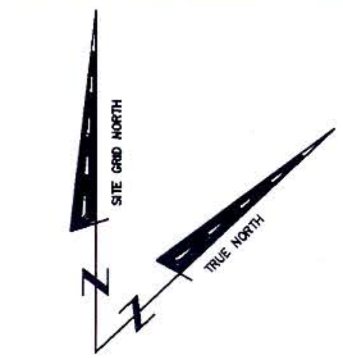
ASHLAND LAKEFRONT PROPERTY

FIGURE 6
TOTAL BETX
SHALLOW GROUNDWATER
ISOCONCENTRATION MAP

PROJ. NO. WDNR9401
DATE 5/1/97

6/9





SCALE IN FEET
0 50 100 200

LEGEND

—— 10 ——	TOTAL PAH ISOCONCENTRATION CONTOUR (ug/l)
— — ? — —	SUFFICIENT GROUNDWATER DATA NOT AVAILABLE TO PROVIDE ISOCONCENTRATION CONTOUR DEFINITION
●	SEH SEDIMENT SAMPLING LOCATION
▼	SEH SOIL BORING LOCATION
◆	GROUNDWATER SEEP
MW-1 1595 ✦	NORTHERN ENVIRONMENTAL TECHNOLOGIES, INC. GROUNDWATER MONITORING WELL AND TOTAL PAH CONCENTRATION IN ug/l.
MW-1 BDL ✦	DAMES AND MOORE GROUNDWATER MONITORING WELL AND TOTAL PAH CONCENTRATION IN ug/l.
TW-12 621 ✦	EXISTING SEH GROUNDWATER MONITORING WELL AND TOTAL PAH CONCENTRATION IN ug/l.
TW-8 214 ✦	FORMER SEH TEMPORARY GROUNDWATER MONITORING WELL AND TOTAL PAH CONCENTRATION IN ug/l.
— 605 —	TOPOGRAPHIC CONTOUR (1' INTERVAL)

KEY (COLOR)

GROUNDWATER PAH CONCENTRATIONS

🟥	= 10,000 TO 100,000 ug/l
🟥	= 1,000 to 10,000 ug/l
🟧	= 100 TO 1,000 ug/l
🟨	= 10 to 100 ug/l
🟩	= NO DEFINED IMPACT TO SHALLOW GROUNDWATER

SEDIMENT INVESTIGATION RESULTS

🟪	= SEDIMENTS IMPACTED BY PAH CONTAMINANTS
🟦	= SEDIMENTS NOT IMPACTED BY PAH CONTAMINANTS

1. GROUNDWATER ISOCONCENTRATION INTERVALS ARE LABELED WITH THE TOTAL PAH CONCENTRATIONS (ug/l).
2. WHERE DATA FROM A SAMPLING EVENT IS AVAILABLE FOR EACH PAH COMPOUND, TOTAL PAH CONCENTRATIONS ARE REPRESENTED AS AVERAGE CONCENTRATIONS OF ALL AVAILABLE ANALYTICAL DATA QUANTIFIED FROM EACH SHALLOW GROUNDWATER MONITORING WELL.
3. NO GROUNDWATER DATA AVAILABLE IN OFFSHORE SEDIMENTS.
4. SEDIMENT IMPACTS SHOWN ARE BASED ON ANALYTICAL DATA FOR SEDIMENT SAMPLES.

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE - COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

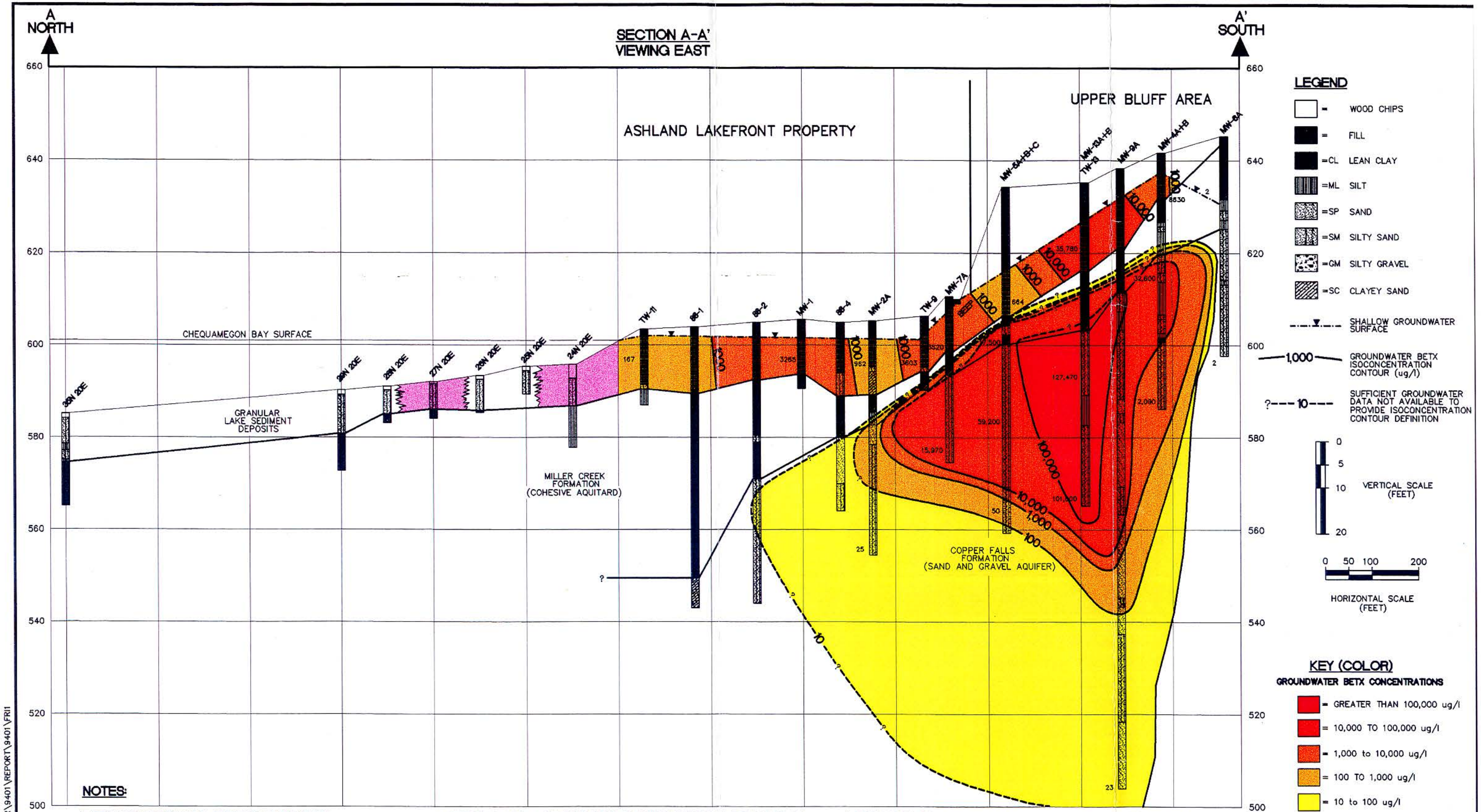
ASHLAND LAKEFRONT PROPERTY

FIGURE 7
TOTAL PAH
SHALLOW GROUNDWATER
ISOCONCENTRATION MAP

PROJ. NO. WDNR9401
DATE 5/1/97

7/9

F:\WASTE\DWG2\WASTE\WDNR\9401\RERORT\FRI2



NOTES:

1. ELEVATIONS ARE SHOWN IN REFERENCE TO SITE DATUM.
2. FOR THE PURPOSE OF ILLUSTRATING SUBSURFACE CONDITIONS ON THE CROSS SECTIONS, SOME OF THE BORING LOGS HAVE BEEN SIMPLIFIED. FOR A DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT INDIVIDUAL BORINGS, REFER TO SOIL BORING LOGS.
3. HORIZONTAL DISTANCES ARE MEASURED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION.
4. WHERE DATA FROM A SAMPLING EVENT IS AVAILABLE FOR EACH BETX COMPOUND, TOTAL BETX CONCENTRATIONS ARE REPRESENTED AS AVERAGE CONCENTRATIONS OF ALL AVAILABLE ANALYTICAL DATA QUANTIFIED FROM EACH SHALLOW GROUNDWATER MONITORING WELL.
5. A BREACH CONNECTING THE SHALLOW CONTAMINANTS WITH THE DEEPER AQUIFER CONTAMINANTS EXISTS IN THE MILLER CREEK SOILS. THE EXACT LOCATION OF THE BREACH HAS NOT BEEN DETERMINED.
6. REFER TO FIGURE 4 FOR A DETAILED CROSS SECTIONAL VIEW OF SITE SOILS.
7. SEDIMENT IMPACTS SHOWN ARE BASED ON ANALYTICAL DATA FOR SEDIMENT SAMPLES.

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE – COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

SEH
ENGINEERS ARCHITECTS PLANNERS

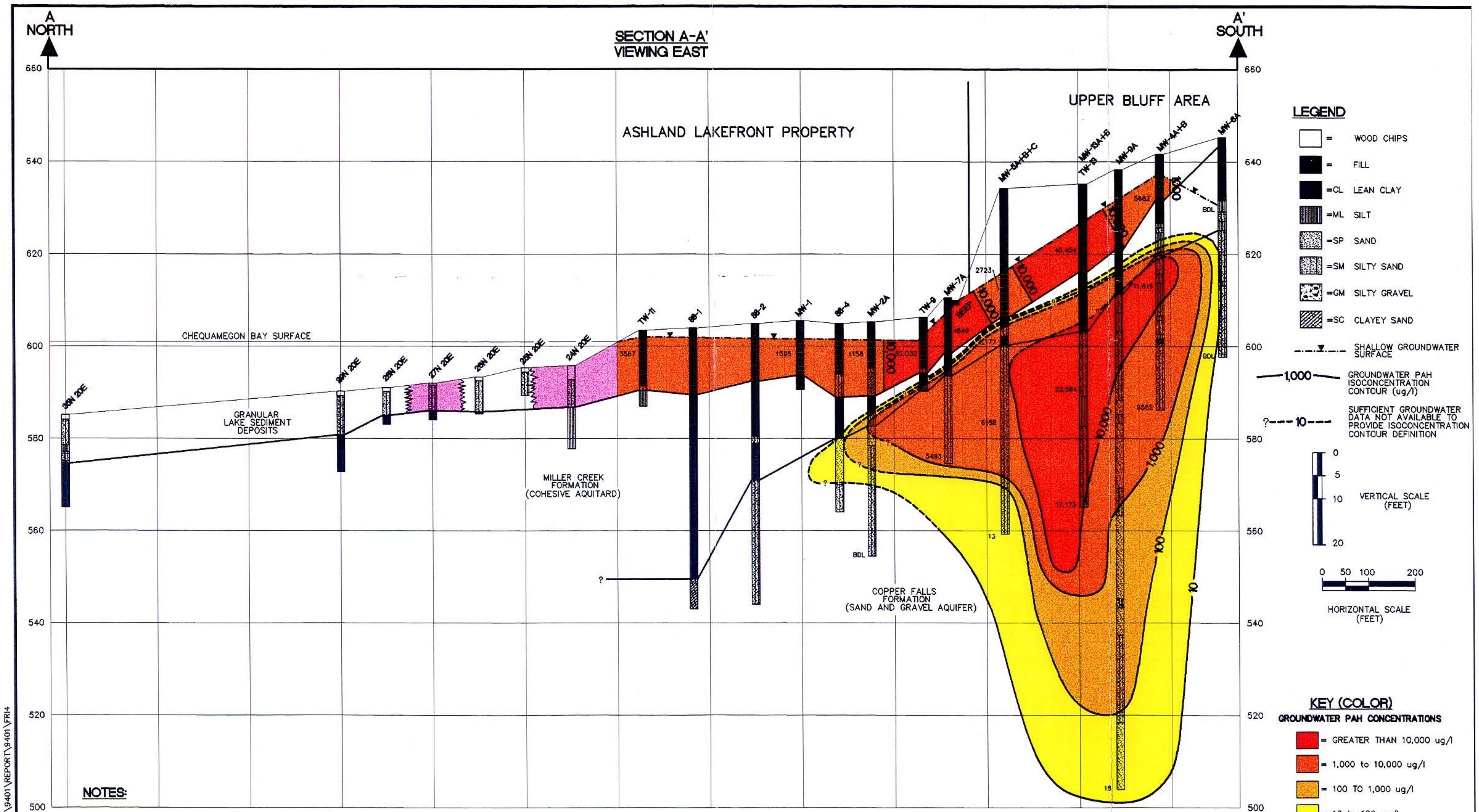
ASHLAND LAKEFRONT PROPERTY

FIGURE 8
GROUNDWATER
ISOCONCENTRATION CONTOURS
TOTAL BETX

PROJ. NO. WDNR9401
DATE 5/1/97

8 / 9

F:\WASTE\DWG2\WASTE\WDNR\9401\REPORT\9401\FRI1



NOTES:

1. ELEVATIONS ARE SHOWN IN REFERENCE TO SITE DATUM.
2. FOR THE PURPOSE OF ILLUSTRATING SUBSURFACE CONDITIONS ON THE CROSS SECTIONS, SOME OF THE BORING LOGS HAVE BEEN SIMPLIFIED. FOR A DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT INDIVIDUAL BORINGS, REFER TO SOIL BORING LOGS.
3. HORIZONTAL DISTANCES ARE MEASURED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION.
4. WHERE DATA FROM A SAMPLING EVENT IS AVAILABLE FOR EACH PAH COMPOUND, TOTAL PAH CONCENTRATIONS ARE REPRESENTED AS AVERAGE CONCENTRATIONS OF ALL AVAILABLE ANALYTICAL DATA QUANTIFIED FROM EACH SHALLOW GROUNDWATER MONITORING WELL.
5. A BREACH CONNECTING THE SHALLOW CONTAMINANTS WITH THE DEEPER AQUIFER CONTAMINANTS EXISTS IN THE MILLER CREEK SOILS. THE EXACT LOCATION OF THE BREACH HAS NOT BEEN DETERMINED.
6. REFER TO FIGURE 4 FOR A DETAILED CROSS SECTIONAL VIEW OF SITE SOILS.
7. SEDIMENT IMPACTS SHOWN ARE BASED ON ANALYTICAL DATA FOR SEDIMENT SAMPLES.

NO.	DATE	ISSUE/REVISIONS	DRAWN BY		DESIGN		FIELD REVIEW		QC CHECK	
1	5/1/97	ISSUED TO CLIENT FOR REVIEW	JLE	4/97	JEG	4/97			JEG	4/97
2	5/16/97	FINAL ISSUE - COMPREHENSIVE ENVIRONMENTAL INVESTIGATION REPORT	BRH	5/97					KEA	5/97

SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS

ASHLAND LAKEFRONT PROPERTY

FIGURE 9
GROUNDWATER
ISOCONCENTRATION CONTOURS
TOTAL PAH

PROJ. NO. WDNR9401
DATE 5/1/97

9/9

F:\WASTE\DWG2\WASTE\WDNR\9401\REPORT\9401\FRI4