FINAL

Classification Exception Area Information For Various Sites

M-12 Landfill Site, M-18 Landfill Site, Site 80/166, Site 108, Site 283, Site 812, Site 1122 and Site 2567

U. S. Army Installation Fort Monmouth
Fort Monmouth, New Jersey

Directorate of Public Works

July 12, 2004

201 Gibraltar Road, Suite 100
Horsham, Pennsylvania 19044

United States Army

Fort Monmouth, New Jersey

Classification Exception Area Information For Various Sites

M-12 Landfill Site, M-18 Landfill Site, Site 80/166, Site 108,
Site 283, Site 812, Site 1122 and Site 2567

Fort Monmouth, New Jersey

July 12, 2004

PREPARED BY:

201 Gibraltar Road, Suite 100
Horsham, PA 19044-2314

July 12, 2004

TABLE OF CONTENTS

FIGURES

APPENDICES

Appendix A	CEA Fact Sheet: M-12 Landfill site
Appendix B	CEA Fact Sheet: M-18 Landfill site
Appendix C	CEA Fact Sheet: Site 80/166
Appendix D	CEA Fact Sheet: Site 108
Appendix E	CEA Fact Sheet: Site 283
Appendix F	Groundwater Modeling Information and BIOCHLOR spreadsheets for Site 812
Appendix G	CEA Fact Sheet: Site 812
Appendix H	CEA Fact Sheet: Site 1122
Appendix I	CEA Fact Sheet: Site 2567

1.0 INTRODUCTION

VERSAR, Inc. (VERSAR) was contracted by the United States (U.S.) Army Garrison, Fort Monmouth (Fort Monmouth), Directorate of Public Works (DPW), Fort Monmouth, New Jersey to assemble and present Classification Exception Area (CEA) information to document CEA status of the following eight sites located at Fort Monmouth: M-12 Landfill site, M-18 Landfill site, Site 80/166, Site 108, Site 283, Site 812, Site 1122 and Site 2567.

1.1 Objective

The objective of this document is to provide CEA information for the eight sites within Fort Monmouth that present contaminants of concern (COCs) exceeding their respective New Jersey Department of Environmental Protection (NJDEP) Groundwater Quality Criteria (GWQC). This CEA Information document was prepared in accordance with NJDEP Groundwater Quality Standards (GWQS) (January 1993), NJAC 7:9-6.6, et seq. and NJDEP *Final Guidance on Designation of Classification Exceptions Areas* (November 1998).

1.2 CEA Locations

Figure 1-1 contains each CEA area at Fort Monmouth that will be discussed in **Section 3.0** through **Section 10.0**.

1.3 Document Organization

Section 2.0 provides background information on Fort Monmouth and the surrounding region. **Section 3.0** presents site-specific CEA information for the M-12 Landfill site. **Section 4.0** presents site-specific CEA information for the M-18 Landfill site. **Section 5.0** presents site-specific CEA information for Site 80/166. **Section 6.0** presents site-specific CEA information for Site 108. **Section 7.0** presents site-specific CEA information for Site 283. **Section 8.0** presents site-specific CEA information for Site 812. **Section 9.0** presents site-specific CEA information for Site 1122. **Section 10.0** presents site-specific CEA information for Site 2567. References used in this document are identified in **Section 11.0**.

2.0 FORT MONMOUTH BACKGROUND INFORMATION

The following sections describe the site background and environmental setting of the area surrounding Fort Monmouth. Included is a description of the site location and environmental setting.

2.1 Site Location and Description

Fort Monmouth is located in the central-eastern portion of New Jersey in Monmouth County, approximately 45 miles south of New York City and 70 miles northeast of Philadelphia (**Figure 2-1**). In addition to the Main Post, the installation includes two subposts, the Charles Wood Area and the Evans Area. The Main Post encompasses approximately 630 acres and is generally bounded by State Highway 35, Parkers Creek, Lafetra Creek, the New Jersey Transit Railroad and a residential area to the south. The post was established in 1918 during World War I (WWI) as an Army Signal Corps training center. The Main Post currently provides administrative, training, and housing support functions, as well as providing many of the community facilities for Fort Monmouth. The primary mission of Fort Monmouth is to provide command, administrative, and logistical support for Headquarters, U.S. Army Communications and Electronics Command (CECOM). CECOM is a major subordinate command of the U.S. Army Materiel Command (AMC) and is the host tenant at Fort Monmouth.

2.2 Environmental Setting

The following is a description of the geological/hydrogeological setting of the area surrounding Fort Monmouth.

2.2.1 Regional Geology

Monmouth County lies within the New Jersey Section of the Atlantic Coastal Plain physiographic province. The geologic map of New Jersey is provided as **Figure 2-2**.

In general, New Jersey Coastal Plain formations consist of a seaward-dipping wedge of unconsolidated deposits of clay, silt, sand and gravel. These formations typically strike northeast-southwest with a dip ranging from 10-60 feet per mile and were deposited on Precambrian and lower Paleozoic rocks (Zapecza, 1989). These sediments, predominantly derived from deltaic, shallow marine and continental shelf environments, date from Cretaceous through the Quaternary Periods. The mineralogy ranges from quartz to glauconite.

The formations record several major transgressive/regressive cycles and contain units, which are generally thicker to the southeast and reflect a deeper water environment. More than 20 regional geologic units are present within the sediments of the Coastal Plain. Regressive, upward coarsening deposits are usually aquifers (e.g., Englishtown and Kirkwood Formations and the Cohansey Sand), while the transgressive deposits act as confining units (e.g., the Merchantville, Marshalltown and Navesink Formations). The individual thickness for these units varies greatly (e.g., from several feet to several hundred feet). The Coastal Plain deposits thicken to the southeast from the Fall Line (e.g., a boundary zone between older, resistant rocks and younger,

softer plain sediments) to greater than 6,500 feet in Cape May County (Brown and Zapecza, 1990).

Based on the regional geologic map (Jablonski, 1968), the Cretaceous age Red Bank and Tinton Sands outcrop at the Main Post area. The Red Bank Sand conformably overlies the Navesink Formation and dips to the southeast at 35 feet per mile. The upper member (Shrewsbury) of the Red Bank Sand is a yellowish-gray to reddish brown clayey, medium-to-coarse-grained sand that contains abundant rock fragments, minor mica and glauconite (Jablonski). The lower member (Sandy Hook) is a dark gray to black, medium-to-fine grained sand with abundant clay, mica and glauconite.

The Tinton Sand conformably overlies the Red Bank Sand and ranges from a clayey medium to very coarse-grained feldspathic-quartz and glauconite-sand to a glauconitic-coarse sand. The color varies from dark yellowish orange or light brown to moderate brown and from light olive to grayish olive. Glauconite may constitute 60-80 percent of the sand fraction in the upper part of the unit. The upper part of the Tinton is often highly oxidized and iron oxide encrusted (Minard, 1969). Groundwater occurs beneath the site at a depth of approximately 2-12 feet below ground surface (bgs).

The Kirkwood Formation (part of the Kirkwood-Cohansey system) crops out southeast of the Main Post and dips to the southeast at a slope of 20 feet per mile (Jablonski, 1968). The Kirkwood Formation consists of alternating layers of sand and clay. The upper unit is a light gray to yellowish-brown, fine-grained quartz sand with quartz nodules and small pebbles. The lower unit is brown silt in Monmouth County (Jablonski, 1968).

2.2.2 Hydrogeology

Fort Monmouth lies in the Atlantic and Eastern Gulf Coastal Plain groundwater region (Meisler et al., 1988). This groundwater region is underlain by undeformed, unconsolidated to semi-consolidated sedimentary deposits. The chemistry of the water near the surface is variable with low dissolved solids and high iron concentrations. The water chemistry in areas underlain by glauconitic sediments (such as Red Bank, Tinton and Hornerstown Sands) is dominated by calcium, magnesium, manganese, aluminum and iron. The sediments in the area of Fort Monmouth were deposited in fluvial-deltaic to near shore environments.

The water table aquifer underlying Fort Monmouth is identified as part of the "Navesink-Hornerstown Confining Units," or minor aquifers. The minor aquifers include the Navesink formation, Red Bank Sand, Tinton Sand, Hornerstown Sand, Vincentown Formation, Manasquan Formation, Shark River Formation, Piney Point Formation and the basal clay of the Kirkwood Formation. These geologic formations comprise a "Composite Confining Bed" for the Wenonah Mount Laurel Aquifer (Zapecza, 1989).

Wells installed in the Red Bank and Tinton Sands produce 2-25 gallons per minute (gpm) (Jablonski, 1968). Groundwater at Fort Monmouth is typically encountered at shallow depths ranging from 2-9 feet bgs. Water in the surficial aquifer generally flows east toward the Atlantic Ocean.

Based on a review of the NJDEP GWQS (NJAC 7:9-6), January 7, 1993, Versar has determined that Fort Monmouth is underlain by a Class III-A aquifer. A formal presentation of this finding was made to the NJDEP on November 21, 2003. The primary designated use for Class III-A groundwater is the release or transmittal of groundwater to adjacent classification areas and surface water, as relevant. Secondary designated uses in Class III-A include any reasonable use. Further discussion of the Class III-A aquifer classification is presented in **Section 2.2.3**.

Shallow groundwater may be locally influenced within Fort Monmouth by the following factors:

- Tidal influence (based on proximity to the Atlantic Ocean, rivers, and tributaries)
- Topography
- Nature of the fill material within Fort Monmouth
- Presence of clay and silt lenses in the natural overburden deposits
- Local groundwater recharge areas (e.g., streams, lakes)
- Roadways, utility conduits and stormwater culverts

Due to the fluvial nature of the overburden deposits (e.g., sand and clay lenses), shallow groundwater flow direction is best determined on a case-by-case basis.

2.2.3 Aquifer Classification

On review of the NJDEP GWQS (N.J.A.C. 7:9-6, January 1993), the site is underlain by a Class III-A aquifer (**Figure 2-3**). The primary designated use for Class III-A groundwater is the release or transmittal of groundwater to adjacent classification areas and surface water, as relevant. Secondary designated uses in Class III-A include any reasonable uses. For an area to be classified as a Class III-A aquifer, the ground water must meet the following characteristics:

- Class III-A ground water includes portions of the saturated zones (that meet the criteria below) of the Woodbury Formation, Merchantville Formation, Marshalltown Formation, Navesink Formation, Hornerstown Formation, aquitard formations of the Potomac-Raritan-Magothy aquifer system and the Kirkwood aquifer system, portions of the glacial moraine and glacial lake deposits, and other geologic units having the characteristics of an aquitard. Class III-A areas have the following characteristics (N.J.A.C. 7:9-6.5):

    - The average thickness of a Class III-A area must be at least 50 feet;
    - Typical hydraulic conductivity of a Class II-A aquifer is approximately 0.1 ft/day or less; and
    - The aerial extent defined as Class III-A must be at least 100 acres.

The shallow aquifer at Fort Monmouth meets each of the four criteria listed above. These criteria are discussed below:

- As presented in **Figure 2-4**, Fort Monmouth is located within the outcrop area of the "Navesink-Hornerstown Confining Unit." The Navesink and Hornerstown Formations are part of the Composite Confining Unit (Martin, 1998), which also includes the Red

Bank Sand, Tinton Sand, Vincentown Formation, Manasquan Formation, Shark River Formation, Piney Point Formation, and the basal clay of the Kirkwood Formation. **Figure 2-5** illustrates the thickness of the Hornerstown-Navesink Confining Unit, which, in the vicinity of Fort Monmouth, is approximately 125 feet.

- Published hydraulic conductivities (Martin, 1998) for the Navesink-Hornerstown Confining Unit, yielding a geometric mean of 0.12 feet per day.
- The land area of Fort Monmouth is greater than 100 acres.

3.0 CEA INFORMATION FOR THE M-12 LANDFILL SITE

The following includes all relevant CEA information for the M-12 Landfill site, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

3.1 Site Background

The M-12 Landfill site was a former historic fill site located on the central portion of the Main Post (**Figure 3-1**) south of Husky Brook and west of Murphy Drive. The M-12 Landfill site consists of two areas, a northwest area and a southwest area. The approximate size of the northeast area is 60,100 ft^2 (1.4 acres). The approximate size of the southwest area is 29,200 ft^2 (0.7 acre). The Roy F. Weston (Weston) Site Investigation (SI) report (1995) showed that the M-12 Landfill site was suspected to contain domestic and industrial wastes and was used for the disposal of old automobile wastes. The period of operation of the M-12 Landfill site is unknown.

Both SI and Remedial Investigation (RI) activities were performed by Weston and the Fort Monmouth DPW, respectively, at the M-12 Landfill site. The results of these investigations are detailed in the following reports:

- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- VERSAR's *Remedial Investigation Report and Sediment Quality Evaluation, M-12/M-14 Landfill Site, Fort Monmouth, New Jersey*, October 2003.
- VERSAR's *Remedial Investigation Report for Near-Surface Soils, M-12 Landfill Site, Fort Monmouth, New Jersey*, October 2003.
- VERSAR's *Remedial Investigation Report, M-12 Landfill Site*, September 2003.

Weston conducted geophysical surveys, including a Ground Penetrating Radar (GPR) survey and magnetometer surveys, to locate the historic fill boundaries. The results of the geophysical surveys identified fill and buried ferrous material within the suspected boundaries of the historic fill site. Monitoring wells were installed at strategic locations to monitor groundwater downgradient of these areas. Groundwater sampling results indicated that no analytes exceeded the NJDEP GWQC in samples collected from the monitoring wells. The Weston SI Report (1995) also presented a DPW proposal for the M-12 Landfill site that was subsequently implemented by the DPW. A long-term groundwater and surface water monitoring program was developed utilizing the existing monitoring wells and supplemental wells installed during follow-up investigations.

The DPW also conducted a sediment quality evaluation at the M-12/M-14 Landfill site to determine potential PCB-related impacts to stream sediments in Husky Brook, which flows through the M-12/M-14 Landfill site. The DPW obtained samples from multiple borings in Husky Brook in April 2000. Based on the results of this sediment quality evaluation, no PCBs

were detected above the NJDEP guidance criteria for sediment quality in any sample, and no potential exists for long-term adverse benthic effects in Husky Brook associated with the M-12/M-14 Landfill site.

The DPW conducted a near-surface soil investigation at the M-12 Landfill site to characterize the shallow soils that cover the historic fill areas. The DPW obtained samples from the top two feet of soil at various locations throughout the site between March 1998 and September 1999. Low concentrations of various analytes were detected, but no COCs were identified at concentrations that require remedial actions to be performed.

3.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, including the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, and groundwater sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater and surface water in the vicinity of the M-12 Landfill site. Remedial investigation activities were performed from October 1996 and continued through February 2001.

Eleven monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 3-2**). Section 3.3 summarizes results from the quarterly groundwater and surface water sampling program conducted from June 1997 through February 2001 at the M-12 Landfill site. Two specific monitoring wells at the M-12 Landfill site indicated elevated concentrations of arsenic and lead. As a result of these findings, the DPW will incorporate a document equivalent to a Declaration of Environmental Restriction (DER) in the Fort Monmouth Installation Master Plan for the arsenic and lead groundwater contamination at the M-12 Landfill site.

3.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, arsenic and lead are identified as potential COC at the M-12 Landfill site. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report, M-12 Landfill Site*, September 2003. See **Table 3-1** below for a COC summary:

Table 3-1
Determination of COCs
M-12 Landfill site

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
Arsenic	8	52.9	18
Lead	10	82.9	9

3.4 Groundwater Modeling Results

A conceptual site model for the M-12 Landfill site was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report, M-12 Landfill Site*, September 2003.

Arsenic

After the groundwater flow was calibrated, the transport simulation for arsenic was run for 10,000 simulated days (~27.4 years). The model was run for this lengthy period to allow for prediction of the time required for the arsenic concentration in site groundwater to decrease below the NJDEP criteria. **Figure 3-3a** and **Figure 3-3b** show the predicted arsenic distributions in site groundwater plotted as brown contour lines for wells M12-MW16 and M12-MW22, respectively, at the simulated time of 99 and 150 years, respectively. The arsenic concentrations presented in **Figure 3-3a** and **Figure 3-3b** represent the first time steps in the model in which the arsenic concentration is entirely below 8.0 ug/L. The concentrations of arsenic at wells M12-MW16 and M12-MW22 are plotted against simulation time in **Figure 3-3c**, which confirms the 99 and 150-year predictions. The groundwater modeling results indicate that arsenic migration will be minimal due to low hydraulic conductivity and strong retardation by the soils.

Lead

The transport simulation for lead was run for 100,000 days (274 years). The model was run for this lengthy period to allow for prediction of the time required for the lead concentration in site groundwater to decrease below the NJDEP criteria. **Figure 3-4a** shows the predicted lead distribution in site groundwater at 274 years plotted as brown contour lines. Because the lead concentration contours did not fall below the NJDEP criterion of 10 ug/L, projections for the lead concentration at these two wells were made using the observed concentration trends from the model. The slope of the line shown in **Figure 3-4b** was 1.2×10^{-5} ug/L per day, which led to an estimated time to achieve compliance with the NJDEP criterion of 4,500 years. Similar to arsenic, the results of the groundwater modeling indicate that lead migration will be minimal due to low hydraulic conductivity and strong retardation by the soils.

3.5 CEA Fact Sheet

The CEA Fact Sheet for the M-12 Landfill site can be found in **Appendix A**.

4.0 CEA INFORMATION FOR THE M-18 LANDFILL SITE

The following includes all relevant CEA information for the M-18 Landfill site, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

4.1 Site Background

Due to the close proximity of a landfill area to several former UST sites, the remedial investigation presented in this report includes areas originally intended as separate site investigations at former UST sites. The M-18 Landfill site consists of a historic fill site and Buildings 290 and 296, which had UST closures performed at each facility. The M-18 Landfill site is located in the northern portion of the Main Post (**Figure 4-1**), between Parkers Creek to the north and Sherrill Avenue to the south. The approximate area of the M-18 Landfill site is 177,300 ft^2 (4.1 acres).

The Weston SI report (1995) showed that the landfill area at the M-18 Landfill site was used after 1919 as an Army Signal School Training Area. Diesel and gasoline generators, situated approximately 150 meters from Parkers Creek, were used to support field exercises. It was suspected that numerous fuel spills that occurred in the area of the generator had impacted the site. A riot control agent was also used in this area for troop protective mask training. During Weston's site inspection in 1993 (Weston, 1995), there was a suspected debris disposal area used for building rubble in the area north of Building 289.

Both SI and RI activities were performed by Weston and the Fort Monmouth DPW, respectively, at the M-18 Landfill site. The results of these investigations are detailed in the following reports:

- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- VERSAR's *Remedial Investigation Report and Sediment Quality Evaluation, M-18 Landfill Site, Fort Monmouth, New Jersey*, February 2004.
- VERSAR's *Remedial Investigation Report for Near-Surface Soils, M-18 Landfill Site, Fort Monmouth, New Jersey*, March 2004.
- VERSAR's *Remedial Investigation Report, M-18 Landfill Site*, October 2003.

Weston conducted soil sampling, monitoring well installation, groundwater sampling and geophysical surveying. The geophysical surveys, including GPR and electromagnetic (EM) surveys, were conducted to investigate the extent of debris disposal north of Building 289. Two groundwater monitoring wells were installed by Weston in January 1995 to monitor groundwater downgradient (north) of the M-18 Landfill site. In addition to these two monitoring wells, the Weston site investigation included two rounds of groundwater samples collected from a third monitoring well which had been installed during site investigation activities related to former UST closures at Building 296. The DPW developed a long-term groundwater and surface water monitoring program utilizing the existing monitoring wells and supplemental wells installed during follow-up investigations.

The DPW also conducted a sediment quality evaluation at the M-18 Landfill site to determine potential PCB-related impacts to stream sediments in Parkers Creek, which flows adjacent to the M-18 Landfill site. The DPW obtained samples from multiple borings in Parkers Creek in April 2000. Based on the results of this sediment quality evaluation, no potential exists for long-term adverse benthic effects in Parkers Creek associated with the M-18 Landfill site.

The DPW conducted a near-surface soil investigation at the M-18 Landfill site to characterize the shallow soils that cover the historic fill areas. The DPW obtained samples from the top two feet of soil at various locations throughout the site between March 1998 and September 1999. Low concentrations of various analytes were detected, but no COCs were identified at concentrations that require remedial actions to be performed.

4.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, including the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, and groundwater sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater and surface water in the vicinity of the M-18 Landfill site. Remedial investigation activities were performed from October 1996 and continued through February 2001.

Eleven monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 4-2**). Section 4.3 summarizes results from the quarterly groundwater and surface water sampling program was conducted from June 1997 through February 2001 at the M-18 Landfill site. Elevated concentrations of benzene, arsenic, cadmium, chromium and lead were detected at the M-18 Landfill site. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the benzene, arsenic, cadmium, chromium and lead groundwater contamination at the M-18 Landfill site.

4.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, benzene, arsenic, cadmium, chromium and lead are identified as potential COCs at the M-18 Landfill site. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report, M-18 Landfill Site*, October 2003. See **Table 4-1** below for a COC summary:

Table 4-1
Determination of COCs
M-18 Landfill site

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
Benzene	1	29.18	8
Arsenic	8	221	48
Cadmium	4	630.7	19
Chromium	100	1344	11
Lead	10	836	34

4.4 Groundwater Modeling Results

A conceptual site model for the M-18 Landfill site was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report, M-18 Landfill Site*, October 2003.

Benzene

A *Microsoft Excel* spreadsheet was used to predict the biodegradation and migration of benzene at the M-18 Landfill site. The biodegradation model incorporates the effects of horizontal groundwater flow, first-order biodegradation and retardation.

Benzene was detected at the M-18 Landfill site above the NJDEP GWQC of 1.0 ug/L in two of the 11 groundwater monitoring wells sampled. Due to the lack of a decreasing trend in the benzene detections, a site-specific decay rate for benzene was not calculated. The first-order, aerobic decay constant of 0.00095 (1/day) was obtained from published results (Howard, 1991) and used in the model. This published decay constant corresponds to a half-life of 730 days. Predicted benzene concentrations at wells 0296-MW04 and 0296-MW06 are presented in **Figures 4-3a** and **4-3b**, respectively.

At monitoring well 0296-MW04, the initial benzene concentration used in the model was 3.19 ug/L, which was sampled on February 22, 2001. This initial concentration led to a predicted time of 3.5 years for compliance with the NJDEP criteria (1.0 ug/L). The migration distance to achieve compliance at well 0296-MW04 is predicted to be 89 feet. At well 0296-MW06, the initial benzene concentration used in the model was 6.5 ug/L, which was sampled on November

13, 2000, led to a time of 5.4 years for NJDEP compliance, with a predicted migration distance of 139 ft. **Figure 4-4** displays the area at the M-18 Landfill site that is estimated to be impacted by future benzene migration.

Metals

The migration of the COCs that are metals (arsenic, cadmium, chromium and lead) in groundwater at the M-18 Landfill site was simulated in MODFLOW. The model was run for a simulated time of 137 years (50,000 days) for each metal to model the effects of time on contaminant movement and direction. The model results are presented in **Figures 4-5a and 4-5b** (arsenic), **Figures 4-6a and 4-6b** (cadmium), **Figures 4-7a and 4-7b** (chromium), and **Figures 4-8a and 4-8b** (lead).

For each of the metal COCs at the M-18 Landfill site, the predicted concentrations at 137 years exceeded the respective NJDEP groundwater criteria (**Figures 4-5a** and **b** through **4-8a** and **b**), and the estimated times for compliance with the NJDEP criteria is greater than 1,000 years. The results of the groundwater modeling indicate that COC migration will be minimal due to low hydraulic conductivity and strong retardation by the soils.

4.5 CEA Fact Sheet

The CEA Fact Sheet for the M-18 Landfill site can be found in **Appendix B**.

5.0 CEA INFORMATION FOR SITE 80/166

The following includes all relevant CEA information for Site 80/166, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

5.1 Site Background

Site 80/166 is located in the eastern part of the Main Post Area of Fort Monmouth, north of Riverside Avenue and south of Building 166 (**Figure 5-1**). Site 80/166 is located approximately 500 feet northwest of Oceanport Creek.

Underground Storage Tank (UST) removal, SI and RI activities were performed by ATC, Weston and the Fort Monmouth DPW at Site 80/166. The results of these investigations are detailed in the following reports:

- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- ATC's *UST Closure and Site Investigation Report for Former Building T-80, NJDEP Registration No. 090010-06,* July 1998.
- ATC's *UST Closure and Site Investigation Report, Building 166, UST No. 90017-17*, May 2000.
- VERSAR's *Remedial Investigation Report, Site 80/166*, February 2004 (Draft).

As part of Weston's SI of the Fort Monmouth military installation, soil sampling, monitoring well installation and sampling and geophysical surveying were conducted. In addition to sampling soil and groundwater at sites throughout the Main Post and Charles Wood areas of Fort Monmouth, Weston established background concentrations for soil and groundwater for the Fort Monmouth installation.

ATC's UST Closure Report stated that there was one single-wall steel UST located immediately north of former Building T-80. Following the removal of this UST, a spill was reported to the NJDEP Hotline. UST No. 090010-06 was cleaned, excavated and disposed of in accordance with NJDEP requirements. Approximately 56 cubic yards of potentially contaminated soil was removed and disposed offsite. In response to the observation of potentially contaminated soil near the shallow water table, one shallow monitoring well was installed at the former Building T-80 area. Monitoring well 80-MW1 was sampled, and the results indicated the presence of benzene at concentrations exceeding its NJDEP GWQC.

ATC's UST Closure Report stated that there was one UST located under the pavement approximately 20 feet west of the southwest corner of Building 80/166. When the DPW closed this UST, stained soils were observed in the UST excavation, and a spill was reported to the NJDEP Hotline. Approximately 24 cubic yards of potentially contaminated soil was excavated and disposed offsite during the UST closure. In response to the observation of potentially contaminated soil near the shallow water table, one shallow monitoring well was installed

southwest of Building 166. Monitoring well 166-MW1 was sampled, and the results showed no exceedences of the NJDEP GWQC.

5.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, including soil sampling, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, and groundwater sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included monitoring well installation, the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 80/166. Remedial investigation activities were performed from April 1997 and continued through August 2001.

Six monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 5-2**). Section 5.3 summarizes results from the quarterly groundwater sampling program was conducted from April 1997 through January 2001 at Site 80/166. Elevated concentrations of a-chlordane, g-chlordane, arsenic and lead were detected at Site 80/166. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the a-chlordane, g-chlordane, arsenic and lead groundwater contamination at Site 80/166.

5.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, a-chlordane, g-chlordane, arsenic and lead are identified as potential COCs at Site 80/166. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report, Site 80/166*, February 2004 (Draft). See **Table 5-1** below for a COC summary:

Table 5-1
Determination of COCs
Site 80/166

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
a-Chlordane	0.5	1.625	3
g-Chlordane	0.5	2.719	2
Arsenic	8	71.6	19
Lead	10	84.1	15

5.4 Groundwater Modeling Results

A conceptual site model for Site 80/166 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report, Site 80/166*, February 2004 (Draft).

Pesticides

For a-chlordane and g-chlordane, a degradation spreadsheet model was used to predict the decay and contaminant transport. The degradation model was applied to g-chlordane only, because g-chlordane concentrations in Site 80/166 groundwater samples have been higher than concentrations of a-chlordane, and these two pesticides are addressed as one compound in Howard (1991).

For g-chlordane, the estimated time of compliance at Site 80/166 is approximately 20 years, which is the same as predicted using a biodegradation spreadsheet. This result indicates that the additional components of 3-dimensional flow and dispersion did not change the estimated time of compliance. This lack of change is due to the strong retardation of chlordane in soil.

The result for g-chlordane was derived from groundwater concentrations at a single location (80-MW2). Although additional soil and groundwater samples were collected via geoprobe at Site 80/166, a pesticide analysis was not performed. The MODFLOW results are presented in **Figures 5-3a** and **5-3b**.

Metals

For each of the metal COCs at Site 80/166 (arsenic and lead), the predicted concentrations at 20 years exceeded their respective NJDEP GWQC. The MODFLOW results for arsenic and lead are shown in **Figure 5-4a** and **5-4b** (arsenic), and **Figure 5-5a** and **5-5b** (lead). The estimated times for compliance with the NJDEP criteria is 600 years for arsenic and greater than 1,000 years for lead. The results of the groundwater modeling indicate that COC migration will be minimal due to low hydraulic conductivity and strong retardation by the soils.

5.5 CEA Fact Sheet

The CEA Fact Sheet for Site 80/166 can be found in **Appendix C**.

6.0 CEA INFORMATION FOR SITE 108

The following includes all relevant CEA information for Site 108, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

6.1 Site Background

Site 108 is located in the eastern part of the Main Post Area of Fort Monmouth, east of Riverside Avenue in the vicinity of buildings 63, 484 and 488 (**Figure 6-1**). Site 108 is located approximately 400 feet northwest of Oceanport Creek and approximately 180 feet west of the New Jersey Transit Railroad.

UST removal, SI and RI activities were performed by Weston, Smith Technologies Corporation (Smith) and the Fort Monmouth DPW at Site 108. The results of these investigations are detailed in the following reports:

- Weston's *UST Closure and Site Investigation Report for Building 108, NJDEPE Facility No. 090010, TMS No. 60, 61, 62, 63 and 64, Fort Monmouth, New Jersey*, May 1994.
- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- Smith's *UST Closure and Site Investigation Report for Former Building 108, UST No. 090010-7*, February 1996.
- VERSAR's *Remedial Investigation Report, Site 108*, February 2004 (Draft).

Weston's UST Closure Report stated that there were five USTs located north of building 488, which is north of former Building 108. The five USTs were drained, removed and disposed offsite. Approximately 221 cubic yards of potentially contaminated soil was removed and disposed offsite. Soil and groundwater samples were collected to document the closure of UST Nos. 60 through 64. Soil sampling results indicated the presence of Total Petroleum Hydrocarbons (TPHC), benzene and methylene chloride. In response to the observation of potentially contaminated soil, sheen on groundwater, and free product during the UST removals, three shallow monitoring wells were installed at Site 108. Monitoring wells 108-MW1, 108-MW2 and 108-MW3 were sampled, and the results indicated the presence of benzene, methylene chloride, bis(2-ethylhexyl)phthalate and lead. A fourth shallow monitoring well, 108-MW4, was installed at Site 108.

As part of Weston's SI of the Fort Monmouth military installation, soil sampling, monitoring well installation and sampling and geophysical surveying were conducted. In addition to sampling soil and groundwater at sites throughout the Main Post and Charles Wood areas of Fort Monmouth, Weston established background concentrations for soil and groundwater for the Fort Monmouth installation.

Smith's UST Closure Report stated that there was one UST located immediately adjacent to former Building 108. UST No. 7 was drained, removed and disposed offsite. Based on visual inspection of the UST, field screening of subsurface soils and analytical results of collected soil

samples, the DPW concluded that no significant historical discharges were associated with UST No. 7 or associated piping.

6.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, and groundwater sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 108. Remedial investigation activities were performed from April 1997 and continued through August 2001.

Four monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 6-2**). Section 6.3 summarizes results from the quarterly groundwater sampling program was conducted from April 1997 through February 2001 at Site 108. Elevated concentrations of arsenic were detected at Site 108. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the arsenic groundwater contamination at Site 108.

6.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, arsenic is identified as a potential COC at Site 108. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report, Site 108*, February 2004 (Draft). See **Table 6-1** below for a COC summary:

Table 6-1
Determination of COCs
Site 108

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
Arsenic	**8**	**63.2**	**40**

6.4 Groundwater Modeling Results

A conceptual site model for Site 108 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was

chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report, Site 108*, February 2004 (Draft).

For arsenic, the predicted concentrations at 10 years exceeded its NJDEP GWQC. The MODFLOW results are presented in **Figures 6-3a** and **6-3b**. The estimated times for compliance with the NJDEP GWQC for arsenic concentration at well 108-MW1 is greater than 1,000 years. The results of the groundwater modeling indicate that COC migration will be minimal due to low hydraulic conductivity and strong retardation by the soils.

6.5 CEA Fact Sheet

The CEA Fact Sheet for Site 108 can be found in **Appendix D**.

7.0 CEA INFORMATION FOR SITE 283

The following includes all relevant CEA information for Site 283, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

7.1 Site Background

Site 283 is located in the north part of the Main Post Area of Fort Monmouth, on the north side of Sherrill Avenue (**Figure 7-1**). Site 283 is located approximately 200 feet south of Parkers Creek.

UST removal, SI and RI activities were performed by SMC Environmental Services Group (SMC), VERSAR, Weston and the Fort Monmouth DPW at Site 283. The results of these investigations are detailed in the following reports:

- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- SMC's *UST Closure and Site Investigation Report, Building 283B, Main Post-West Area, NJDEP Registration No. 0081533-59*, September 1998.
- VERSAR's *UST Closure and Site Investigation Report, Building 283C, NJDEP Registration No. 0081533-229*, October 2000.
- VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 283*, April 2004.

As part of Weston's SI of the Fort Monmouth military installation, soil sampling, monitoring well installation and sampling and geophysical surveying were conducted. In addition to sampling soil and groundwater at sites throughout the Main Post and Charles Wood areas of Fort Monmouth, Weston established background concentrations for soil and groundwater for the Fort Monmouth installation.

SMC's UST Closure Report stated that there was one tar-coated steel UST located north of former Building 283. UST number 0081533-59 was cleaned, excavated and disposed of in accordance with NJDEP requirements. Based on visual inspection of the UST, field screening of subsurface soils and seven post-excavation soil sampling results, the soil that was excavated during the UST excavation was backfilled into the excavation.

VERSAR's UST Closure Report stated that there was one UST located in the courtyard area of Building 283. UST No. 0081533-229 was cleaned, excavated and disposed of in accordance with NJDEP closure requirements. Based on visual inspection of the UST, field screening of subsurface soils and groundwater, and analytical results of collected soil and groundwater samples, a spill was reported to the NJDEP. Approximately 398 cubic yards of potentially contaminated soil was removed and disposed off-site. Soil sampling showed that benzene was detected at concentrations exceeding the NJDEP soil cleanup criteria. In response to the post-excavation soil sampling results and visual observations of potentially contaminated soil in the

excavation area, one shallow overburden monitoring well was installed at the excavation area. Two additional monitoring wells were installed in the vicinity of Building 283.
Multiple rounds of groundwater monitoring well sampling showed that benzene, ethylbenzene, total xylenes, aluminum, iron and lead were detected in groundwater samples at concentrations exceeding their respective NJDEP GWQC.

7.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, and groundwater sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 283. Remedial investigation activities were performed from September 1999 and continued through February 2004.

Three monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 7-2**). Section 7.3 summarizes results from the quarterly groundwater sampling program was conducted from September 1999 through February 2004 at Site 283. Elevated concentrations of benzene, ethylbenzene, total xylenes and lead were detected at Site 283. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the benzene, ethylbenzene, total xylenes and lead groundwater contamination at Site 283.

7.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, benzene, ethylbenzene, total xylenes and lead are identified as potential COCs at Site 283. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 283*, May 2004. See **Table 7-1** below for a COC summary:

Table 7-1
Determination of COCs
Site 283

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
Benzene	**1**	**1009.73**	**11**
Ethylbenzene	**700**	**1160.45**	**6**
Total Xylenes	**1000**	**5960.7**	**7**
Lead	**10**	**33.1**	**10**

7.4 Groundwater Modeling Results

A conceptual site model for Site 283 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 283*, April 2004.

The COCs in groundwater at Site 283 can be separated into two groups: organic and inorganic. The three organic COCs consist of benzene, ethylbenzene and total xylenes. The one inorganic COC is lead. The COCs that are organic may have the potential to degrade through biological means, whereas lead is not biodegradable. Because the two other organic COCs (ethylbenzene and total xylenes) are less mobile than benzene, have lower concentrations relative to their respective GWQC, and have faster degradation rates, the model predictions for organic compounds (discussed below) are limited to benzene.

Benzene

As shown in **Figure 7-3a**, the MODFLOW simulation predicts that the benzene concentration in groundwater at Site 283 will be reduced to concentrations below 1.0 ug/L in 19 years. The predicted time of 19 years for compliance with the GWQC is slightly less than the 20 years predicted using a biodegradation spreadsheet. In well 283-MW2, the MODFLOW simulation predicts that benzene concentrations will diminish to less than the NJDEP criteria of 1.0 ug/L in approximately 18 years (**Figure 7-3b**). In well 283-MW3, the MODFLOW simulation predicts that benzene concentrations will diminish to less than the NJDEP criteria of 1.0 ug/L in approximately 9 years (**Figure 7-3c**). In the MODFLOW simulation, benzene migration was slowed due to sorption of benzene to subsurface soil and biodegradation. A cross-section view of the benzene concentrations in groundwater near well 283-MW2 is shown in **Figure 7-3d**. This cross-section view shows that benzene has not migrated downward below Layer 3 and into Layer 4 (Layers 2 and 3 represent of the Composite Confining Unit and Layer 4 represents the Wenonah-Mount Laurel aquifer).

Although the MODFLOW simulation predicts that benzene migration will be minimal, it is possible that benzene migration may occur northward and into Parkers Creek. This possibility is demonstrated by the results of the spreadsheet model and by the presence of underground utility lines. Several underground utility lines are present at elevations below the groundwater table at Site 283. Shallow groundwater might flow along these underground utility lines due to the higher conductivity associated with subsurface fill surrounding these pipes. However, results from the first quarter 2004 groundwater monitoring event indicate downgradient wells 283-MW1

and 283-MW3 contained minor benzene concentrations of non-detect and 3.21 ug/L, respectively, and the application of Oxygen Release Compound (ORC) is proposed in VERSAR's RIR/RAWP.

Lead

Based on the predicted change in concentration of lead in groundwater at Site 283 over 20 years (**Figure 7-4a**), the estimated times for compliance with the NJDEP criteria is approximately 210 years (**Figure 7-4b**). The results of the groundwater modeling indicate that lead migration will be minimal due to low hydraulic conductivity and strong retardation by the soils at Site 283.

7.5 CEA Fact Sheet

The CEA Fact Sheet for Site 283 can be found in **Appendix E**.

8.0 CEA INFORMATION FOR SITE 812

The following includes all relevant CEA information for Site 812, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

8.1 Site Background

Site 812 is located in the south-central portion of the Main Post near the Main Street entrance to Fort Monmouth (**Figure 8-1**). Site 812 is bordered by Murphy Drive to the east and south and to the northwest by an access road, Building 1000 (the Post Exchange or PX), and Building 1001 (the Four Seasons Store). "Building" 812, the Army Community Service Center and associated parking areas, currently occupies the area defined as Site 812, which encompasses approximately 2.75 acres. Specific historical information is not available regarding previous operations and conditions at Site 812. Reportedly, Site 812 is the former location of a gasoline station with underground fuel storage.

UST removal, SI and RI activities were performed by SMC, VERSAR and the Fort Monmouth DPW at Site 812. The results of these investigations are detailed in the following reports:

- SMC's *Underground Storage Tank Closure and Site Investigation Report – Building 812,* 1998.
- VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 812*, June 2001.

SMC's UST Closure Report stated that a fiberglass UST located on the east side of Building 812 was closed by removal in accordance with NJDEP UST closure procedures. The post-excavation soil sampling results did not identify contaminated soils. No further action was proposed regarding the UST closure.

VERSAR conducted an aerial photograph historical and site record review because specific historical information was not available regarding previous operations and conditions at Site 812. This photographs and records review identified a number of former structures and areas of potential concern, which established a basis for SI and RI efforts. The photograph and records review identified several former structures and areas of potential concern including several areas of disturbed soil, a coal storage yard, railroad tracks of the Central New Jersey Railroad, and suggestions of a former gasoline station. An SI was initiated at Site 812 with the installation of soil borings to evaluate the locations of previous site structures/areas of disturbance identified during the historical aerial photograph and records review. Soil and groundwater grab samples were collected from the boring locations. An expanded SI was then conducted at a specific boring location, and additional soil and aqueous samples were collected. The SI and expanded SI failed to identify a distinct source area for soils or define potential COCs. However, the SI and expanded SI did identify one boring location as a potential source area for groundwater contamination by volatile organic compounds (VOCs) requiring further evaluation.

8.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, groundwater sampling and analyses and soil sampling and analyses, to support and expand the results and findings of their SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 812. Remedial investigation activities were performed from December 1999 and continued through June 2001.

Fourteen monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 8-2**). Section 8.3 summarizes results from the quarterly groundwater sampling program consisted of two rounds conducted in May and June 2000 at Site 812. Elevated concentrations of benzene, cis-1,2-dichloroethene, 1,1-dichloroethene, tetrachloroethene , trans-1,2-dichloroethene, trichloroethene, 1,1,1-trichloroethane and vinyl chloride were detected at Site 812. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the benzene, cis-1,2-dichloroethene, 1,1-dichloroethene, tetrachloroethene , trans-1,2-dichloroethene, trichloroethene, 1,1,1-trichloroethane and vinyl chloride groundwater contamination at Site 812.

8.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, benzene, cis-1,2-dichloroethene, 1,1-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, 1,1,1-trichloroethane and vinyl chloride are identified as potential COCs at Site 812. Discussion leading to this conclusion can be found in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 812*, June 2001. See **Table 8-1** below for a COC summary:

Table 8-1
Determination of COCs
Site 812

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
Benzene	1	9.99	2
Cis-1,2-dichloroethene	70	10436.18	2
1,1-dichloroethene	2	8.11	2
Tetrachloroethene	1	2.64	2
Trans-1,2-dichloroethene	100	615.87	2
Trichloroethene	1	5.25	2
1,1,1-trichloroethane	30	43.71	2
Vinyl Chloride	5	147.57	2

8.4 Groundwater Modeling Results

A conceptual site model for Site 812 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The Air Force Center for Environmental Excellence (AFCEE) Technology Transfer Division's BIOCHLOR program was chosen for the groundwater simulation. The software, programmed in the Microsoft Excel spreadsheet environment and based on the Domenico analytical solute transport model, has the ability to simulate 1-D advection, 3-D dispersion, linear adsorption and biotransformation via reductive dechlorination. Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 812*, June 2001. The model was used in conjunction with groundwater flow information to estimate the duration and areal extent of the CEA. An explanation of the groundwater modeling performed at Site 812 and the BIOCHLOR spreadsheets can be found in **Appendix F**.

1,1,1-trichloroethane

As shown in **Figure 8-3** and **Appendix F**, the results of the BIOCHLOR modeling program predict that 1,1,1-trichloroethane concentrations in the vicinity of monitoring wells 812-MW05 and 812-MW07 will be in compliance with its NJDEP GWQC by the end of the year 2000. Although this prediction has proved to be incorrect, 1,1,1-trichloroethane concentrations have subsequently degraded to comply with its NJDEP GWQC. Results of the long-term monitoring program implemented at Site 812 that support compliance with the respective NJDEP GWQC for 1,1,1-trichloroethane are presented in VERSAR's *Remedial Action Progress Report, Site 812*, pending.

Benzene

As shown in **Figure 8-4** and **Appendix F**, the results of the BIOCHLOR modeling program predict that benzene concentrations in the vicinity of monitoring well 812-MW04 will be in compliance with its NJDEP GWQC by the end of the year 2001. Although this prediction has been proven to be incorrect, benzene concentrations have subsequently degraded to comply with its NJDEP GWQC. Results of the long-term monitoring program implemented at Site 812 that support compliance with the respective NJDEP GWQC for benzene are presented in VERSAR's *Remedial Action Progress Report, Site 812*, pending.

Tetrachloroethene and Daughter Products

As shown in **Figure 8-5** and **Appendix F**, the results of the BIOCHLOR modeling program predict that tetrachloroethene and daughter product concentrations in the vicinity of monitoring well 812-MW04 will be in compliance with its NJDEP GWQC by the end of the year 2015.

8.5 CEA Fact Sheet

The CEA Fact Sheet for Site 812 can be found in **Appendix G**.

9.0 CEA INFORMATION FOR SITE 1122

The following includes all relevant CEA information for Site 1122, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

9.1 Site Background

Site 1122 is approximately 1.5 acres and is located in the southwestern part of the Main Post Area of Fort Monmouth, north of Alexander Avenue and just south of Mill Creek (**Figure 9-1**).

UST removal, SI and RI activities were performed by Weston, Smith and the Fort Monmouth DPW at Site 1122. The results of these investigations are detailed in the following reports:

- Weston's *UST Closure and Site Investigation Report, Building 1122, NJDEPE Registration No. 81533-199*, October 1993.
- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- Smith's *UST Closure and Site Investigation Report, Building 1122, UST No. 081533-171*, February, 1996.
- VERSAR's *Remedial Investigation Report, Site 1122*, March 2004 (Draft).

Westons's UST Closure Report and SI stated that there was one single-wall steel UST located under the pavement immediately north of Building 1122. UST No. 081533-199 was cleaned, excavated and disposed of in accordance with NJDEP requirements. Following receipt of post-excavation soil sampling results, which were all below the NJDEP soil cleanup criteria, the UST excavation was backfilled to grade with a combination of uncontaminated excavated soil and certified clean fill.

As part of Weston's SI of the Fort Monmouth military installation, soil sampling, monitoring well installation and sampling and geophysical surveying were conducted. In addition to sampling soil and groundwater at sites throughout the Main Post and Charles Wood areas of Fort Monmouth, Weston established background concentrations for soil and groundwater for the Fort Monmouth installation.

Smith's UST Closure Report and SI stated that there was one UST located under the pavement immediately west of Building 1122. UST No. 081533-171 was cleaned, excavated and disposed of in accordance with NJDEP requirements. Following receipt of post-excavation soil sampling results, which were all below the NJDEP soil cleanup criteria, the UST excavation was backfilled to grade with a combination of uncontaminated excavated soil and certified clean fill.

9.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, groundwater sampling and analyses, surface water sampling and analyses and soil sampling and analyses, to support and expand the results

and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 1122. Remedial investigation activities were performed from November 1996 and continued through August 2001.

Five monitoring wells comprise the quarterly groundwater monitoring program currently conducted by the DPW (**Figure 9-2**). Section 9.3 summarizes results from the quarterly groundwater sampling program was conducted from May 1997 through January 2001 at Site 1122. Elevated concentrations of methyl tert-butyl ether (MTBE) and tetrachloroethene were detected at Site 1122. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the MTBE and tetrachloroethene groundwater contamination at Site 1122.

9.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences, and the wide-ranging results, MTBE and tetrachloroethene are identified as potential COCs at Site 1122. Discussion leading to this conclusion are presented in VERSAR's *Remedial Investigation Report, Site 1122*, March 2004 (Draft). See **Table 9-1** below for a COC summary:

Table 9-1
Determination of COCs
Site 1122

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
MTBE	70	1077.47	4
Tetrachloroethene	1	8.99	13

9.4 Groundwater Modeling Results

A conceptual site model for Site 1122 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations.

Conceptual site model information and model input parameters can be found in VERSAR's *Remedial Investigation Report, Site 1122*, March 2004 (Draft).

MTBE

At monitoring well 1122-MW5, groundwater concentrations were obtained in four rounds of sampling beginning on August 10, 2000. As shown in **Figure 9-3a**, these observed concentrations lead to a half-life of 117 days. The published half-life for MTBE of 365 days (Howard, 1991) was used to make a more conservative prediction for MTBE concentrations at well 1122-MW5.

The initial MTBE concentration used in the model is 493.93 ug/L, which is the average of the two most recent detections (on October 13, 2000 and January 3, 2001). This initial concentration, assumed to be on November 23, 2000, led to a predicted time of 3.0 years for compliance with the NJDEP criteria (70 ug/L). The migration distance to achieve compliance at well 1122-MW5 is predicted to be 910 feet based on the hydraulic gradient of 0.125 feet per foot. Due to the presence of Mill Creek within approximately 70 feet down-gradient of well 1122-MW5, the biodegradation model predicts that MTBE will migrate from well 1122-MW5 into Mill Creek within 83 days. This prediction is shown graphically on **Figure 9-3b**.

The model led to the prediction that MTBE may migrate 910 feet from well 1122-MW5 before MTBE concentrations fall below the NJDEP criteria of 70 ug/L. These results need to be qualified by the fact that Mill Creek is located adjacent to Site 1122. As shown in **Figure 9-4**, MTBE is predicted to migrate into Mill Creek.

Based on the model prediction that MTBE concentrations in groundwater will be reduced to concentrations below the NJDEP criterion of 70 ug/L within approximately 3.0 years, it is possible that MTBE could migrate from Site 1122 into Mill Creek. If the 25-foot wide sewerage easement contains structures that divert groundwater flow, MTBE could migrate along these buried structures. Results from the first quarter 2004 groundwater monitoring event indicate wells 1122-MW2 and 1122-MW5 contained minor MTBE concentrations of 11.84 and 6.10 ug/L, respectively. In April 2004, groundwater samples were collected via Geoprobe® at locations downgradient of these wells and along the City of Eatontown sewer pipe to assess possible MTBE migration. While minimal MTBE results were indicated, the discovery of petroleum product in temporary points GW3, GW7, and GW10) installed along a 15-foot section of the sewer main, required further investigation and characterization of environmental conditions at Site 1122.

A review of historical records identified a 1,500-gallon, steel, heating oil UST was removed from the northwest corner of building 1122 in 1993. Soil closure sample results indicated a release and over-excavation was performed as required. Records indicate that all areas of petroleum impacted soils above NJDEP criteria were removed. A closure report was submitted and the case was closed.

In late April 2004, a Geoprobe® survey including twenty four boring locations (GW1 through GW24) was performed around the former UST area. Soil and groundwater samples were

collected and analyzed for TPHC and VOCs plus 15 tentatively identified compounds (TICs). No concentrations above the NJDEP soil cleanup criteria for TPHC or VOCs were encountered. Groundwater results indicate low concentrations of TPHC in most of the Geoprobe® points. Concentrations of benzene above NJDEP criteria were identified at four Geoprobe® points ranging from 2-32 ug/L. The petroleum product appears to be limited to a small section of the sewer line trench located downgradient of the former UST pit. Three 2" diameter PVC sumps were installed to periodically remove product along this section of the Eatontown sewer line to provide initial abatement. Future remedial options are being assessed.

Tetrachloroethene

At monitoring well 1122-MW1, concentrations of PCE were detected in 16 rounds of sampling beginning on May 2, 1997. As shown in **Figure 9-5a**, the concentration of PCE increased at well 1122-MW1 until July 6, 1999, when PCE was detected in well 1122-MW1 at a concentration of 8.99 ug/L. Following July 6, 1999, the concentration of PCE decreased in well 1122-MW1. The observed half-life of 385 days was derived based on the PCE detections beginning July 6, 1999 (the non-detection of PCE on August 1, 2000 was omitted from this calculation to provide a better regression curve).

The initial PCE concentration used in the model is 3.48 ug/L, which is the average of the two most recent detections (on October 13, 2000 and January 3, 2001). This initial concentration (assumed to be on November 23, 2000), led to a predicted time of 3.7 years for compliance with the NJDEP criteria (1.0 ug/L). The published half-life for PCE of 730 days (Howard, 1991) was used instead of the observed half-life of 385 days to make more conservative predictions for PCE concentrations at well 1122-MW1. The migration distance to achieve compliance at well 1122-MW1 is predicted to be 83 feet. This prediction is shown graphically on **Figure 9-5b**.

The model led to the prediction that PCE could migrate 83 feet from well 1122-MW1 before PCE concentrations fall below the NJDEP criteria of 1.0 ug/L. These results need to be qualified by the fact that Mill Creek is located adjacent to Site 1122. As shown in **Figure 9-4**, PCE is not predicted to migrate into Mill Creek.

9.5 CEA Fact Sheet

The CEA Fact Sheet for Site 1122 can be found in **Appendix H**.

10.0 CEA INFORMATION FOR SITE 2567

The following includes all relevant CEA information for Site 2567, including site background, results of the remedial actions at the site, identification of COCs and groundwater modeling results.

10.1 Site Background

Site 2567 is located in the Charles Wood Area of Fort Monmouth at the northwest corner of the intersection of Laboratory Road and Hope Road (**Figure 10-1**). Site 2567 includes Building 2567, two gasoline dispenser islands located within the paved area south of the building and dense wooded areas located to the south and east of the site.

UST removal, SI and RI activities were performed by Weston, ATC and the Fort Monmouth DPW at Site 2567. The results of these investigations are detailed in the following reports:

- Weston's *UST Closure and Site Assessment Report for Building 2567, Tanks 33 and 46*, October 1993.
- Weston's *UST Closure and Site Assessment Report, Building 2567, UST Nos. 42, 43, 44, and 45*, January 1995.
- Weston's *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.
- ATC's Groundwater Monitoring Letter Report, May 2000.
- VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 2567*, March 2004 (Draft).

Westons's UST Closure Report and Site Assessment (1993) stated that there were two single-walled steel USTs located adjacent to Building 2567. Both USTs were cleaned, excavated and disposed of in accordance with NJDEP requirements. No potentially contaminated soils were observed surrounding the USTs. Following the removal of these two tanks, eight post-excavation samples were collected and analytical results showed that the samples contained either non-detectable concentrations of contaminants or concentrations below NJDEP soil cleanup criteria.

Westons's UST Closure Report and Site Assessment (1995) stated that there were four gasoline USTs located under the pavement approximately 30 feet southeast of Building 2567. In December 1989, the DPW notified the NJDEP of a fuel leak at the Charles Wood gas station, Building 2567. In response to the failed tightness test, one UST was placed out of service and four groundwater monitoring wells were installed in 1991 to evaluate groundwater quality in the area of Building 2567. In February 1993, the USTs were closed at Site 2567. Based on visual observations of stained soils and screening with a PID, approximately 936 cubic yards of soil were excavated from the area surrounding the USTs and the dispenser island. Post-excavation soil sampling analyses showed either non-detect contaminant concentrations or concentrations detected below NJDEP soil cleanup criteria. A second round of post-excavation soil sampling showed elevated concentrations of benzene, ethylbenzene and total xylenes. Five rounds of

groundwater monitoring well sampling showed elevated concentrations of benzene, 1,2-dichloroethene, methylene chloride, total xylenes and lead.

Weston's 1995 SI Report identified MTBE and Tert-butyl Alcohol (TBA) as groundwater contaminants without GWQC. As of December 2001, the NJDEP applies the interim groundwater quality criteria of 70 ug/L and 100 ug/L to MTBE and TBA, respectively. Both analytes exceeded their respective interim GWQC. One additional monitoring well was installed to determine if contaminants were present downgradient from the site. Also as part of Weston's SI of the Fort Monmouth military installation, soil sampling, monitoring well installation and sampling and geophysical surveying were conducted. In addition to sampling soil and groundwater at sites throughout the Main Post and Charles Wood areas of Fort Monmouth, Weston established background concentrations for soil and groundwater for the Fort Monmouth installation.

ATC's Letter Report presented sampling results from five monitoring wells at Site 2567, which were collected during six quarterly sampling rounds between May 1995 and April 1997. During these six sampling events, benzene, MTBE, methylene chloride, TBA and total xylenes were detected in groundwater samples at concentrations greater than their respective GWQC. Lead was not detected at concentrations exceeding the GWQC in any of the groundwater samples collected during this time.

10.2 Remedial Investigation Report Results

Fort Monmouth DPW has conducted RI activities, the implementation of a long-term monitoring program, subsurface hydrogeologic investigations, groundwater monitoring well installation, sampling and analyses, surface water sampling and analyses and soil sampling and analyses, to support and expand the results and findings of the 1995 Weston SI. The RI also included the collection of groundwater depth measurements, the performance of slug tests, evaluation of the aquifer classification, and the completion of a sensitive receptor survey. The results of the field and laboratory investigations were used to develop a conceptual site model to provide a basis for the development of a three-dimensional computer model. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of Site 2567. Remedial investigation activities were performed from September 1991 and continued through February 2004.

Seven monitoring wells comprise the quarterly groundwater monitoring program conducted by the DPW (**Figure 10-2**). The quarterly groundwater sampling program was conducted from April 1997 through February 2004 at Site 2567. Elevated concentrations of TBA were detected at Site 2567. As a result of these findings, the DPW will incorporate a document equivalent to a DER in the Fort Monmouth Installation Master Plan for the TBA groundwater contamination at Site 2567.

10.3 Contaminants of Concern

Based on the magnitude of the exceedences, the frequency of occurrences and the wide-ranging results, TBA is identified as a potential COC at Site 2567. Discussion leading to this conclusion

is presented in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 2567*, March 2004 (Draft). See **Table 10-1** below for a COC summary:

Table 10-1
Determination of COCs
Site 2567

Analyte	NJDEP GWQC (ug/L)	Maximum Result (ug/L)	# of NJDEP GWQC Exceedences
TBA	100	1488.05	24

10.4 Groundwater Modeling Results

A conceptual site model for Site 2567 was developed to provide a basis for the computer model development. The conceptual site model includes the topography, groundwater recharge, groundwater flow conditions and the geologic formations. The parameters used in the groundwater flow model were based on Fort Monmouth survey data, published literature about the hydrogeology of the region, as well as field measurements of groundwater elevation at the site. The USGS Modular Three-Dimensional Groundwater Flow Model, MODFLOW, was chosen for the groundwater simulation to account for the adsorption of the metals to the soil (e.g., retardation), as well as the dispersion (or dilution) of contaminants over time. The simulation also incorporates three-dimensional groundwater flow, groundwater recharge, and considers the variability of soil types, anisotropy and other hydrogeologic considerations. Conceptual site model information and model input parameters are presented in VERSAR's *Remedial Investigation Report and Remedial Action Workplan, Site 2567*, March 2004 (Draft).

The groundwater modeling information presented below does not address the migration of benzene and MTBE because these two contaminants have not been detected above their respective GWQC in recent groundwater samples. Predictions for the migration and change in TBA concentration over time are based on the most recent groundwater sampling results for TBA at Site 2567 and published biodegradation rates for TBA in groundwater.

TBA

At monitoring well 2567-MW1, the initial TBA concentration was measured to be 1,488.05 ug/L on February 9, 2001. This concentration led to a predicted time of 3.9 years for compliance with the NJDEP criteria. The migration distance of TBA from well 2567-MW1 is predicted to be 1,800 feet. The predicted TBA concentration at well 2567-MW1 is shown in **Figure 10-3**. **Figure 10-4** displays the area that is estimated to be impacted by future TBA migration.

The model predictions for TBA do not match past observations of TBA concentrations in groundwater at Site 2567. If the TBA contamination will migrate approximately 1,800 feet in 3.9 years, as predicted in the biodegradation model, TBA should have already migrated to one of the three downgradient monitoring wells. However, TBA was not detected in any of these three monitoring wells in any of the sampling rounds. In addition, neither benzene nor MTBE have been detected at these three downgradient monitoring wells.

A possible explanation for lack of detection of the COCs in the three downgradient monitoring wells is that underground utility lines at Site 2567 may affect the direction of shallow groundwater flow at Site 2567, thus diverting groundwater contaminants away from downgradient monitoring wells. In **Figure 10-4**, the predicted migration of TBA is shown to be extending southward along Hope Road. In this figure, TBA is shown to migrate from Site 2567 southward towards the unnamed tributary to Wampum Brook (approximately 200 feet) and possibly continuing south to Wampum Brook (approximately 800 feet from Site 2567). In February 2004, groundwater samples were collected via Geoprobe® at locations east and southeast of 2567-MW1 (**Figure 10-4**). Results indicate only minor TBA concentrations of 5.52 (GW1), 2.63 (GW2), and 46 ug/L (GW3) at these points demonstrating limited TBA migration. Future remedial options are being assessed.

10.5 CEA Fact Sheet

The CEA Fact Sheet for Site 2567 can be found in **Appendix I**.

11.0 REFERENCES

ATC, July 1998, *UST Closure and Site Investigation Report for Former Building T-80, NJDEP Registration No. 090010-06*.

ATC, May 2000, Groundwater Monitoring Letter Report.

ATC, May 2000, *UST Closure and Site Investigation Report, Building 166, UST No. 90017-17*.

Brown, G.A. and O.S. Zapecza, 1990. *Results of Test Drilling in Howell Township, Monmouth County, New Jersey*. USGS, West Trenton, NJ.

Howard, P.H., et. al., 1991, *Handbook of Environmental Degradation Rates*. Lewis Publishers.

Jablonski, L.A., 1968, *Groundwater Resources of Monmouth County, New Jersey. USGS Special Report 23*. USGS, Washington, DC.

Martin, M., 1998, *Groundwater Flow in the New Jersey Coastal Plain*. USGS Professional Paper 1404-H.

Meisler, H., J.A. Miller, L.L. Knobel, and R.L. Wait, 1988, "Region 22, Atlantic and Eastern Gulf Coastal Plan," in *Hydrogeology: The Geology of North America*, W. Back, J.S. Rosenhein, and P.R. Seaber, editors. Vol. 0-2. pp. 209-218.

Minard, J.P., 1969, *Geology of Sandy Hook Quadrangle in Monmouth County, New Jersey*. U.S. Government Printing Office, Washington, DC.

New Jersey Gelolgic Survey, 1994, *Geologic Map of New Jersey*.

SMC, 1998, *Underground Storage Tank Closure and Site Investigation Report – Building 812*.

SMC, September 1998, *UST Closure and Site Investigation Report, Building 283B, Main Post-West Area, NJDEP Registration No. 0081533-59*.

Smith, February 1996, *UST Closure and Site Investigation Report for Former Building 108, UST No. 090010-7*.

Smith, February 1996, *UST Closure and Site Investigation Report, Building 1122, UST No. 081533-171*.

U.S. Geological Survey, 1981, *Long Branch Quadrangle Map*.

VERSAR, October 2000, *UST Closure and Site Investigation Report, Building 283C, NJDEP Registration No. 0081533-229*.

VERSAR, June 2001, *Remedial Investigation Report and Remedial Action Workplan, Site 812, Fort Monmouth, New Jersey*.

VERSAR, September 2003, *Remedial Investigation Report, M-12 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, October 2003, *Remedial Investigation Report, M-18 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, October 2003, *Remedial Investigation Report and Sediment Quality Evaluation, M-12/M-14 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, October 2003, *Remedial Investigation Report for Near-Surface Soils, M-12 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, February 2004, *Remedial Investigation Report and Sediment Quality Evaluation, M-18 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, March 2004, *Remedial Investigation Report, Site 80/166, Fort Monmouth, New Jersey* (Draft).

VERSAR, March 2004, *Remedial Investigation Report, Site 108, Fort Monmouth, New Jersey* (Draft).

VERSAR, March 2004, *Remedial Investigation Report, Site 1122, Fort Monmouth, New Jersey* (Draft).

VERSAR, April 2004, *Remedial Investigation Report and Remedial Action Workplan, Site 283, Fort Monmouth, New Jersey*.

VERSAR, March 2004, *Remedial Investigation Report and Remedial Action Workplan, Site 2567, Fort Monmouth, New Jersey* (Draft).

VERSAR, March 2004, *Remedial Investigation Report for Near-Surface Soils, M-18 Landfill Site, Fort Monmouth, New Jersey*.

VERSAR, pending, *Remedial Action Progress Report, Site 812, Fort Monmouth, New Jersey*.

Weston, October 1993, *UST Closure and Site Investigation Report, Building 1122, NJDEPE Registration No. 81533-199*.

Weston, October 1993, *UST Closure and Site Assessment Report for Building 2567, Tanks 33 and 46*.

Weston, May 1994, *UST Closure and Site Investigation Report for Building 108, NJDEPE Facility No. 090010, TMS No. 60, 61, 62, 63 and 64, Fort Monmouth, New Jersey*.

Weston, January 1995, *UST Closure and Site Assessment Report, Building 2567, UST Nos. 42, 43, 44, and 45*.

Weston, December 1995, *Site Investigation Report – Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*.

Zapecza, O., 1989, *Hydrogeologic Framework of the New Jersey Coastal Plain*. U.S. Geological Survey Professional Paper 1404-B. U.S. Government Printing Office, Washington, DC.

FIGURES

SITE 2567: TBA (FIGURE 10-4)

M-18 LANDFILL: BENZENE (FIGURE 4-4)

M-18 LANDFILL: ARSENIC (FIGURE 4-5a)

M-18 LANDFILL: LEAD (FIGURE 4-8a)

M-18 LANDFILL: CADMIUM (FIGURE 4-6a)

M-18 LANDFILL: CHROMIUM (FIGURE 4-7a)

SITE 283: LEAD (FIGURE 7-4a)

SITE 283: BENZENE (FIGURE 7-3a)

SITE 108: ARSENIC (FIGURE 6-3a)

SITE 80/166: LEAD (FIGURE 5-5a)

SITE 80/166: ARSENIC (FIGURE 5-4a)

SITE 80/166: g-CHLORDANE (FIGURE 5-3a)

M-12 LANDFILL: ARSENIC (FIGURE 3-3a)

M-12 LANDFILL: LEAD (FIGURE 3-4a)

M-12 LANDFILL: ARSENIC (FIGURE 3-3b)

SITE 812: VINYL CHLORIDE (FIGURE 8-5)

SITE 812: BENZENE (FIGURE 8-4)

SITE 812: 1,1,1-TRICHLOROETHANE (FIGURE 8-3)

SITE 1122: MTBE (FIGURE 9-4)

SITE 1122: TETRACHLOROETHENE (FIGURE 9-4)

N

ROAD (PAVED)		WOODED AREA	
ROAD/TRAILS (UNPAVED)		TREE/BUSH	
FENCE		LIGHT POLE	
BUILDING		UTILITY POLE	
APPROXIMATE BOUNDARY		BROOK/CREEK	
BASE BOUNDARY		MARSHY AREA	
RAILROAD TRACKS			

NOTES:

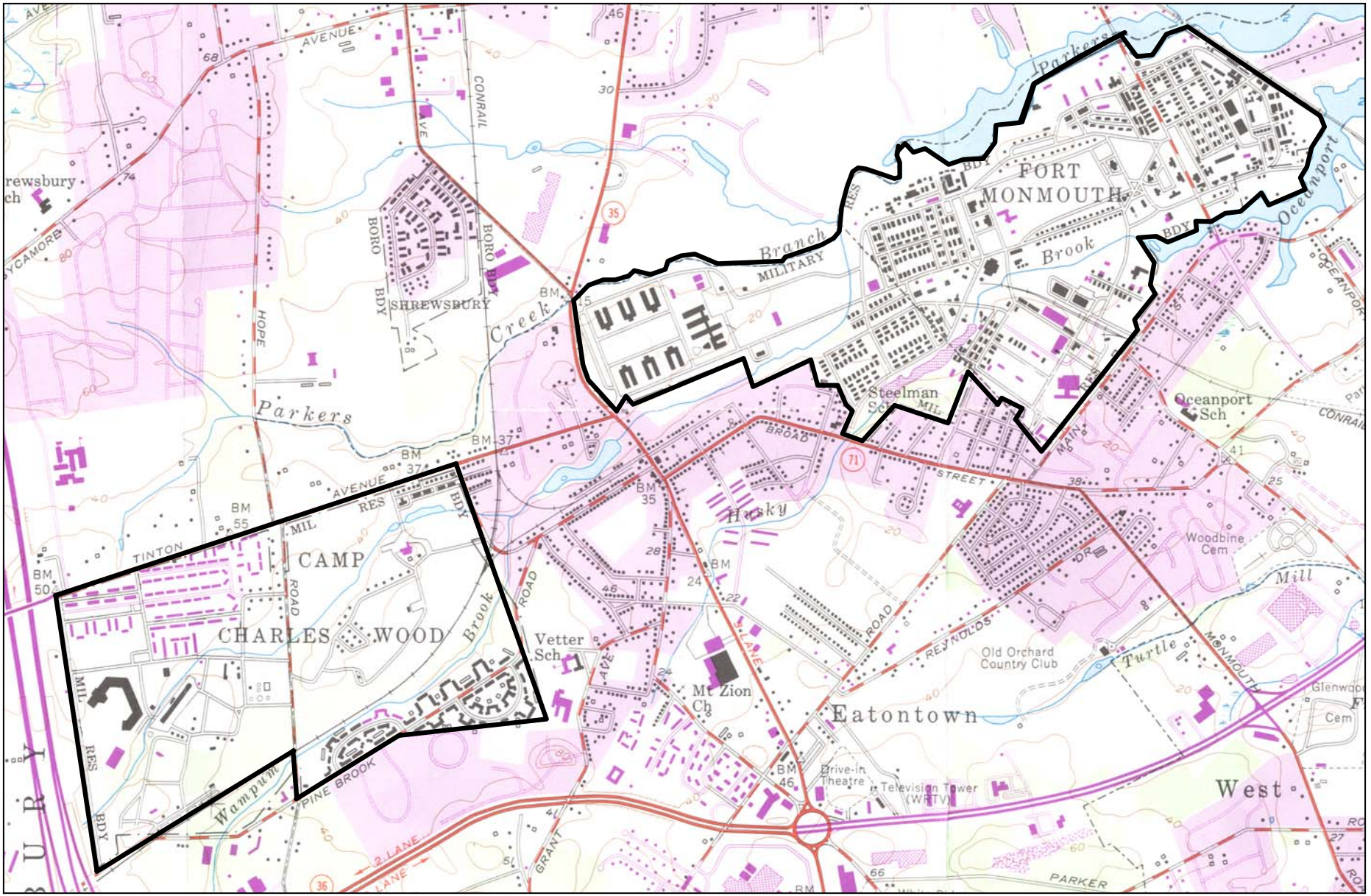
REV.	REVISIONS	APPROVED	DATE	DRAWN BY

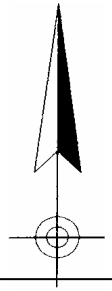
TITLE:

FIGURE 1-1
CEA LOCATIONS
FORT MONMOUTH, NEW JERSEY

DRAWN BY: JM	DATE DRAWN: 02 JUL 01
CHECKED BY:	DATE CHECKED: 02 JUL 01
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 1-1
	FILE No.: FIGURE 1-1
	SCALE: 1" = 250'
	SHEET 1 OF 1 REV.: A

Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955





QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

PHOTOREVISED 1981

DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 2-1
Site Location Map
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

Geologic Map of New Jersey

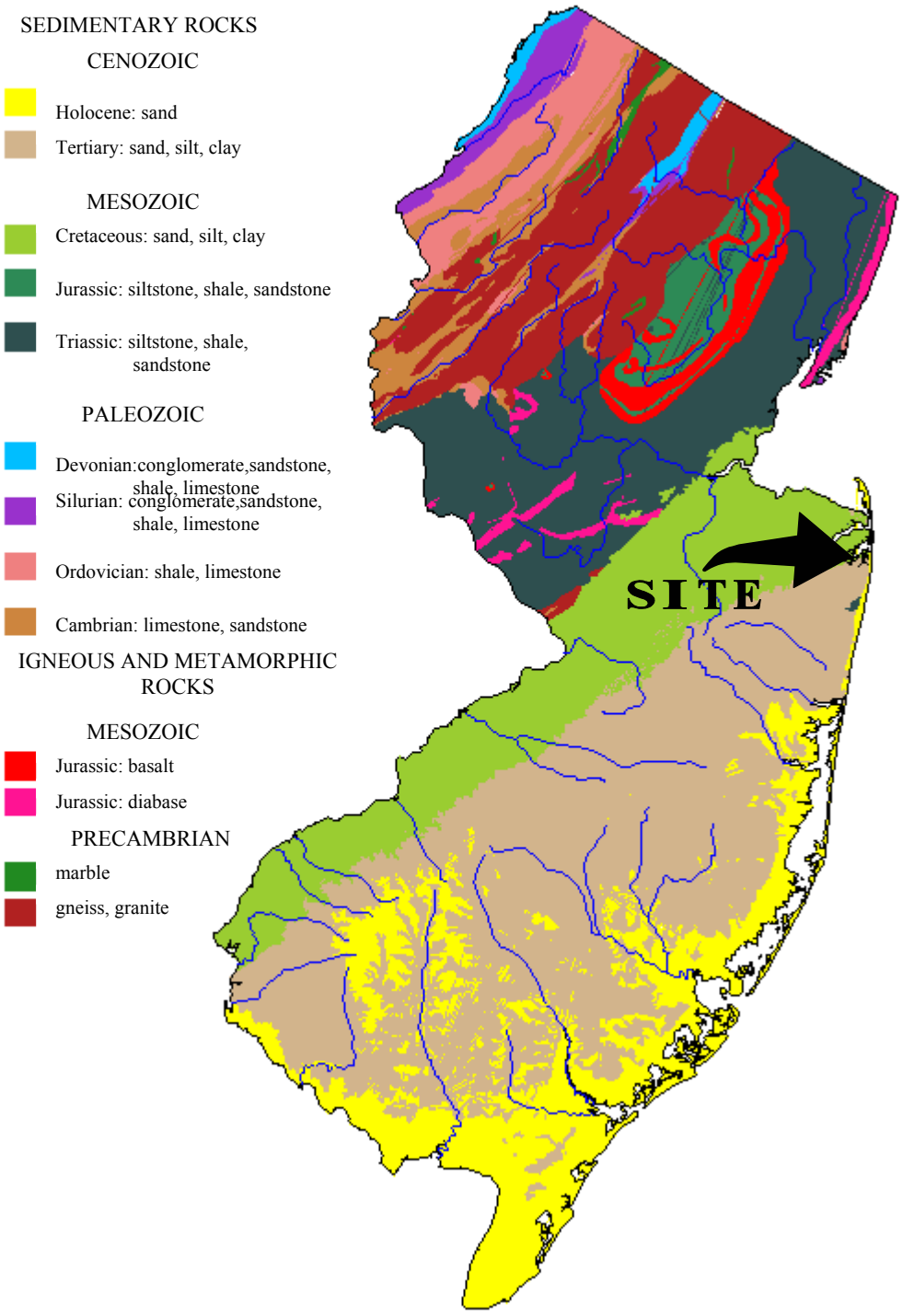
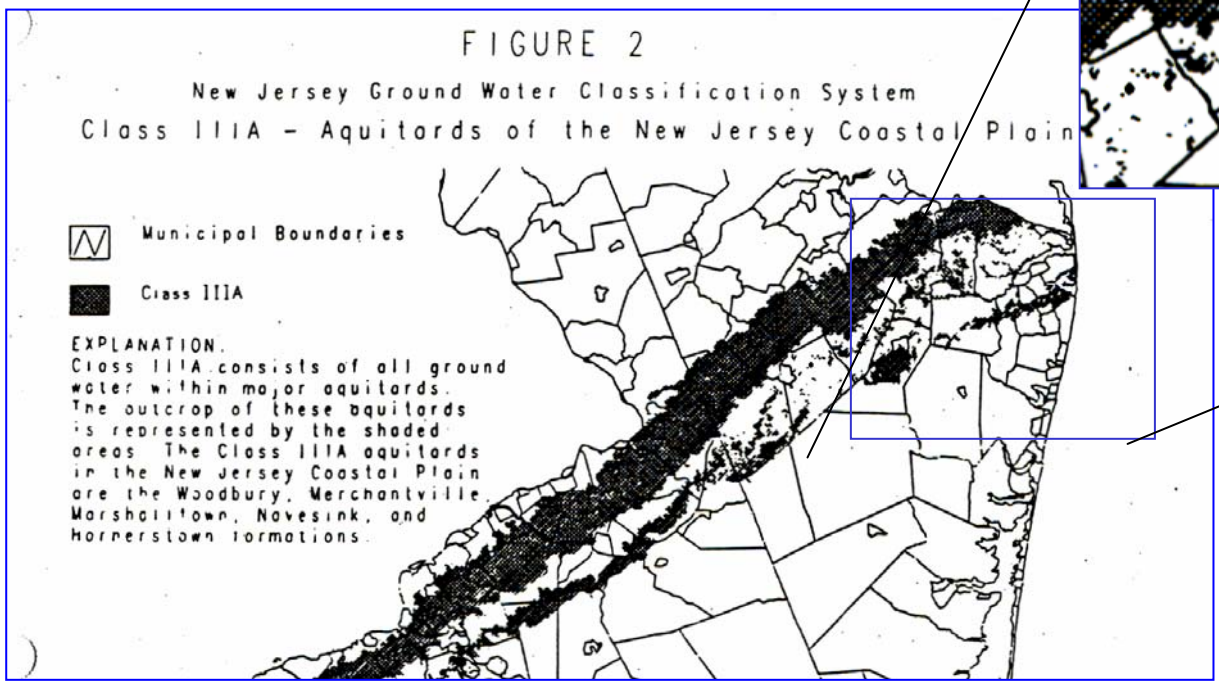


FIGURE 2-2
Geologic Map of New Jersey
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

Source: New Jersey Gelolgic Survey, 1994, *Geologic Map of New Jersey*.



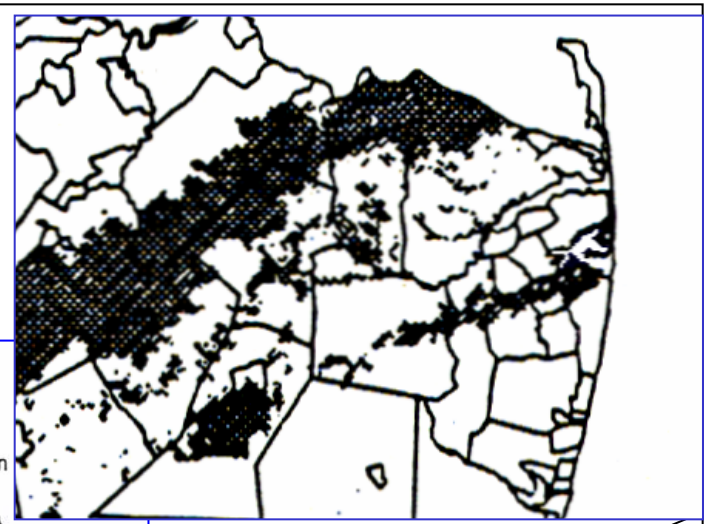


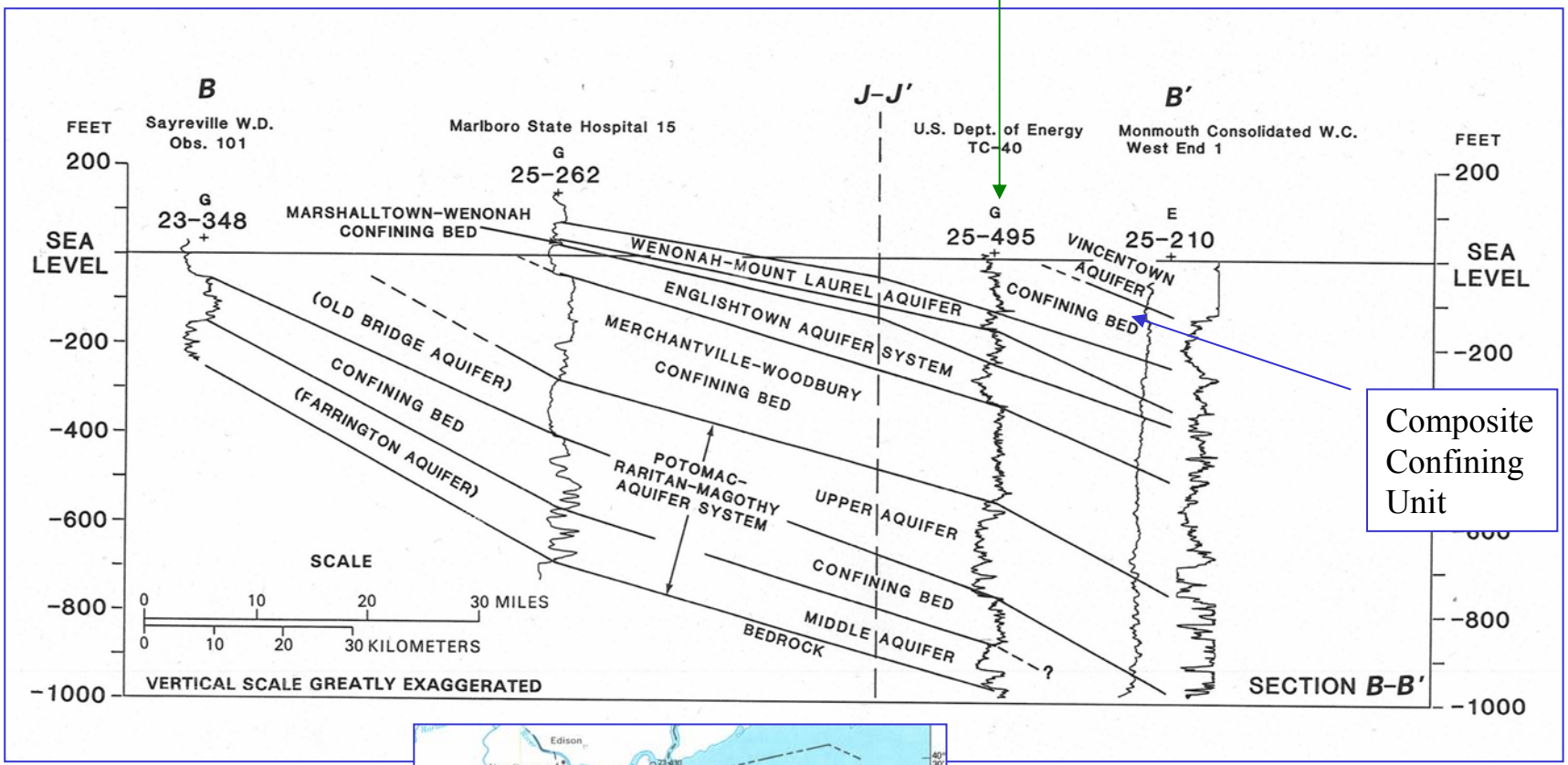
FIGURE 2-3

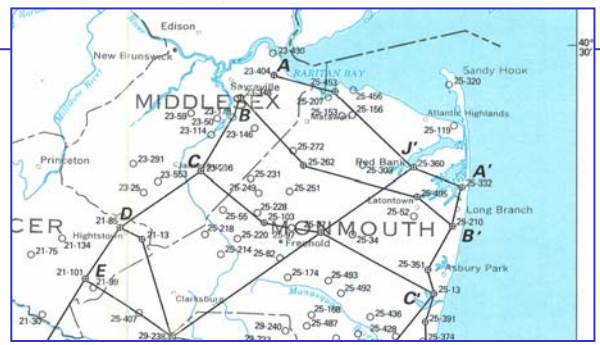
New Jersey Groundwater Classification
Class IIIA
Fort Monmouth, New Jersey

Source: New Jersey Groundwater Quality Standards, NJAC 7:9-6

Versar INC.
201 Gibraltar Rd., Ste. 100
Horsham, PA 19044
(215) 957-0955

Fort Monmouth



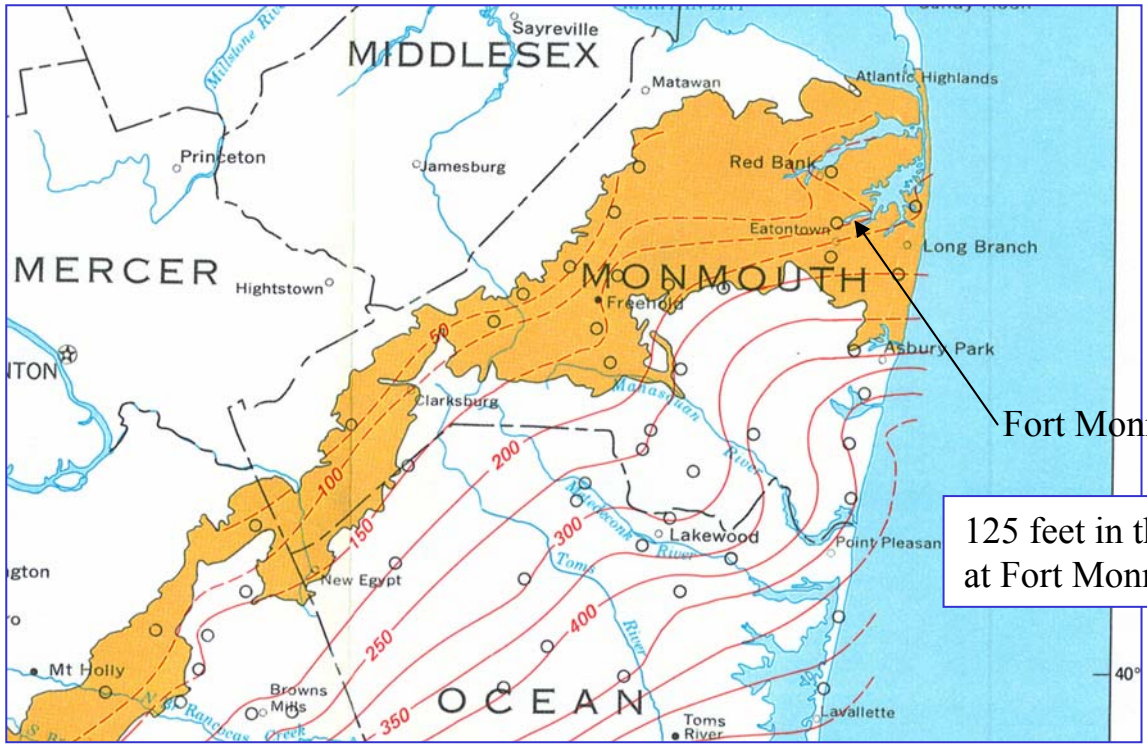


Source: Zapecza, O. 1989. *Hydrogeologic Framework of the New Jersey Coastal Plain.* USGS Professional Paper 1404-B. U.S. Government Printing Office, Washington, DC.

FIGURE 2-4

Geologic Cross-Section
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Ste. 100
Horsham, PA 19044
(215) 957-0955



EXPLANATION

Outcrop area of the Navesink Formation, Red Bank Sand, Tinton Sand, Hornerstown Sand, Vincentown Formation, and Manasquan Formation

600 — Line of equal thickness of the composite confining bed. Dashed where approximately located. Interval 50 feet

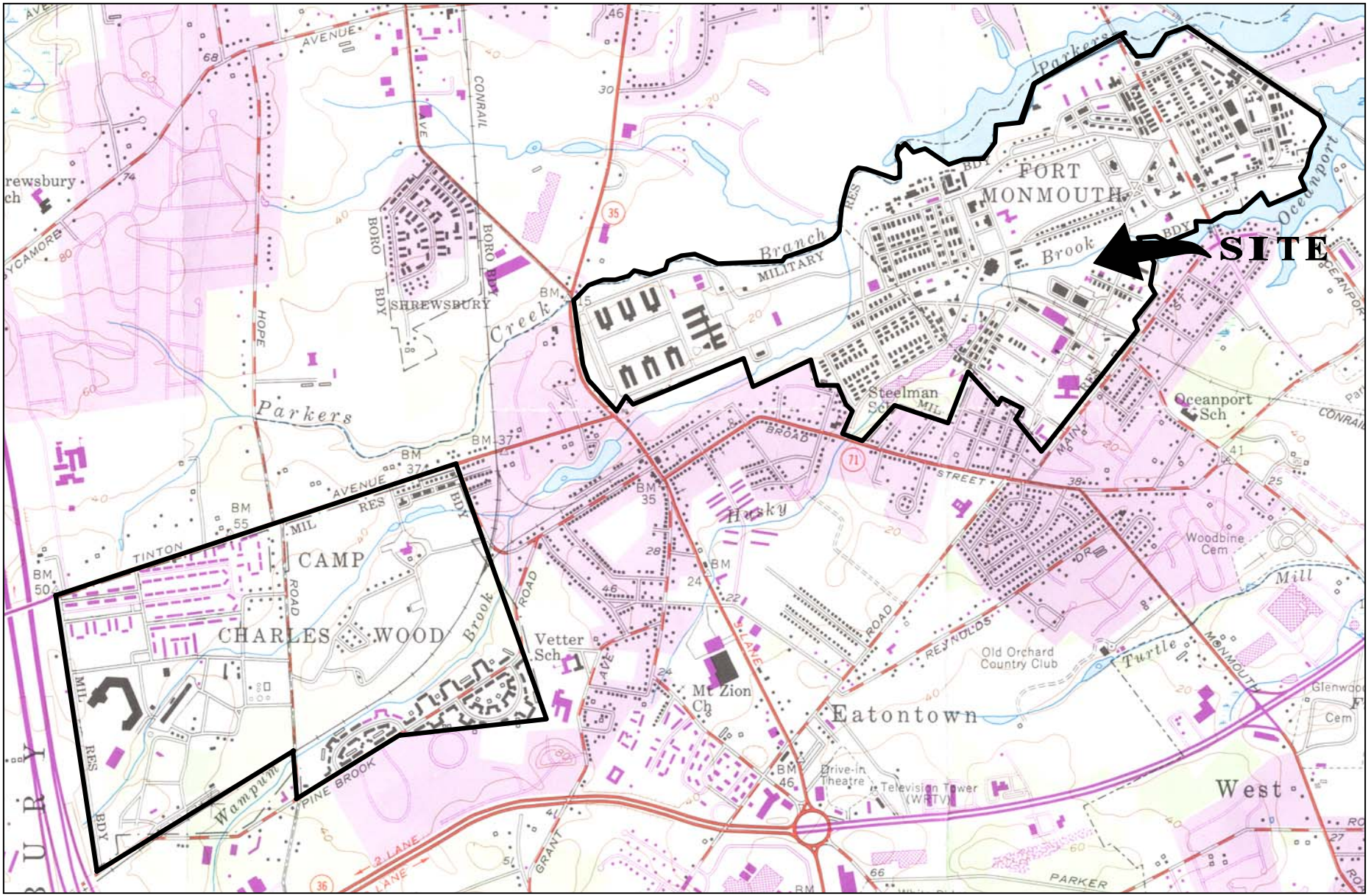
Well location

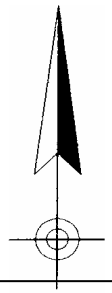
Source: Zapecza, O. 1989. *Hydrogeologic Framework of the New Jersey Coastal Plain.* USGS Professional Paper 1404-B. U.S. Government Printing Office, Washington, DC.

FIGURE 2-5

Outcrop and Thickness of Composite Confining Unit Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Ste. 100
Horsham, PA 19044
(215) 957-0955





QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

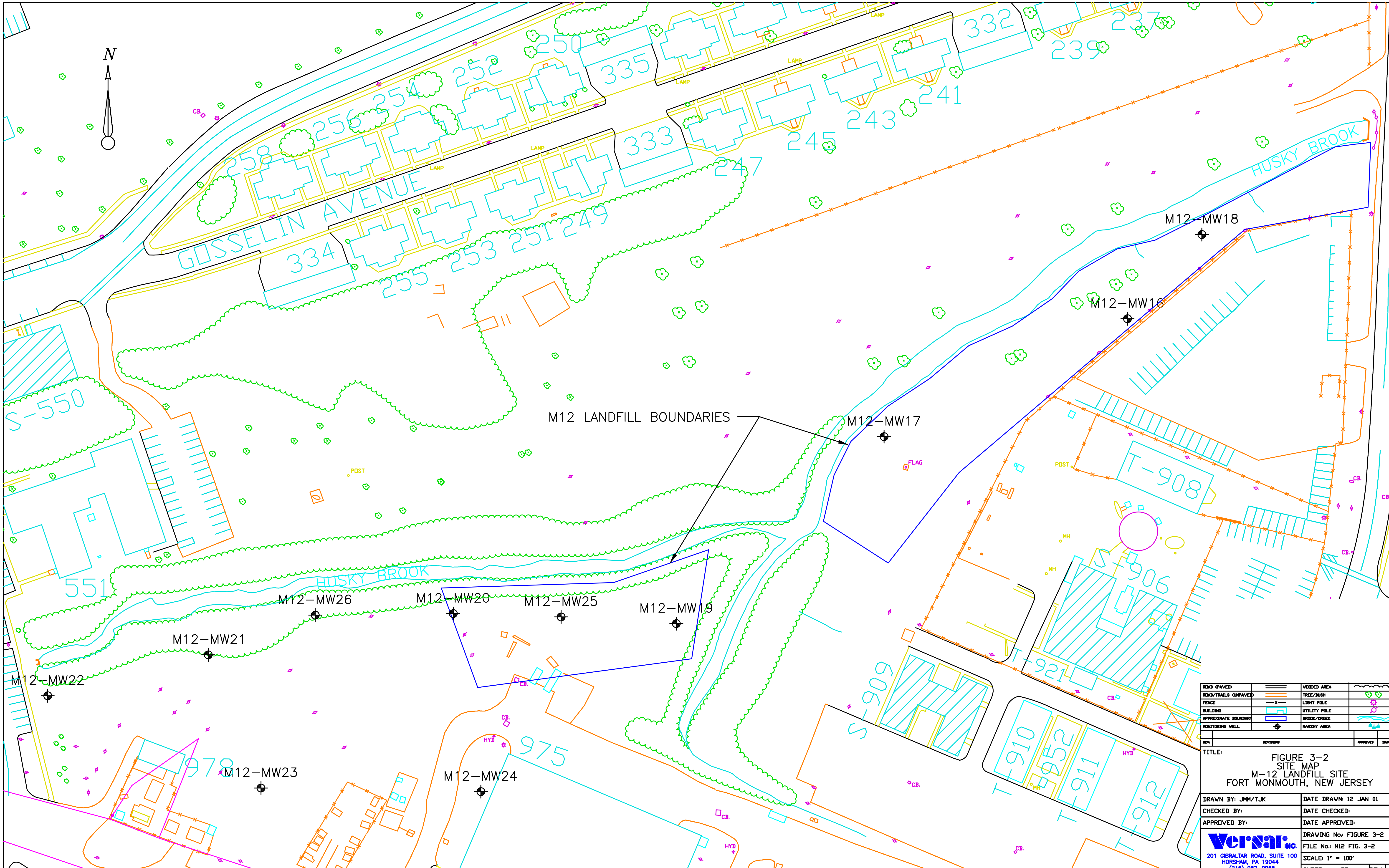
PHOTOREVISED 1981

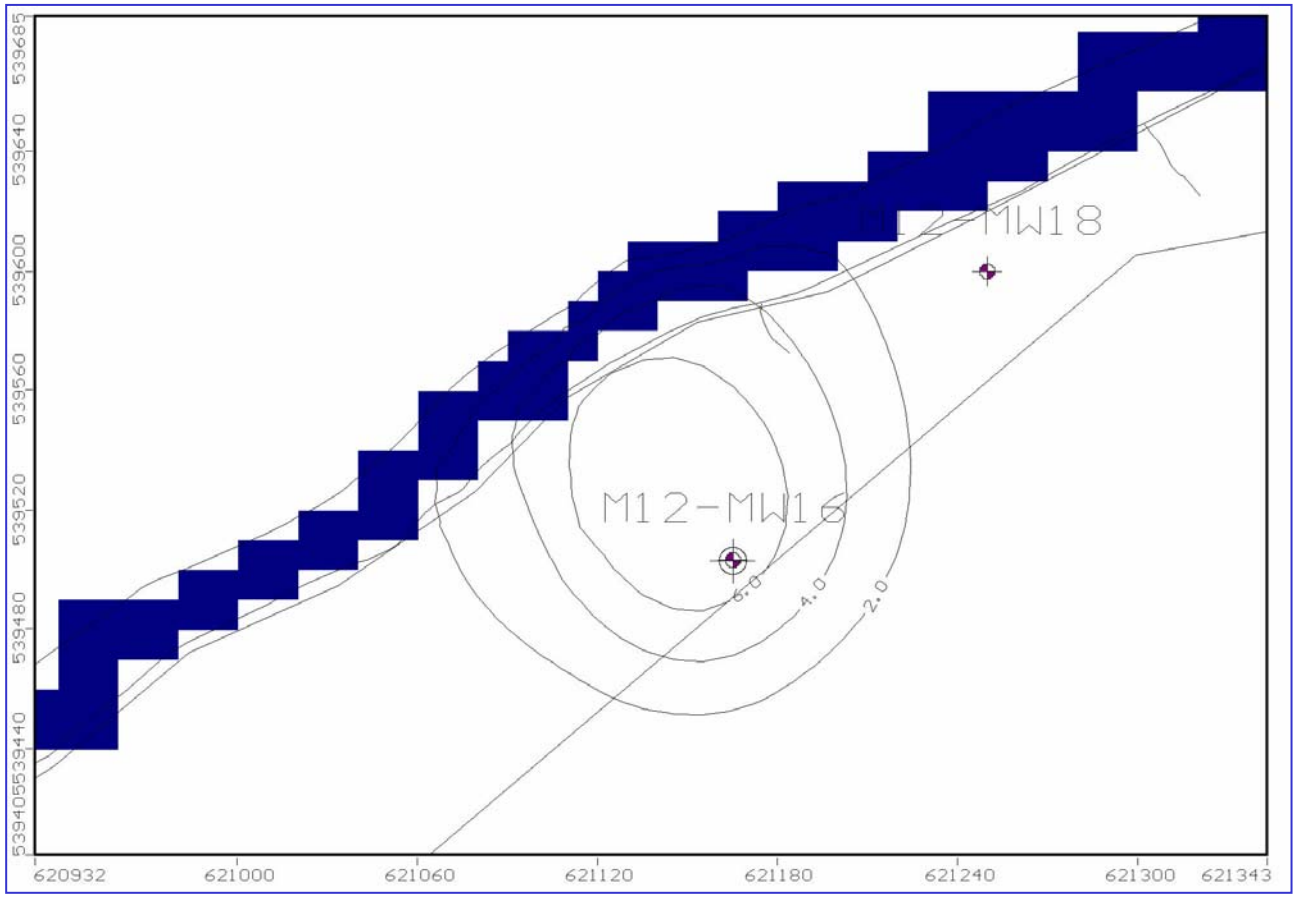
DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 3-1
Site Location Map
M-12 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955


N
GOSSELIN AVENUE
HUSKY BROOK
HUSKY BROOK
M12 LANDFILL BOUNDARIES
M12–MW16
M12–MW17
M12–MW18
M12–MW19
M12–MW20
M12–MW21
M12–MW22
M12–MW23
M12–MW24
M12–MW25
M12–MW26
S-550
551
T-908
S-906
T-921
S-909
910
952
911
912
975
978
332
333
334
335
237
239
241
243
245
247
249
250
251
252
253
254
255
256
258
LAMP
POST
FLAG
MH
HYD
CB.
ROAD (PAVED)
ROAD/TRAILS (UNPAVED)
FENCE
BUILDING
APPROXIMATE BOUNDARY
MONITORING WELL
WOODED AREA
TREE/BUSH
LIGHT POLE
UTILITY POLE
BROOK/CREEK
MARSHY AREA
REV.
REVISIONS
APPROVED
DRAWN BY
TITLE:
FIGURE 3–2
SITE MAP
M–12 LANDFILL SITE
FORT MONMOUTH, NEW JERSEY
DRAWN BY: JMM/TJK
DATE DRAWN: 12 JAN 01
CHECKED BY:
DATE CHECKED:
APPROVED BY:
DATE APPROVED:
Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957–0955
DRAWING No.: FIGURE 3–2
FILE No.: M12 FIG. 3–2
SCALE: 1" = 100'
SHEET OF
REV.: A



Notes:

1) Isoconcentration contours represent predicted arsenic concentrations at 99 years, in the vicinity of monitoring well M12-MW16.
2) Areas shaded blue represents the Husky Brook.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 3-3a

Predicted Arsenic Concentration
99 Years, Well M12-MW16
M-12 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

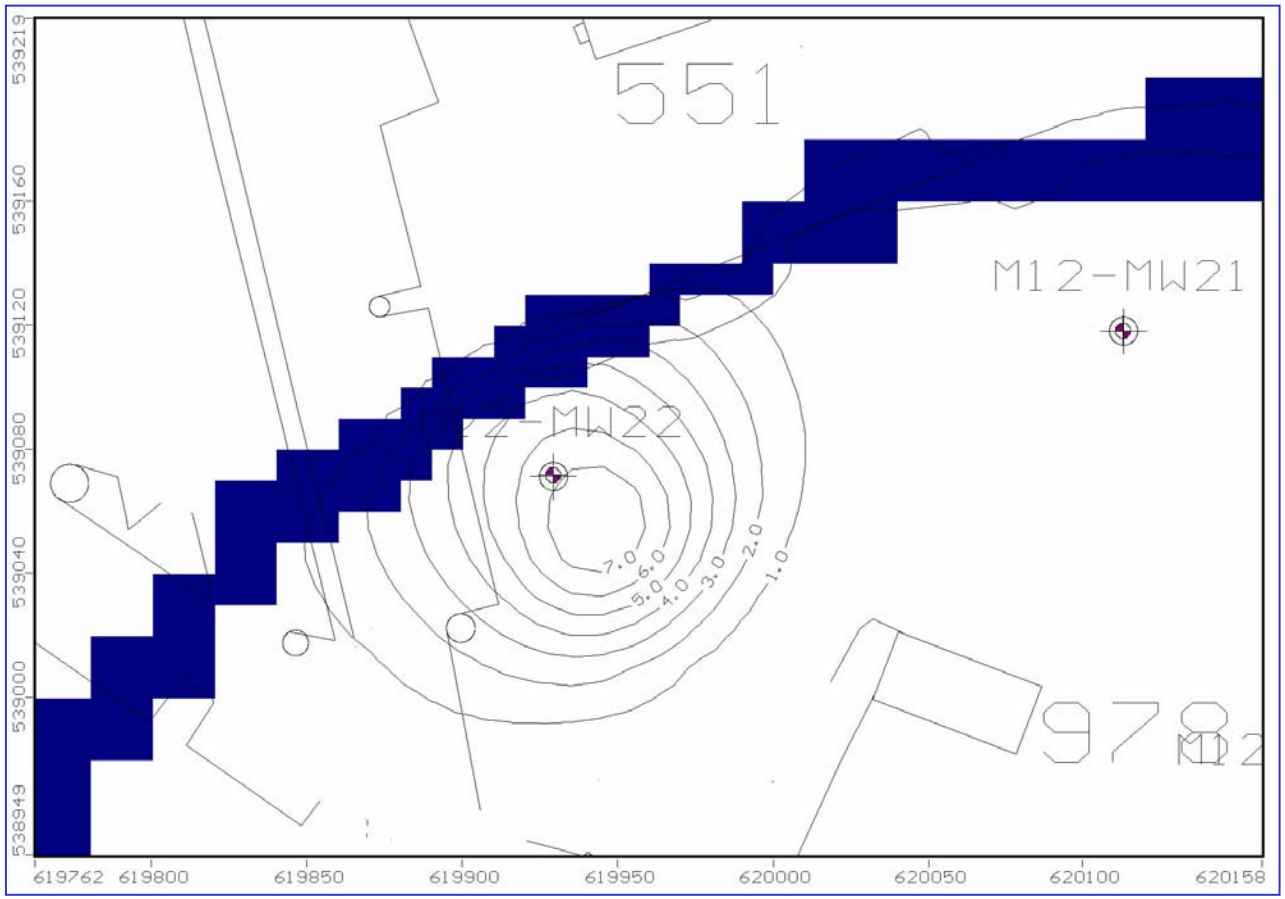
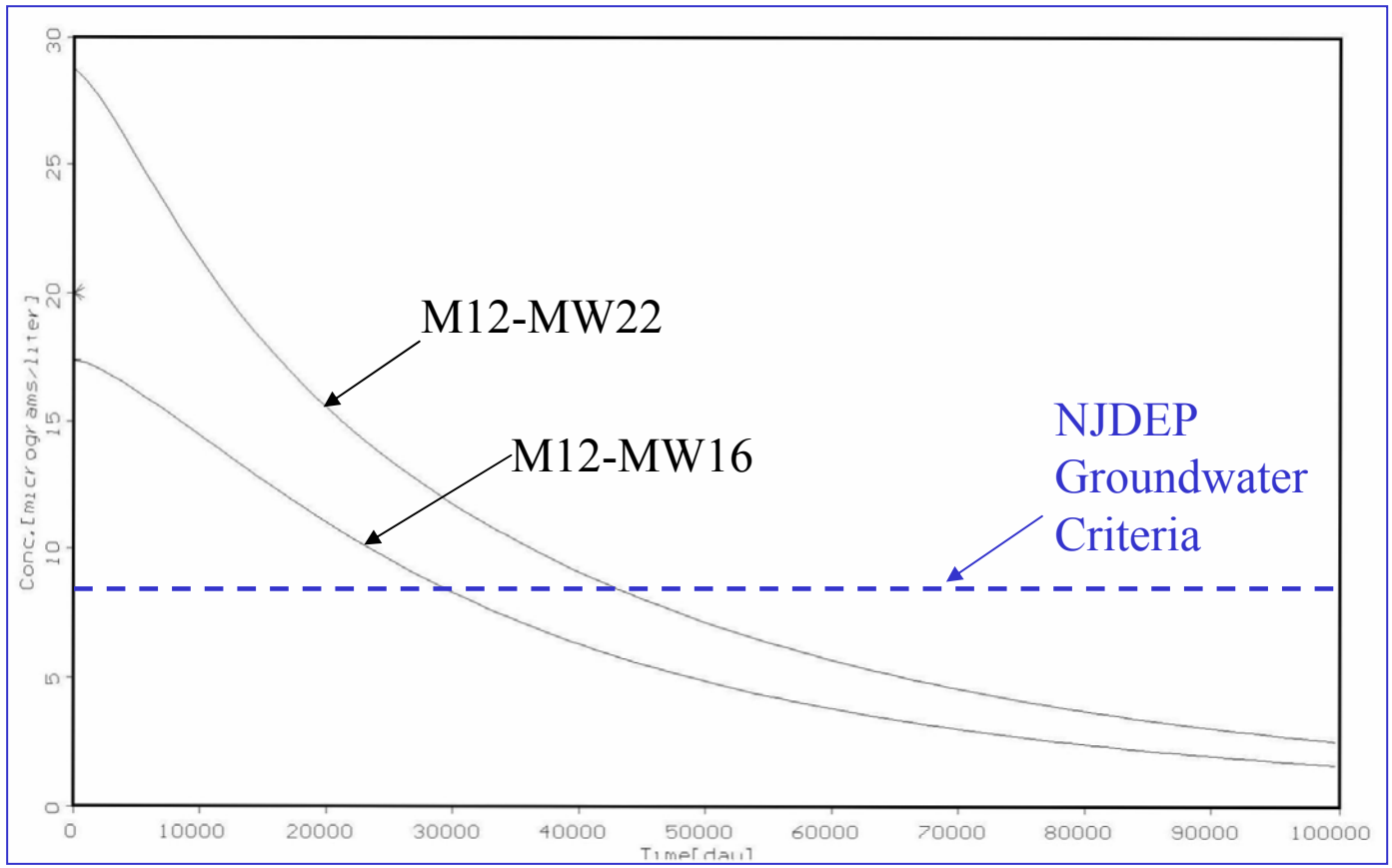


FIGURE 3-3b

Predicted Arsenic Concentration
150 Years, Well M12-MW22
M-12 Landfill Site
Fort Monmouth, New Jersey

Notes:
1) Isoconcentration contours represent predicted arsenic concentrations at 150 years, in the vicinity of monitoring well M12-MW22.
2) Areas shaded blue represents the Husky Brook.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



Notes:
1) NJDEP groundwater criteria for arsenic is 8.0 micrograms per liter (ug/L).
2) Time for compliance at well M12-MW16 is 99 years.
3) Time for compliance at well M12-MW22 is 150 years.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 3-3c

Predicted Arsenic Concentration Versus Time
M-12 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

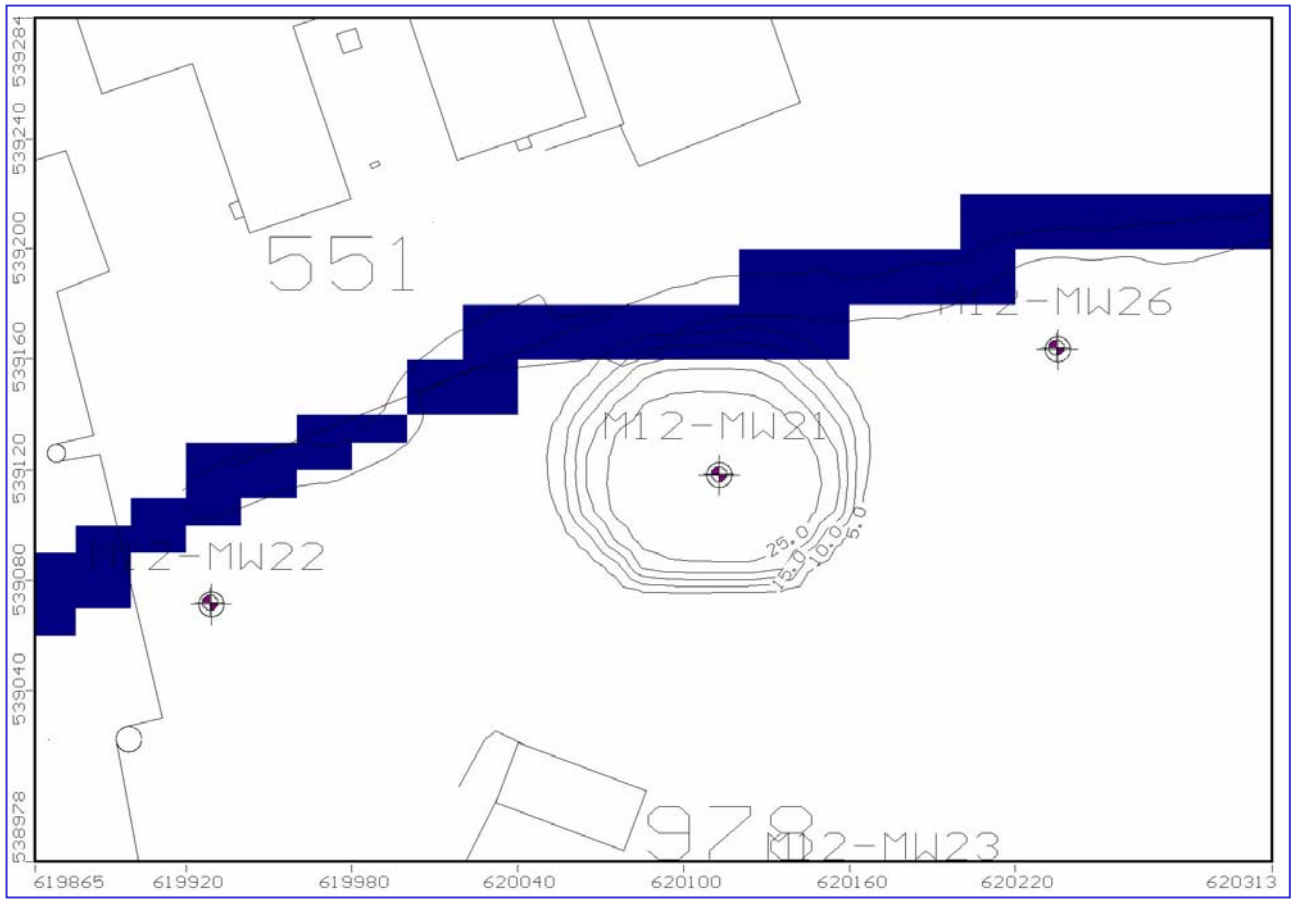
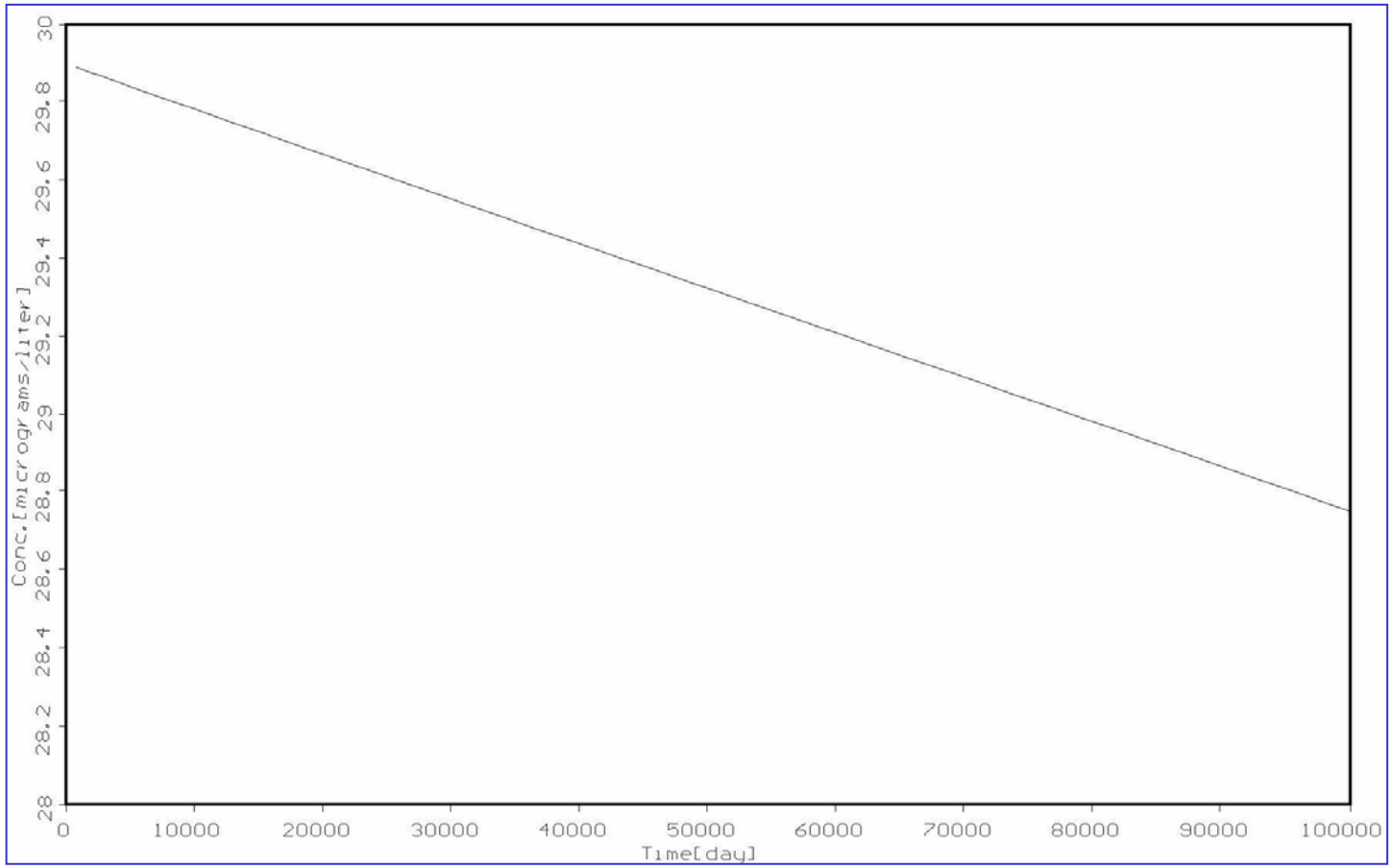


FIGURE 3-4a

Predicted Lead Concentration
274 Years, Well M12-MW21
M-12 Landfill Site
Fort Monmouth, New Jersey

Notes:
1) Isoconcentration contours represent predicted lead concentrations at 274 years, in the vicinity of monitoring well M12-MW21.
2) Areas shaded blue represents the Husky Brook.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

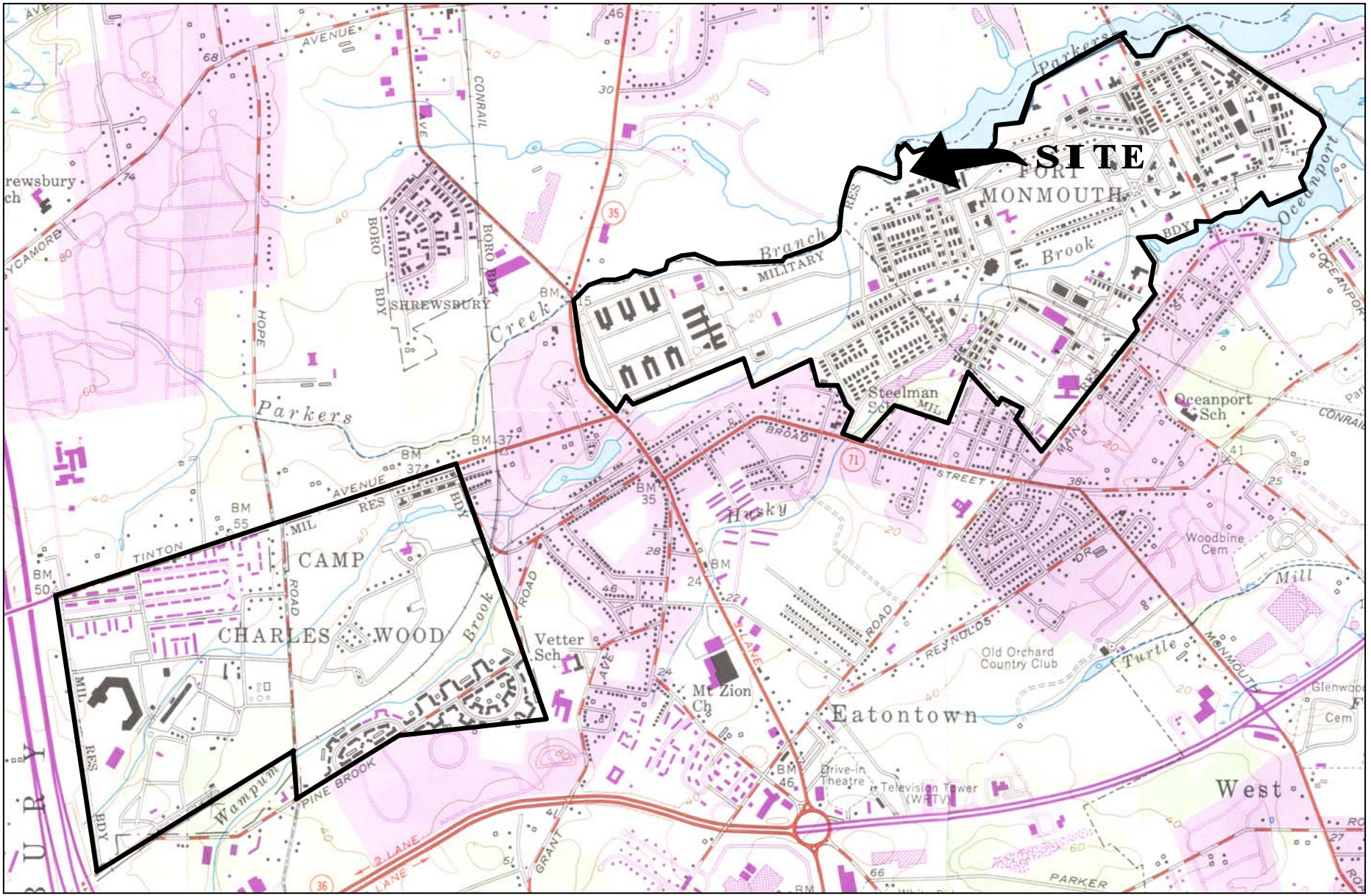


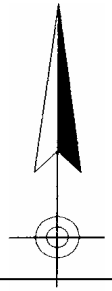
Notes:
1) NJDEP groundwater criteria for lead is 10 micrograms per liter (ug/L).
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 3-4b

Predicted Lead Concentration Versus Time
M-12 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955





QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

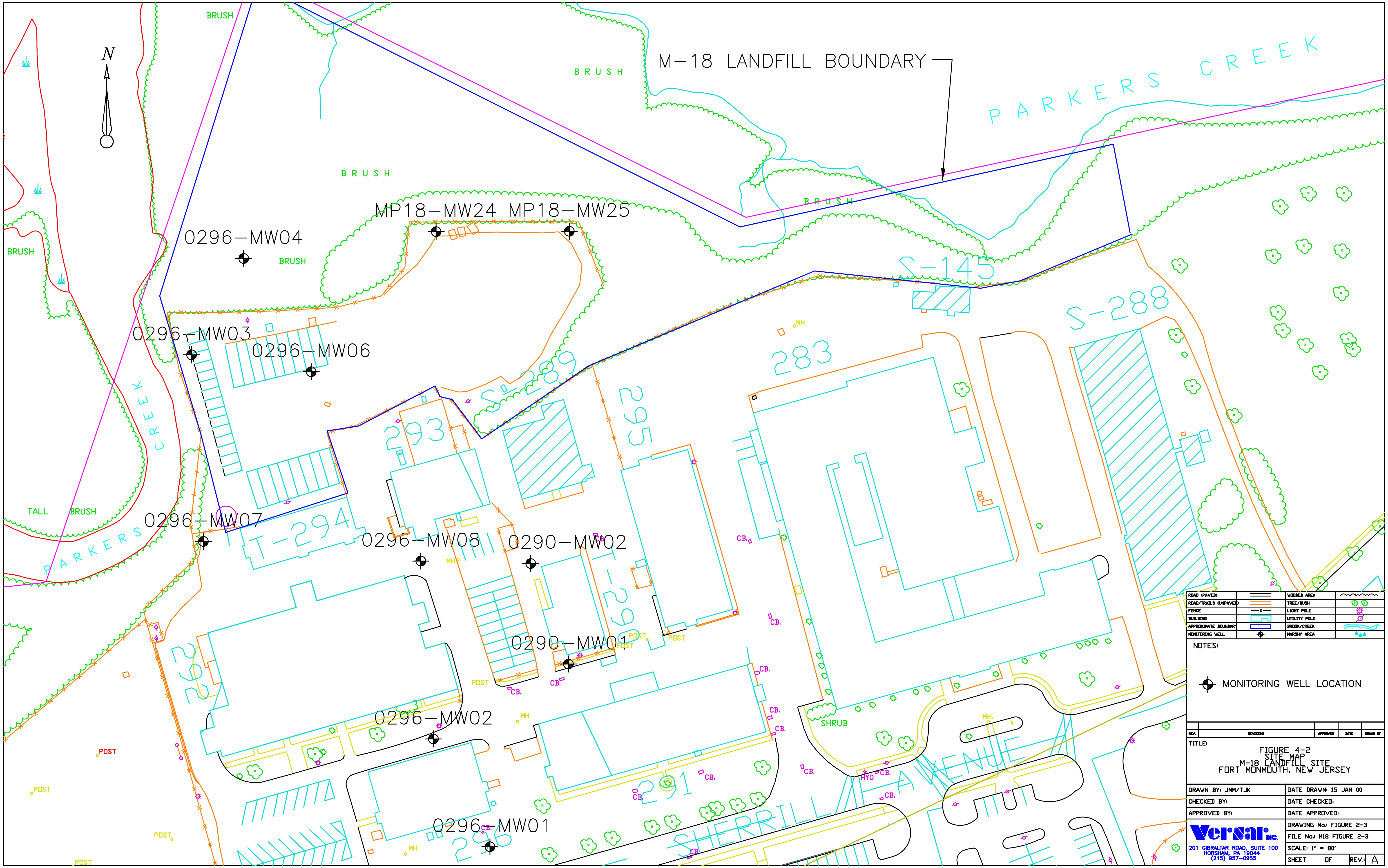
PHOTOREVISED 1981

DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

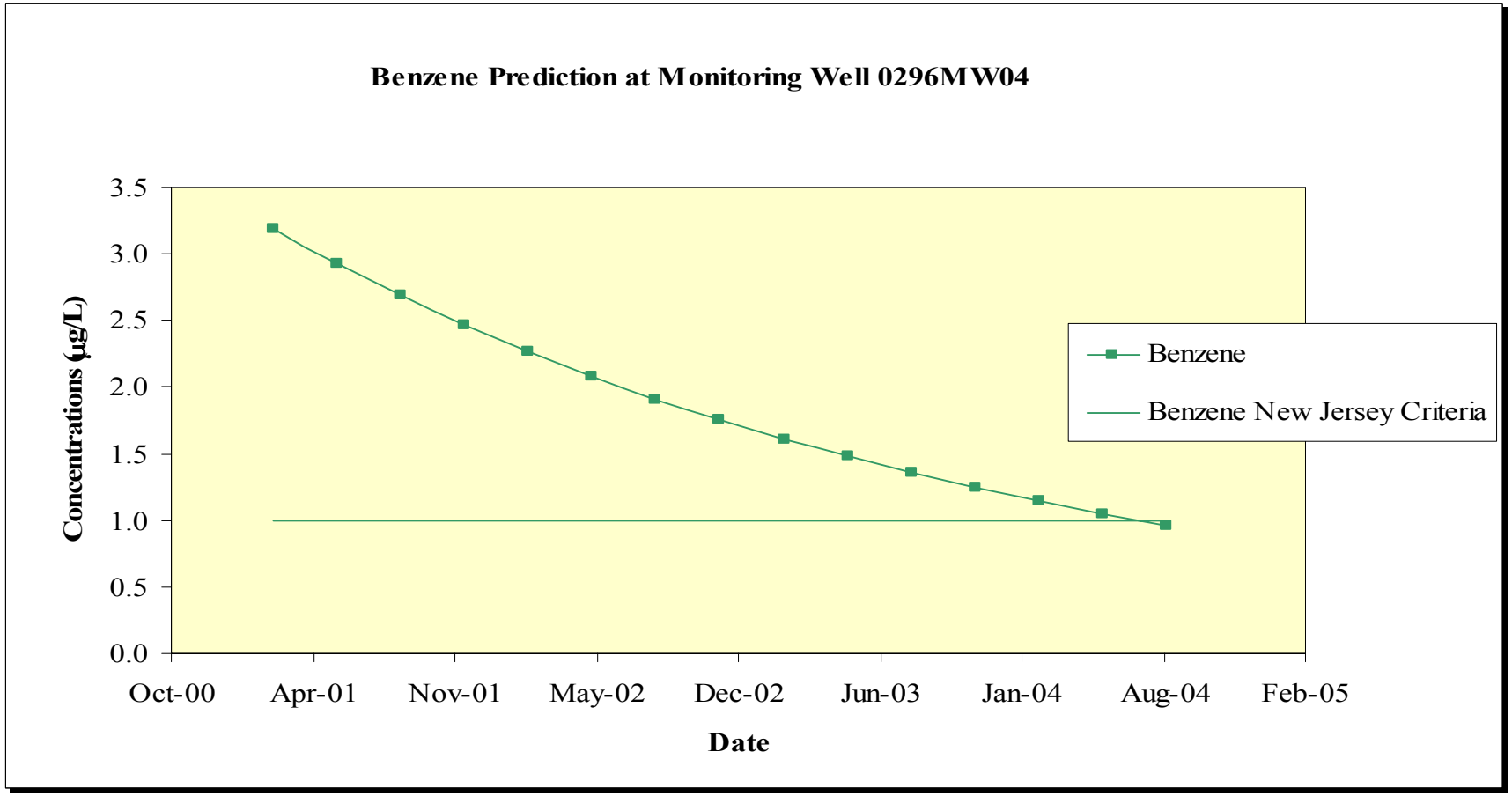
Figure 4-1
Site Location Map
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955


N
M-18 LANDFILL BOUNDARY
PARKERS CREEK
BRUSH
TALL BRUSH
SHRUB
S-145
S-288
S-289
283
293
295
T-294
291
292
SHERRILL AVENUE
MP18-MW24
MP18-MW25
0296-MW04
0296-MW03
0296-MW06
0296-MW07
0296-MW08
0290-MW02
0290-MW01
0296-MW02
0296-MW01
POST
MH
CB.
HYD
ROAD (PAVED)
ROAD/TRAILS (UNPAVED)
FENCE
BUILDING
APPROXIMATE BOUNDARY
MONITORING WELL
WOODED AREA
TREE/BUSH
LIGHT POLE
UTILITY POLE
BROOK/CREEK
MARSHY AREA
NOTES:
MONITORING WELL LOCATION
REV.
REVISIONS
APPROVED
DATE
DRAWN BY
Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955

TITLE: FIGURE 4-2
SITE MAP
M-18 LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: JMM/TJK
DATE DRAWN: 15 JAN 00
CHECKED BY:
DATE CHECKED:
APPROVED BY:
DATE APPROVED:
DRAWING No.: FIGURE 2-3
FILE No.: M18 FIGURE 2-3
SCALE: 1" = 80'
SHEET OF
REV.: A

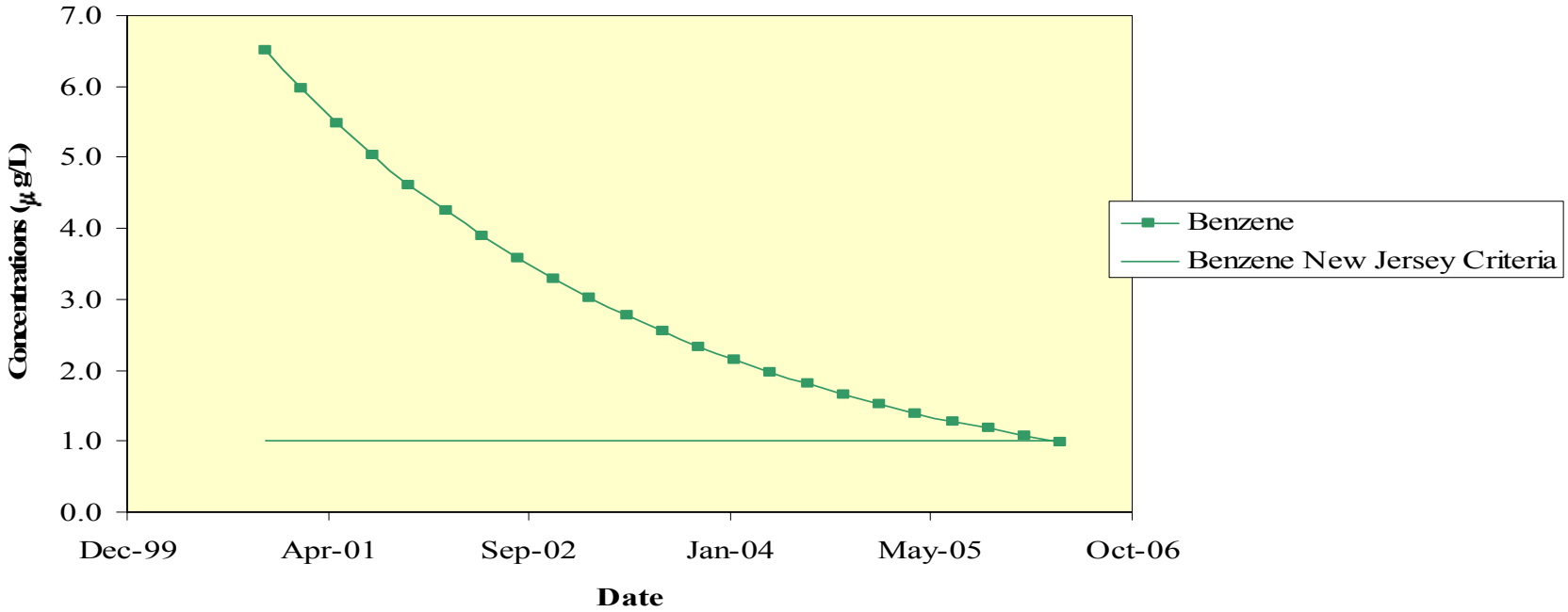


Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Initial benzene concentration at well 0296-MW04 was considered to be 3.19 ug/L on February 22, 2001.
3) Estimated time for NJDEP compliance is 3.5 years.

FIGURE 4-3a

Benzene Prediction
Well 0296-MW04
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Initial benzene concentration at well 0296-MW06 was considered to be 6.5 ug/L on November 13, 2000.
3) Estimated time for NJDEP compliance is 5.4 years.

FIGURE 4-3b

Benzene Prediction
Well 0296-MW06
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

N

M-18 LANDFILL BOUNDARY

PARKERS CREEK

MP18-MW24 MP18-MW25

0296-MW04

0296-MW03

0296-MW06

S-145

S-288

S-289

283

293

295

T-294

0296-MW07

0296-MW08

0290-MW02

0290-MW01

292

292

0296-MW02

291

296

0296-MW01

SHERRILL AVENUE

PARKERS CREEK

0 40 80 160

SCALE IN FEET

NOTES:

- M-18 LANDFILL
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- MONITORING WELL
- AREAL EXTENT OF BENZENE MIGRATION

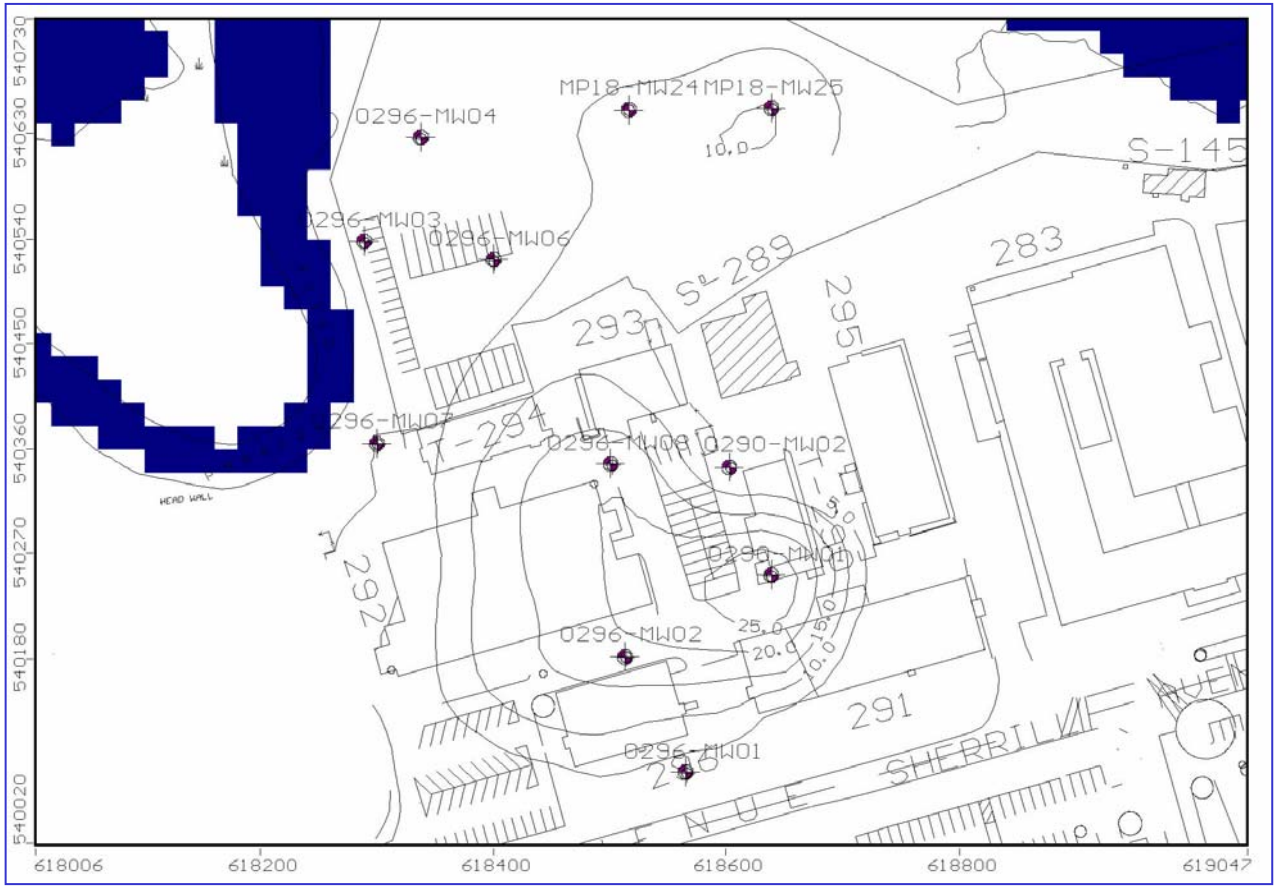
REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 4-4
PREDICTED AREA IMPACTED BY BENZENE
M-18 LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 15 JAN 00
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: M18 CEA
	FILE No.: M18 CEA FIGURE 4-4
	SCALE: 1" = 80'
	SHEET 1 OF 1 REV.: A

Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955

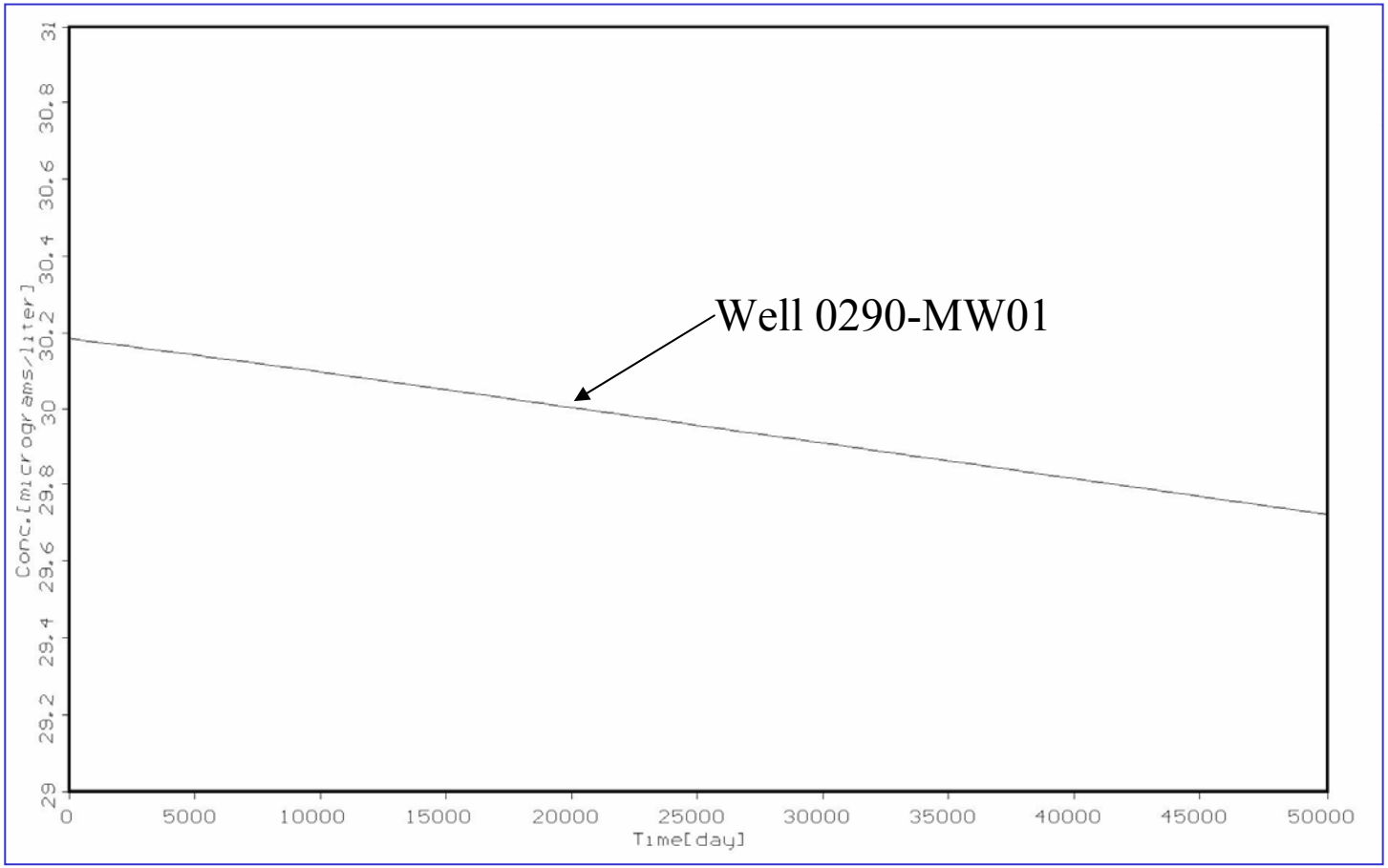


Notes:
1) Isoconcentration contours represent predicted arsenic concentrations at 137 years.
2) Areas shaded blue represents Parkers Creek.
3) Monitoring wells are shown in purple.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-5a

Predicted Arsenic Concentration
137 Years
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

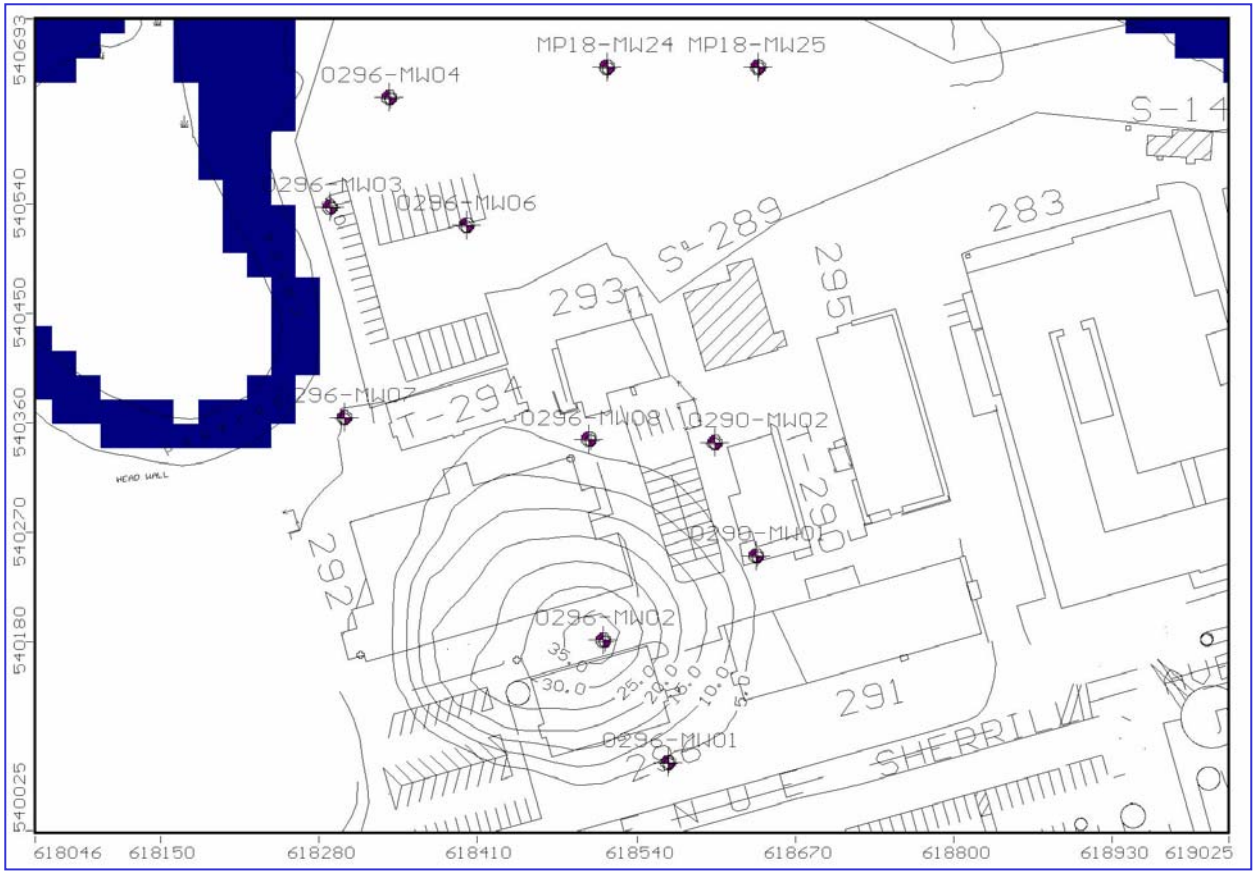


Notes:
1) NJDEP groundwater criteria for arsenic is 8.0 micrograms per liter (ug/L).
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-5b

Predicted Arsenic Concentration Versus Time
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

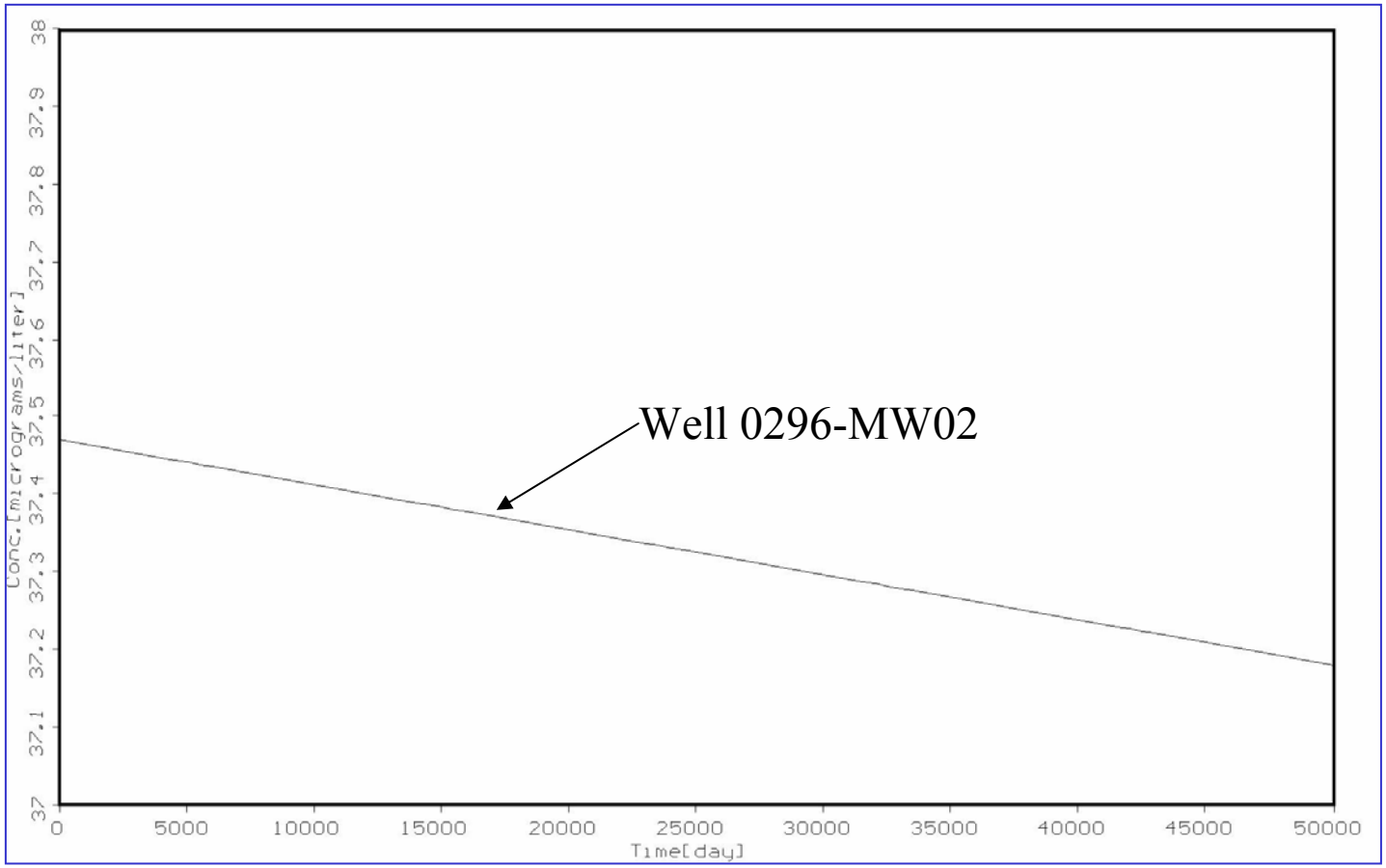


Notes:
1) Isoconcentration contours represent predicted cadmium concentrations at 137 years.
2) Areas shaded blue represents Parkers Creek.
3) Monitoring wells are shown in purple.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-6a

Predicted Cadmium Concentration
137 Years
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

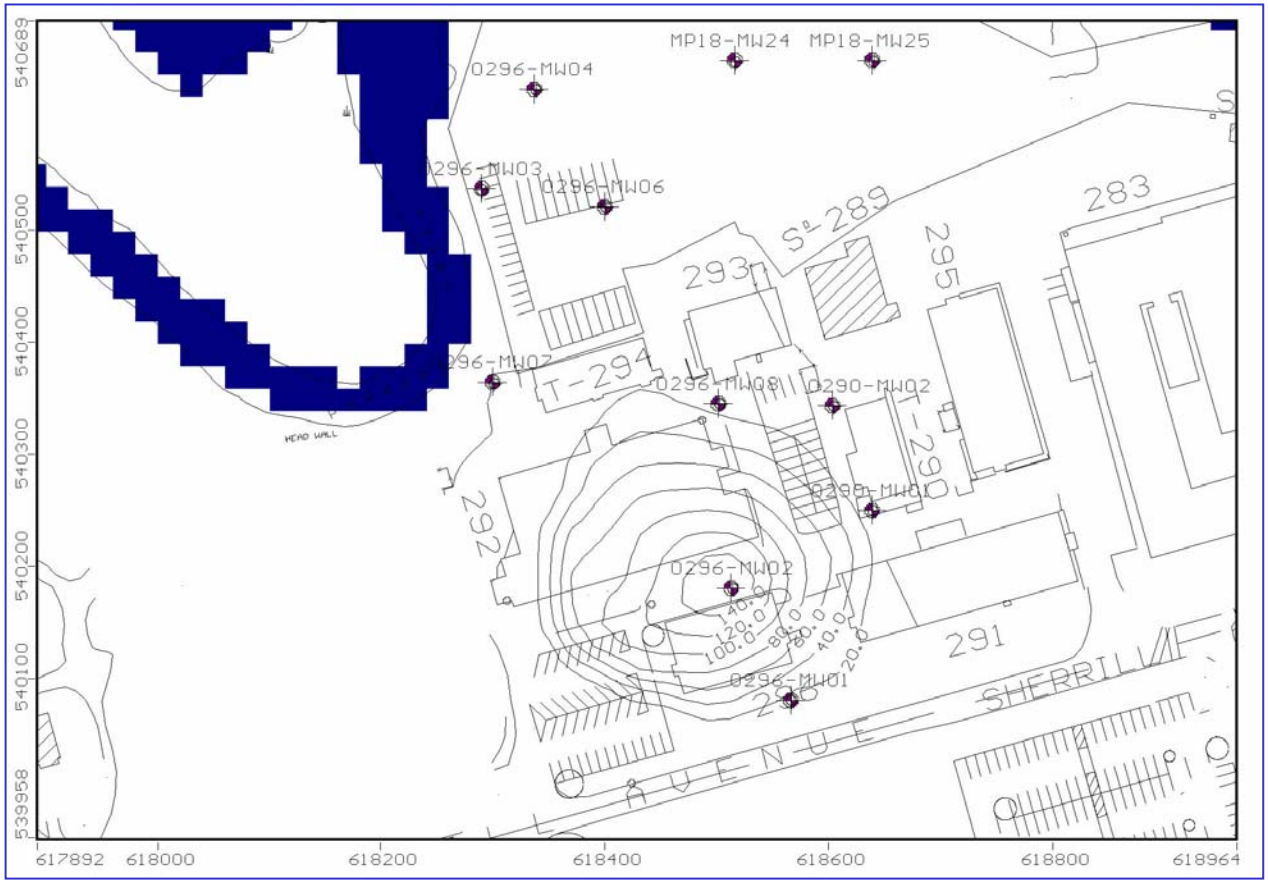


Notes:
1) NJDEP groundwater criteria for cadmium is 4.0 micrograms per liter (ug/L).
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-6b

Predicted Cadmium Concentration Versus Time
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

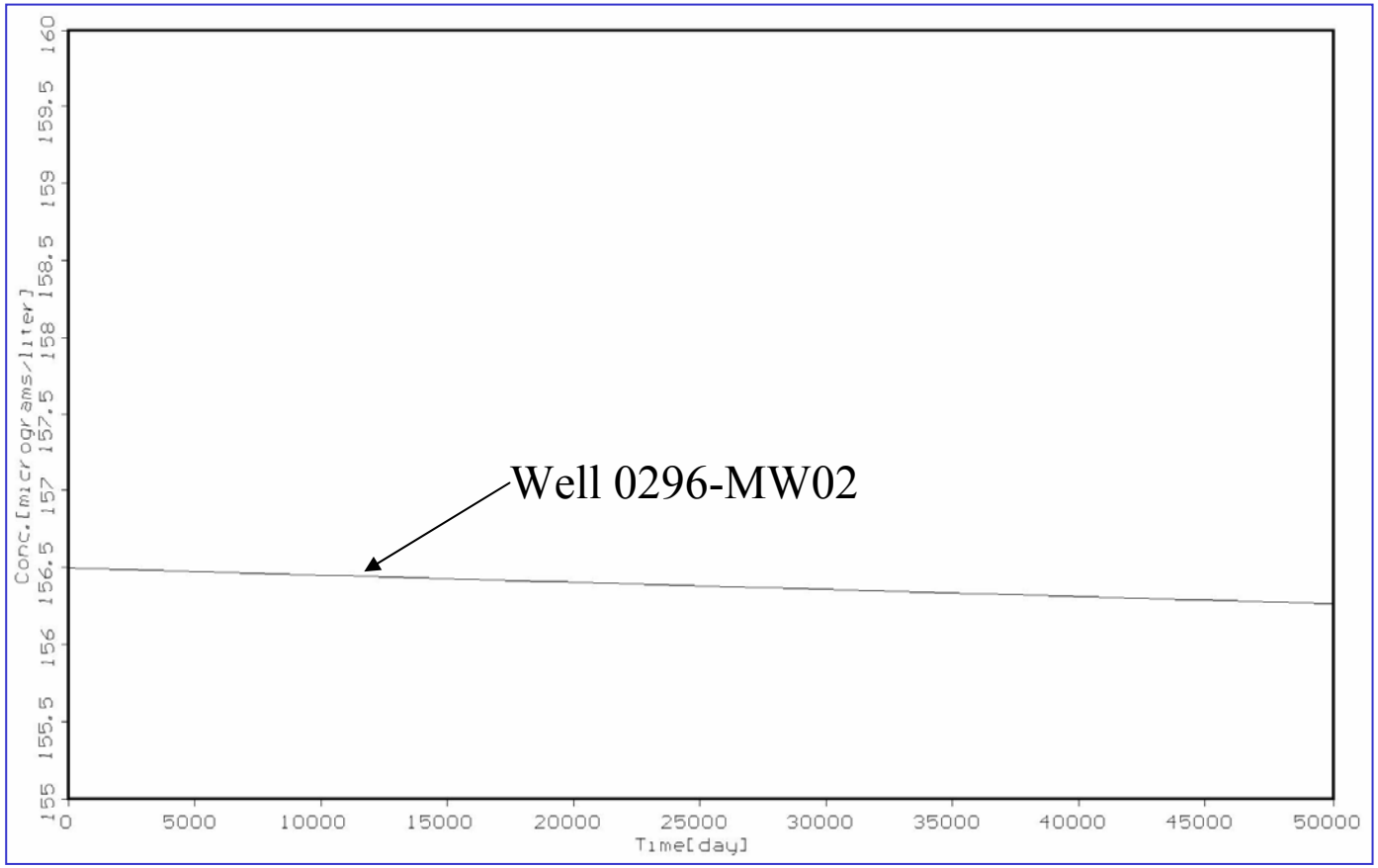


Notes:
1) Isoconcentration contours represent predicted chromium concentrations at 137 years.
2) Areas shaded blue represents Parkers Creek.
3) Monitoring wells are shown in purple.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-7a

Predicted Chromium Concentration
137 Years
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

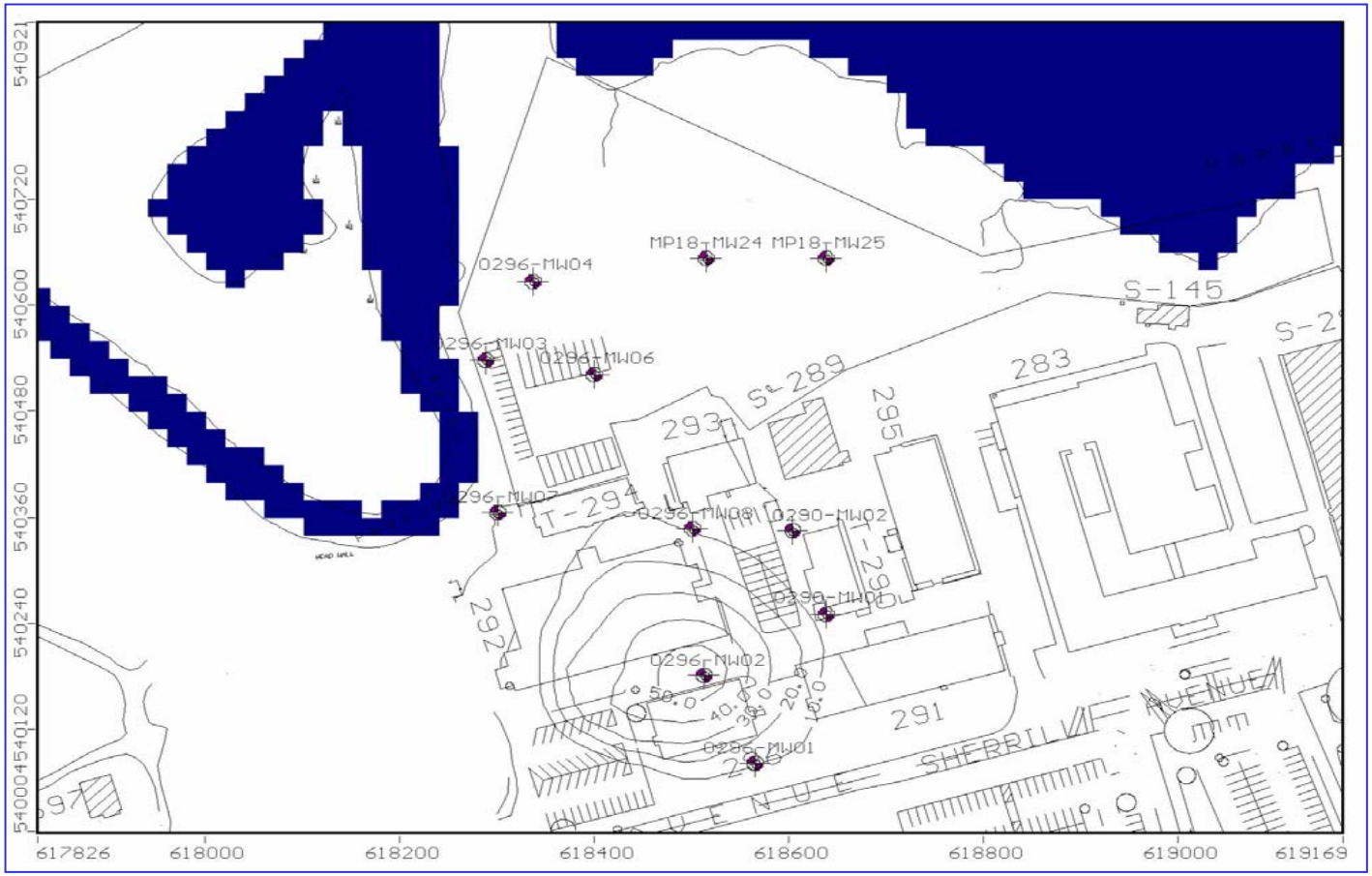


Notes:
1) NJDEP groundwater criteria for chromium is 100 micrograms per liter (ug/L).
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-7b

Predicted Chromium Concentration Versus Time
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

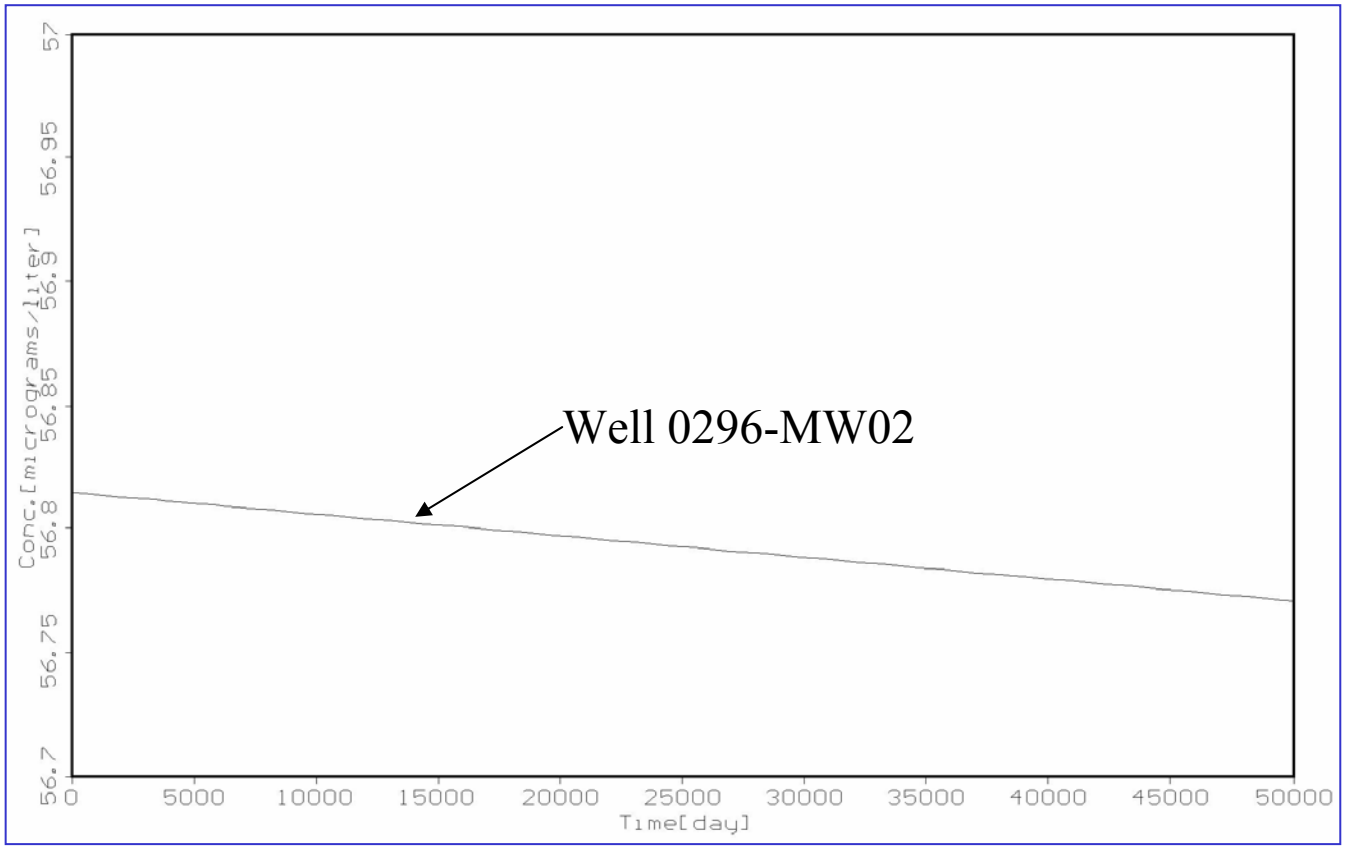


Notes:
1) Isoconcentration contours represent predicted lead concentrations at 137 years.
2) Areas shaded blue represents Parkers Creek.
3) Monitoring wells are shown in purple.
3) Coordinates shown represent NAD-83 survey feet.
4) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-8a

Predicted Lead Concentration
137 Years
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

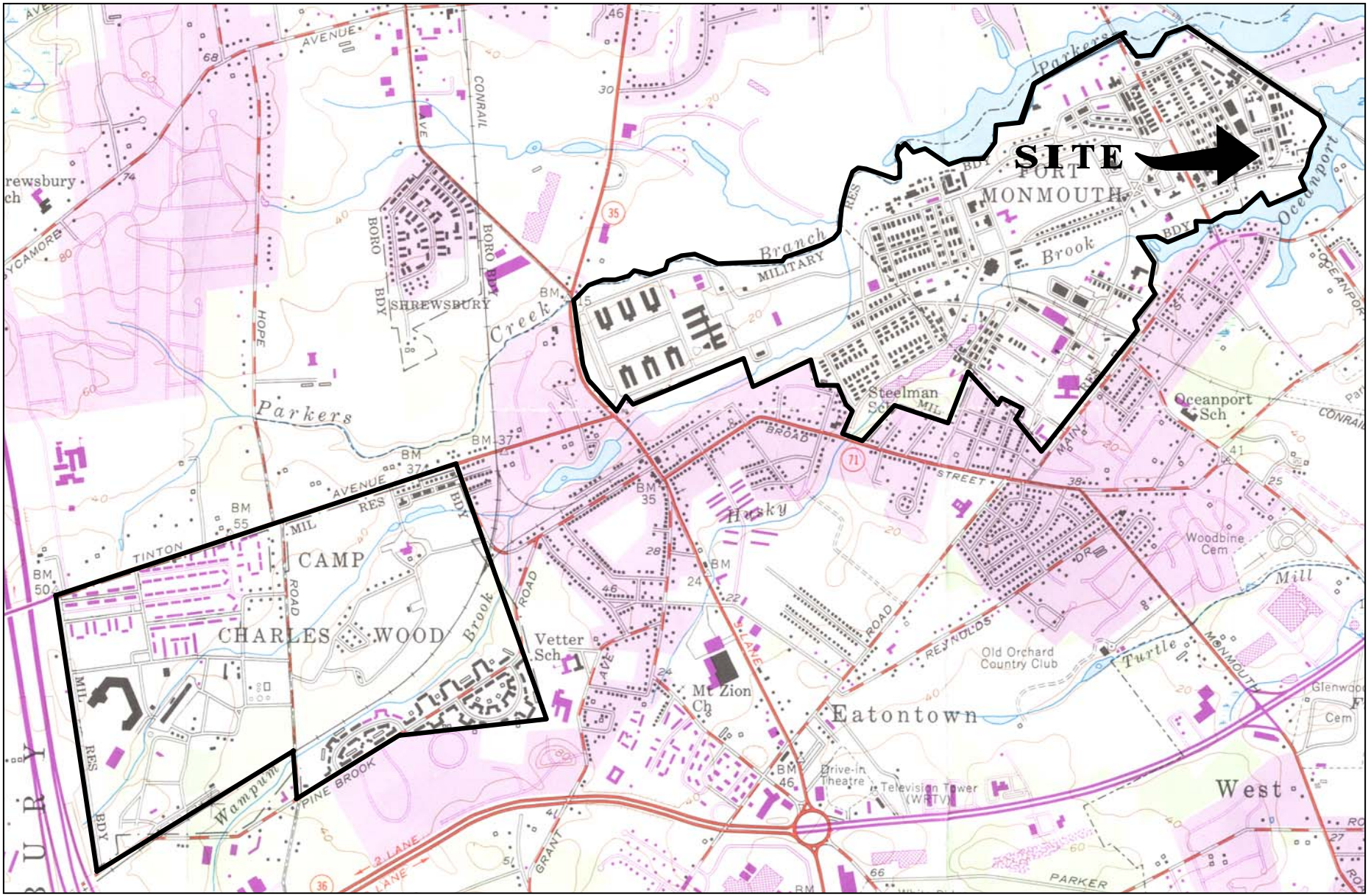


Notes:
1) NJDEP groundwater criteria for lead is 10 micrograms per liter (ug/L).
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: Visual MODFLOW Version 2.7.2, Waterloo Hydrogeologic, Inc.

FIGURE 4-8b

Predicted Lead Concentration Versus Time
M-18 Landfill Site
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



NEW JERSEY

QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

PHOTOREVISED 1981

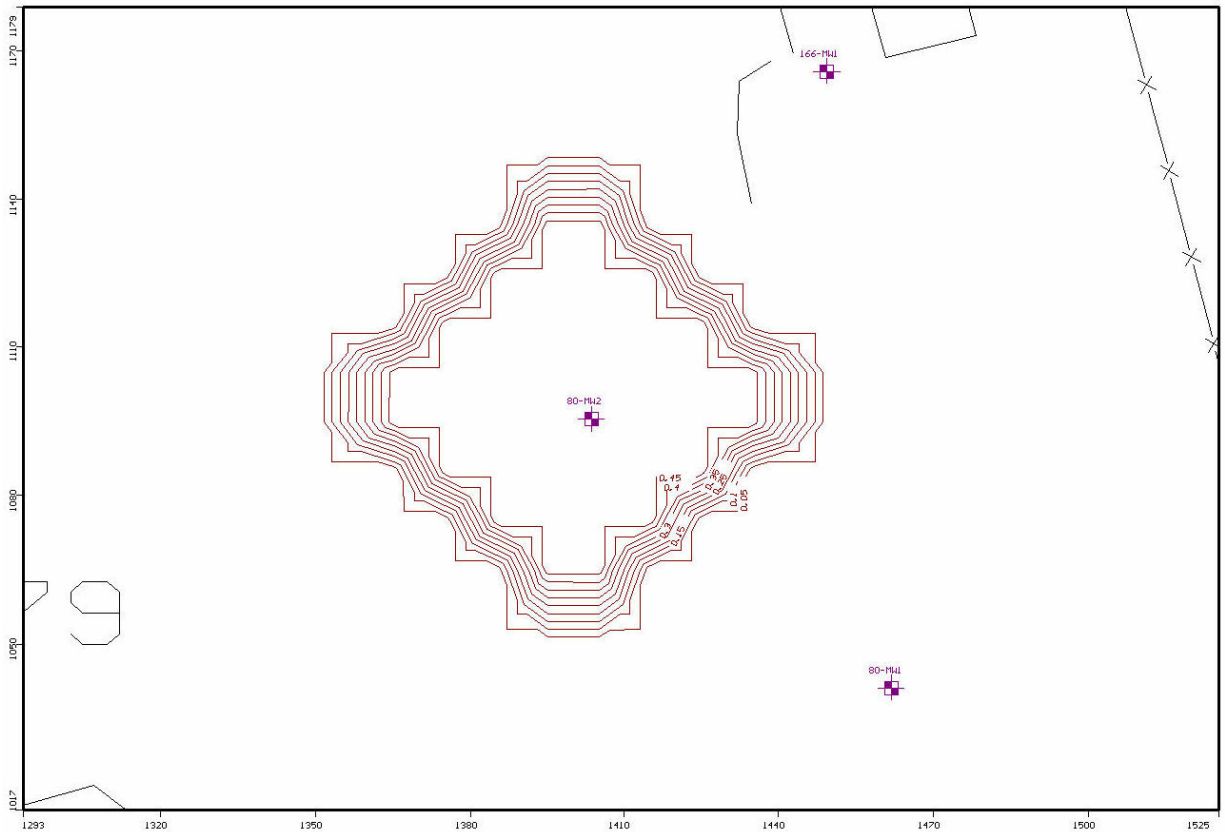
DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 5-1
Site Location Map
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

Vet-Sall INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955



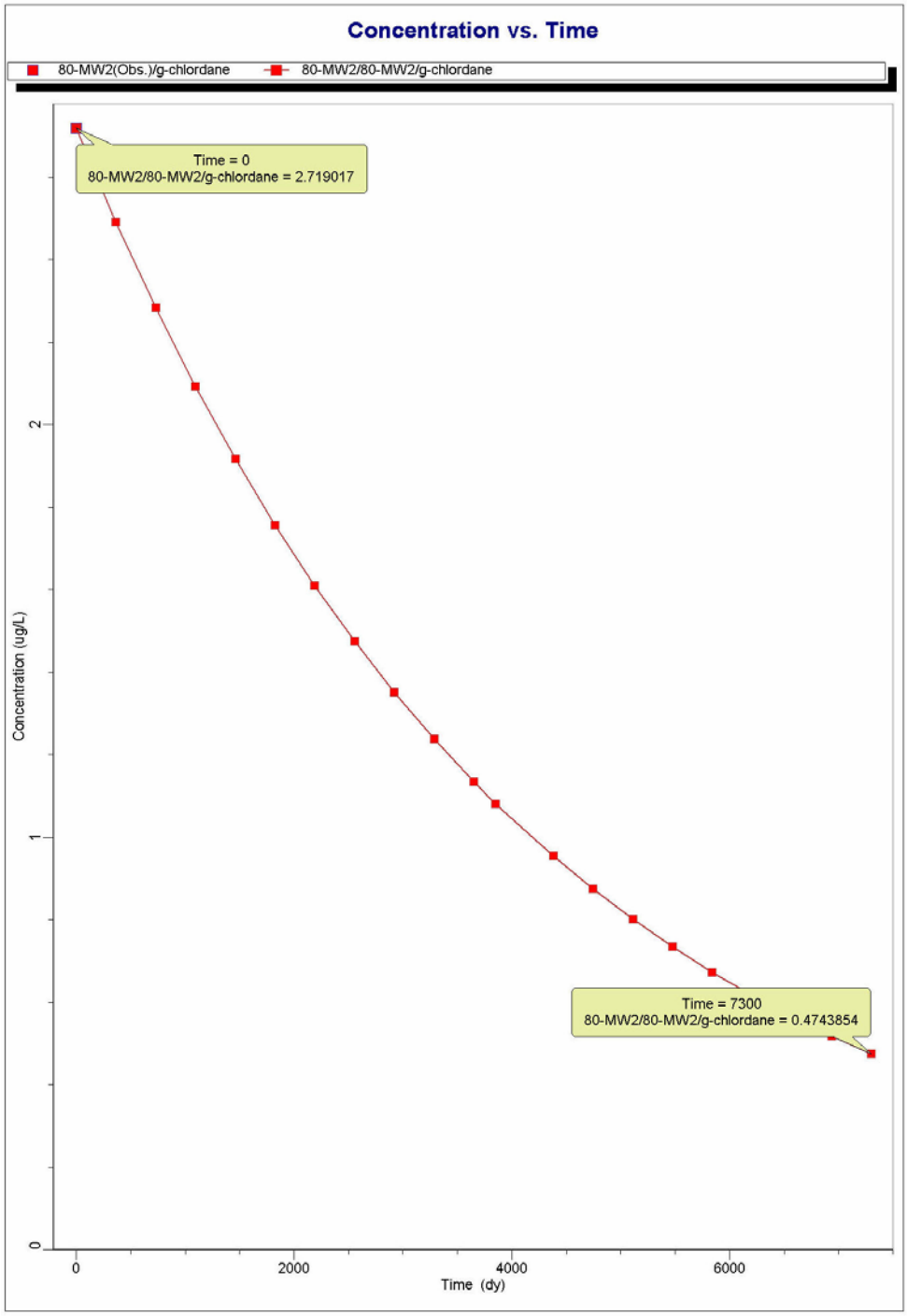
Notes:

1) Isoconcentration contours represent predicted g-chlordane concentrations at 20 years.
   Contour Interval = 0.05 ug/L
2) The NJDEP groundwater quality criteria for g-chlordane is 0.5 ug/L.
3) Monitoring wells for Site 80/166 are shown in purple.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000

FIGURE 5-3a

Predicted g-Chlordane Concentration
20 Years
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

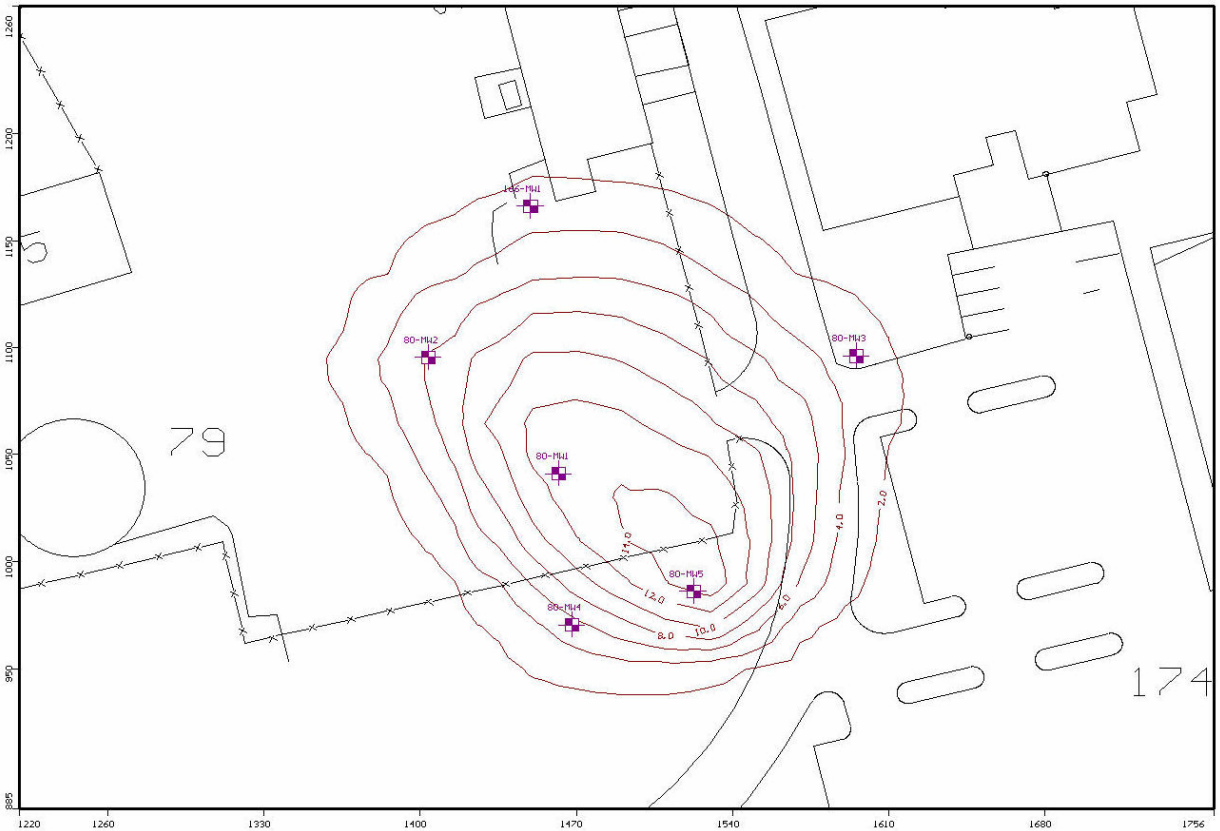


Notes:
1) NJDEP groundwater criteria for g-chlordane is 0.5 ug/L.
2) Time for compliance is estimated from this graph to be approximately 20 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 5-3b

Predicted g-Chlordane Concentration Versus Time
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



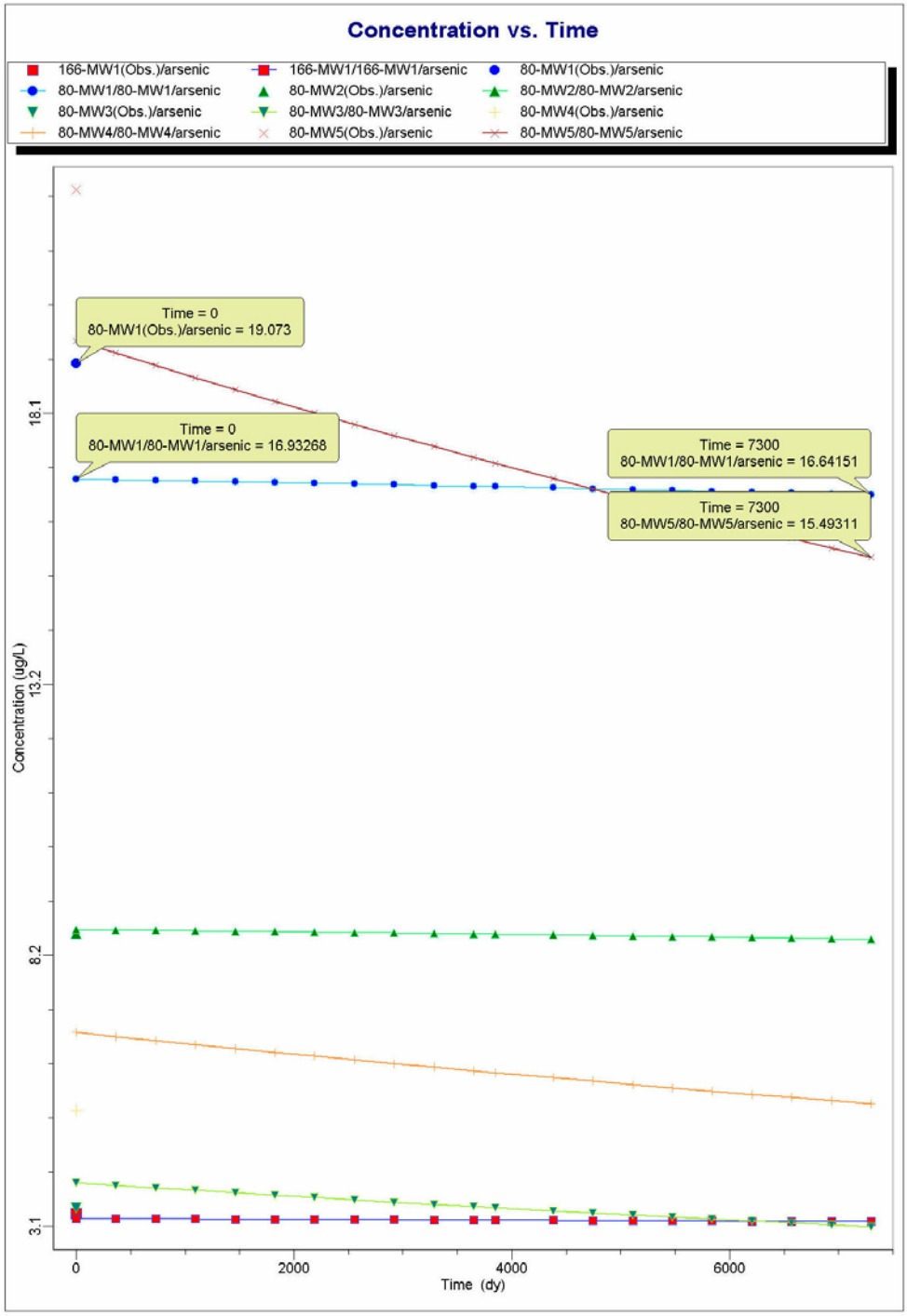
Notes:

1) Isoconcentration contours represent predicted arsenic concentrations at 20 years. Contour Interval = 2.0 ug/L.
2) The NJDEP groundwater quality criteria for arsenic is 8.0 ug/L.
3) Monitoring wells for Site 80/166 are shown in purple.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000

FIGURE 5-4a

Predicted Arsenic Concentration
20 Years
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

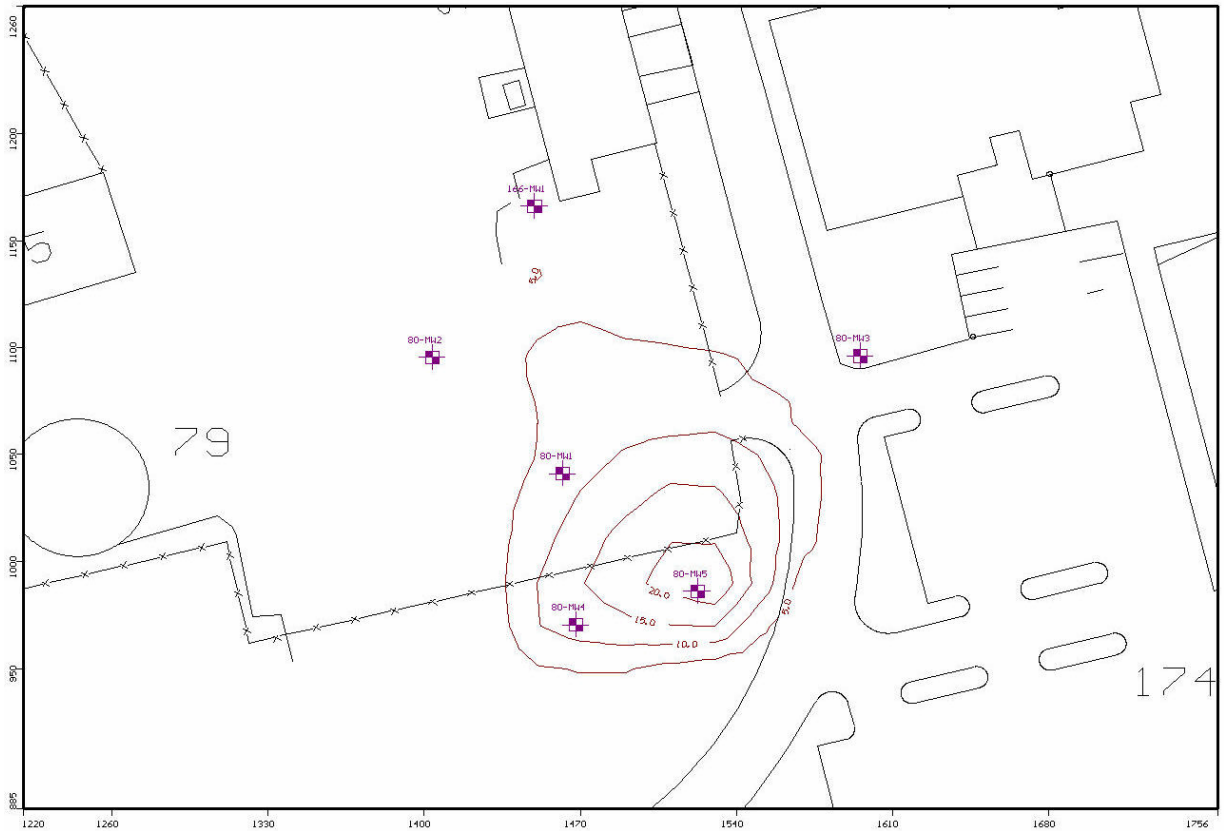


Notes:
1) NJDEP groundwater criteria for arsenic is 8.0 ug/L.
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 5-4b

Predicted Arsenic Concentration Versus Time
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



Notes:

1) Isoconcentration contours represent predicted lead concentrations at 20 years. Contour Interval = 5.0 ug/L.
2) The NJDEP groundwater quality criteria for arsenic is 10 ug/L.
3) Monitoring wells for Site 80/166 are shown in purple.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000

FIGURE 5-5a

Predicted Lead Concentration
20 Years
Site 80/166
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

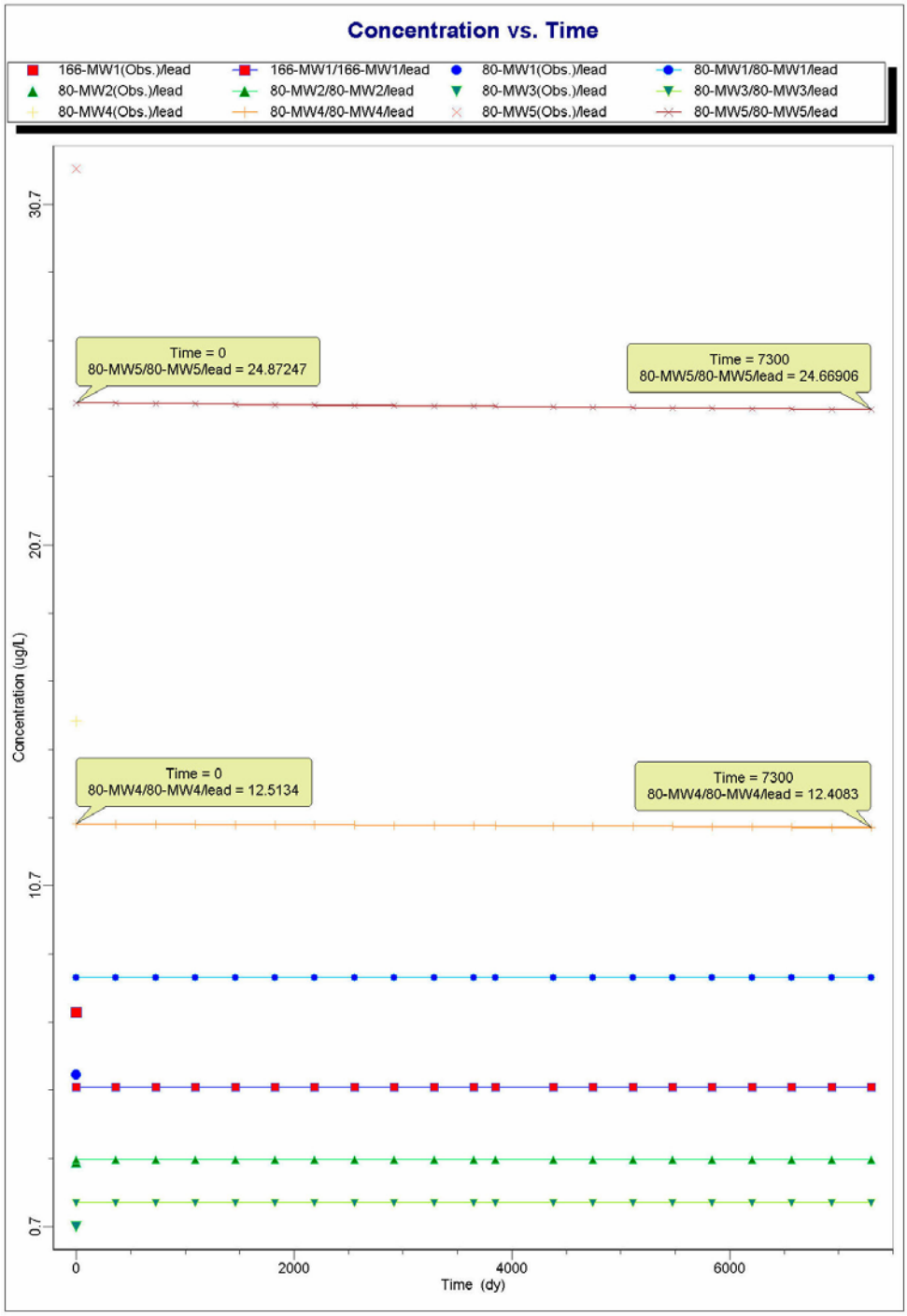
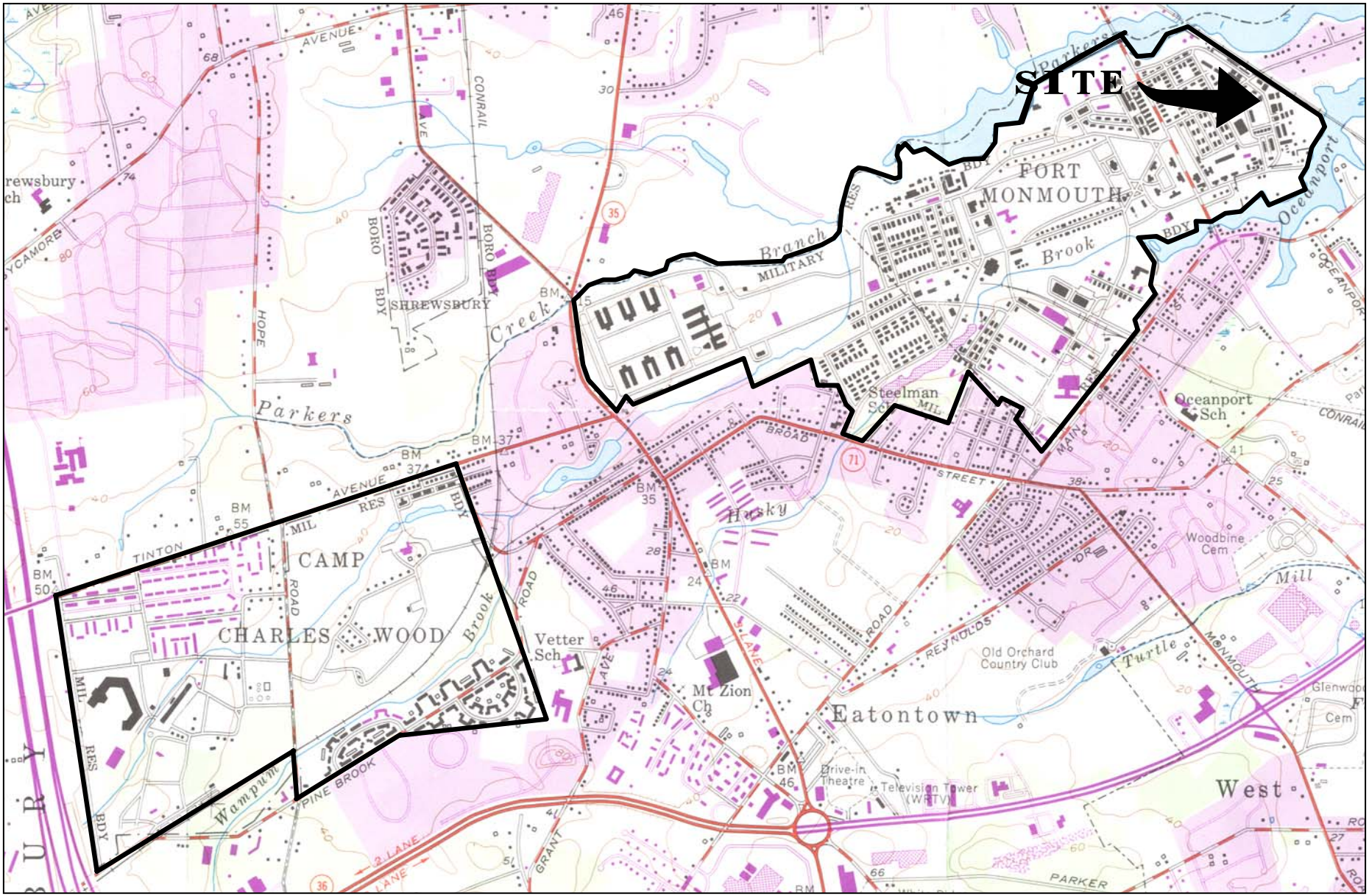


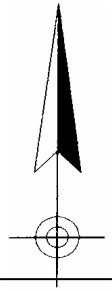
FIGURE 5-5b

Predicted Lead Concentration Versus Time Site 80/166 Fort Monmouth, New Jersey

Notes:
1) NJDEP groundwater criteria for lead is 10 ug/L.
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955





QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

PHOTOREVISED 1981

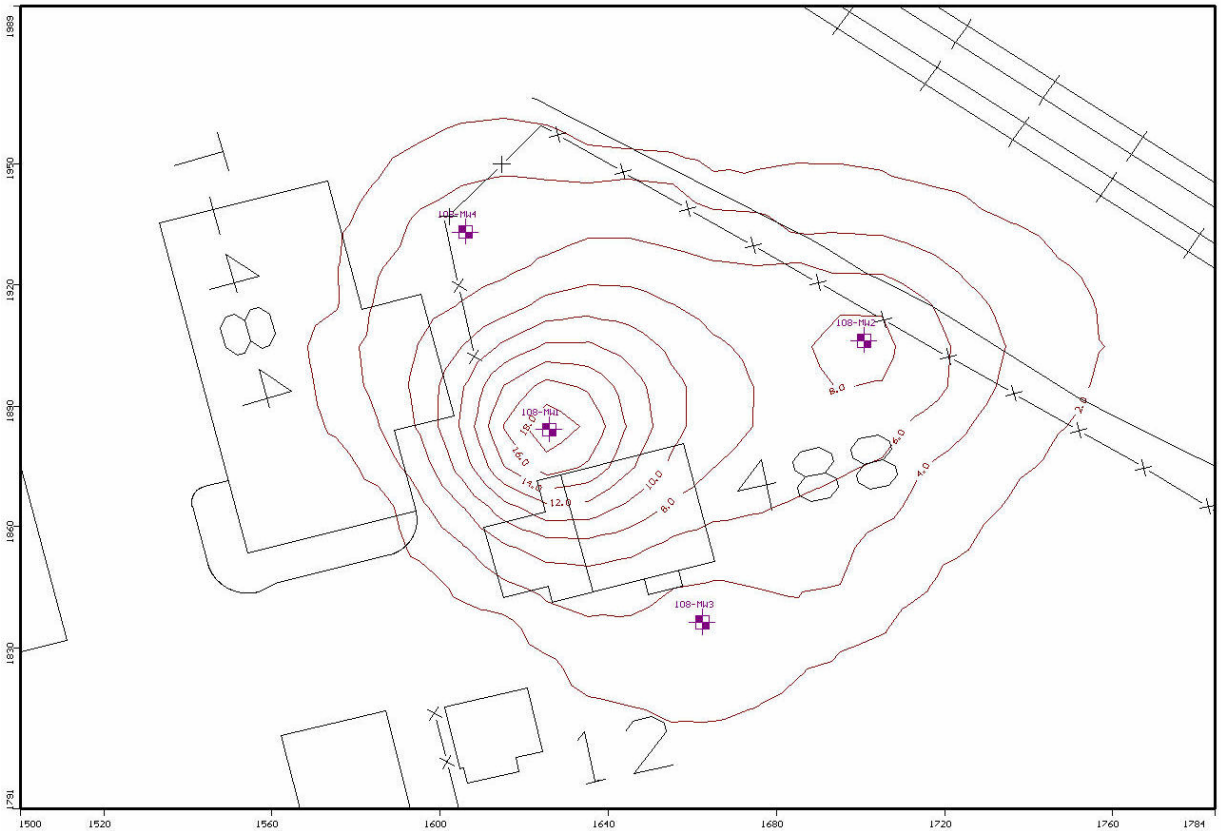
DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 6-1
Site Location Map
Site 108
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

Versar Inc.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955



Notes:

1) Isoconcentration contours represent predicted arsenic concentrations at 10 years. Contour Interval = 2.0 ug/L.
2) The NJDEP groundwater quality criteria for arsenic is 8.0 ug/L.
3) Monitoring wells for Site 108 are shown in purple.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000

FIGURE 6-3a

Predicted Arsenic Concentration
10 Years
Site 108
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

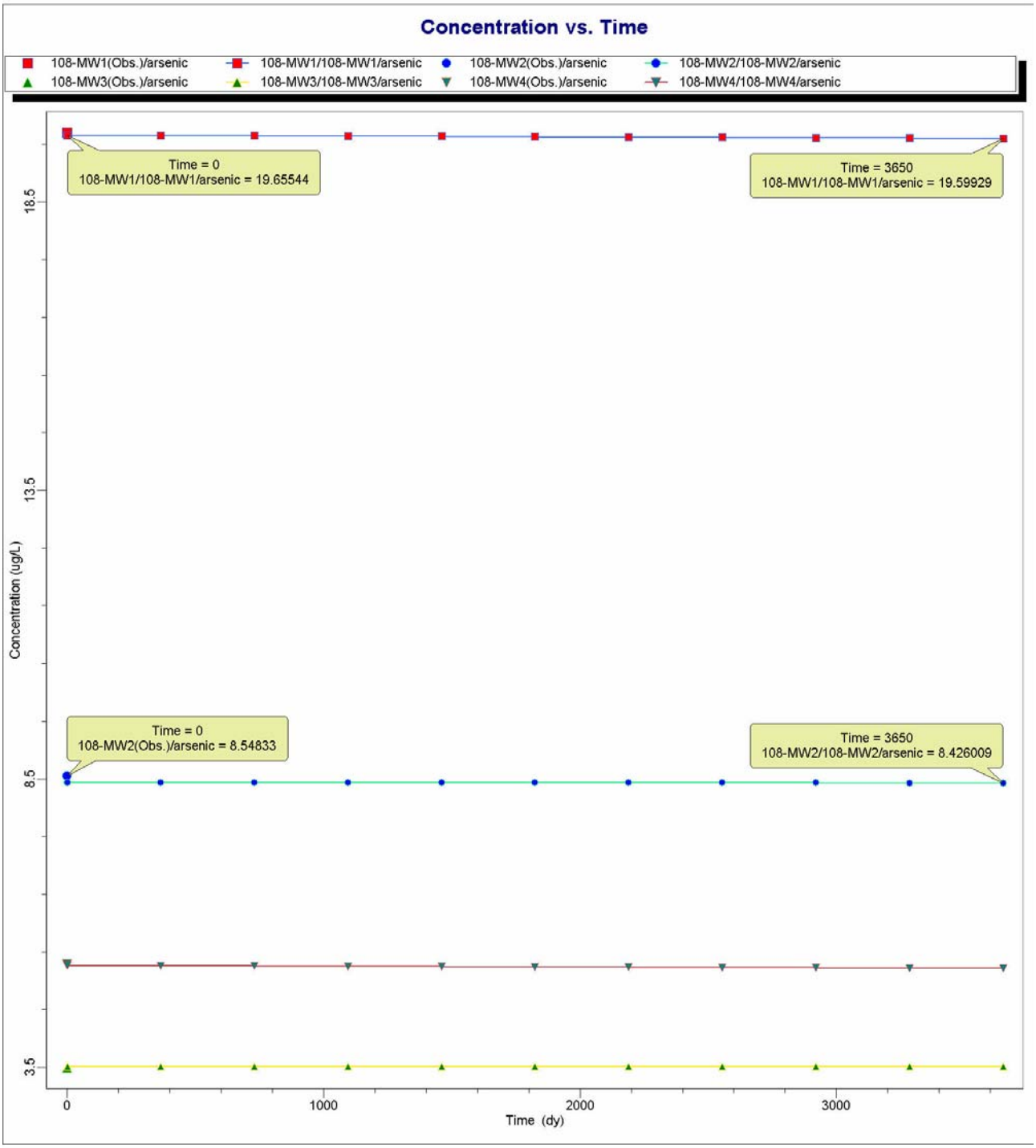
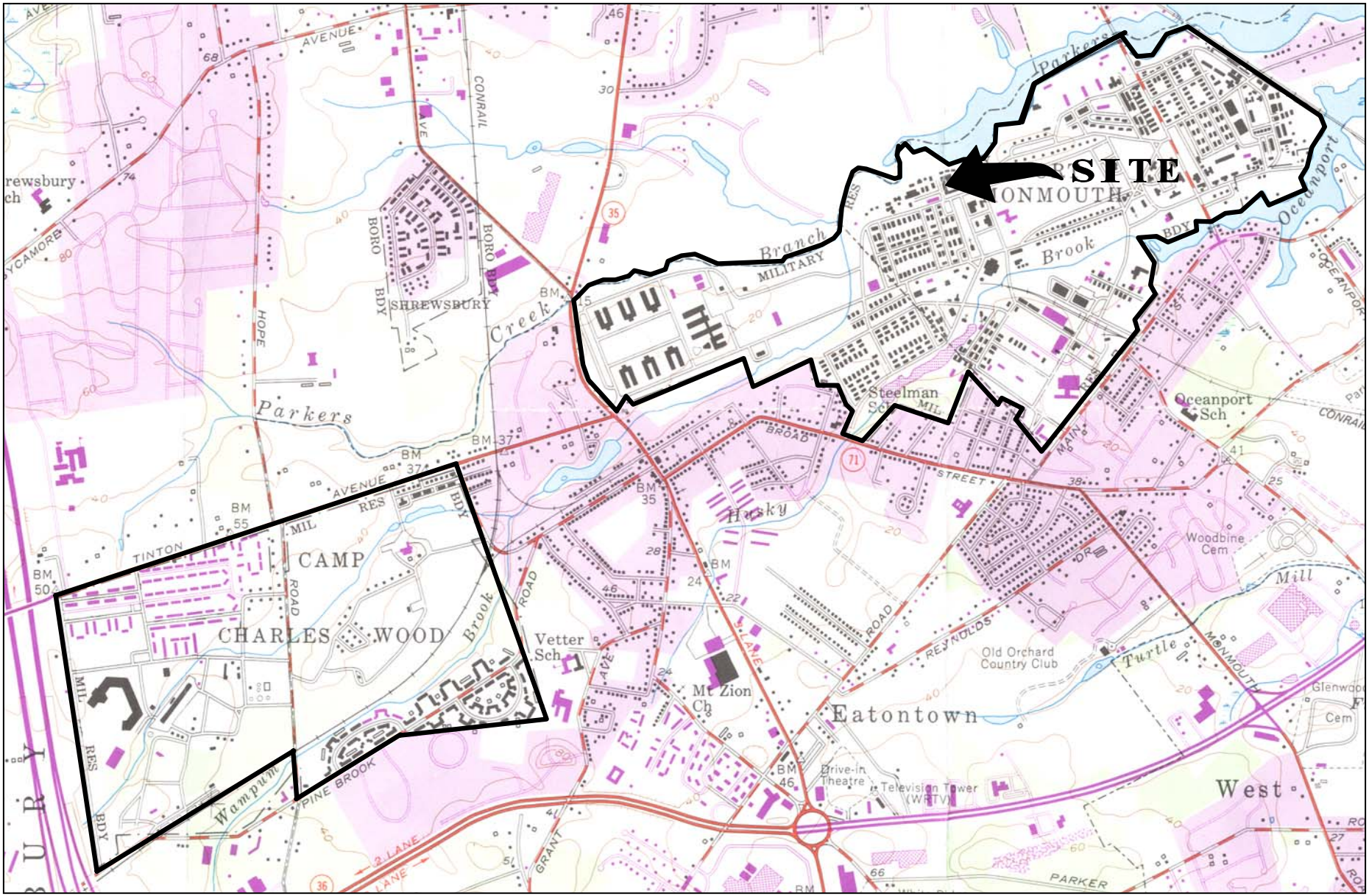


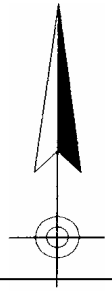
FIGURE 6-3b

Predicted Arsenic Concentration Versus Time
Site 108
Fort Monmouth, New Jersey

Notes:
1) NJDEP groundwater criteria for arsenic is 8.0 ug/L.
2) Time for compliance is estimated from this graph to be greater than 1,000 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955





QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

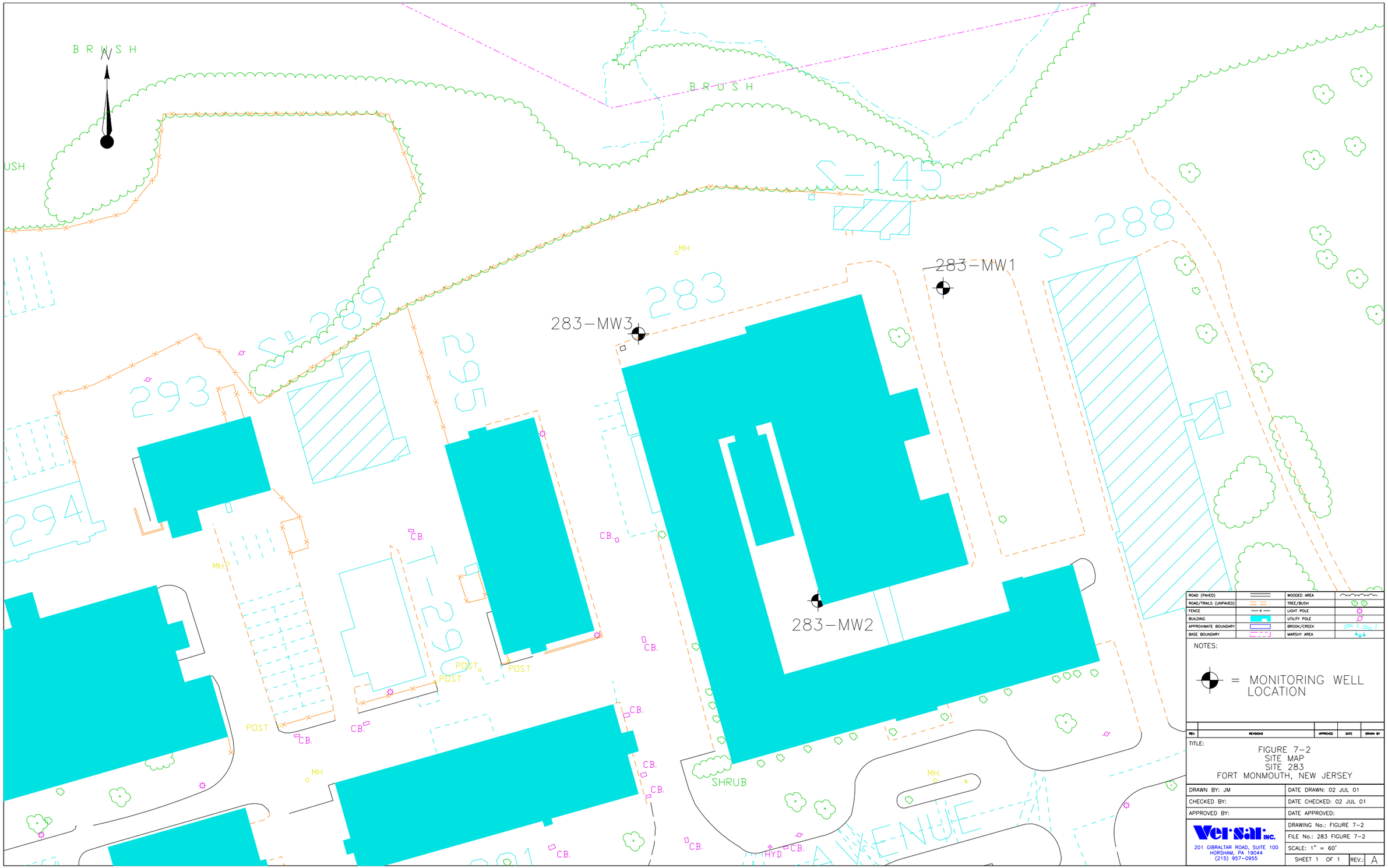
PHOTOREVISED 1981

DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 7-1
Site Location Map
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955



ROAD (PAVED)		WOODED AREA	
ROAD/TRAILS (UNPAVED)		TREE/BUSH	
FENCE	—x—	LIGHT POLE	
BUILDING		UTILITY POLE	
APPROXIMATE BOUNDARY		BROOK/CREEK	
BASE BOUNDARY		MARSHY AREA	

NOTES:

⊕ = MONITORING WELL LOCATION

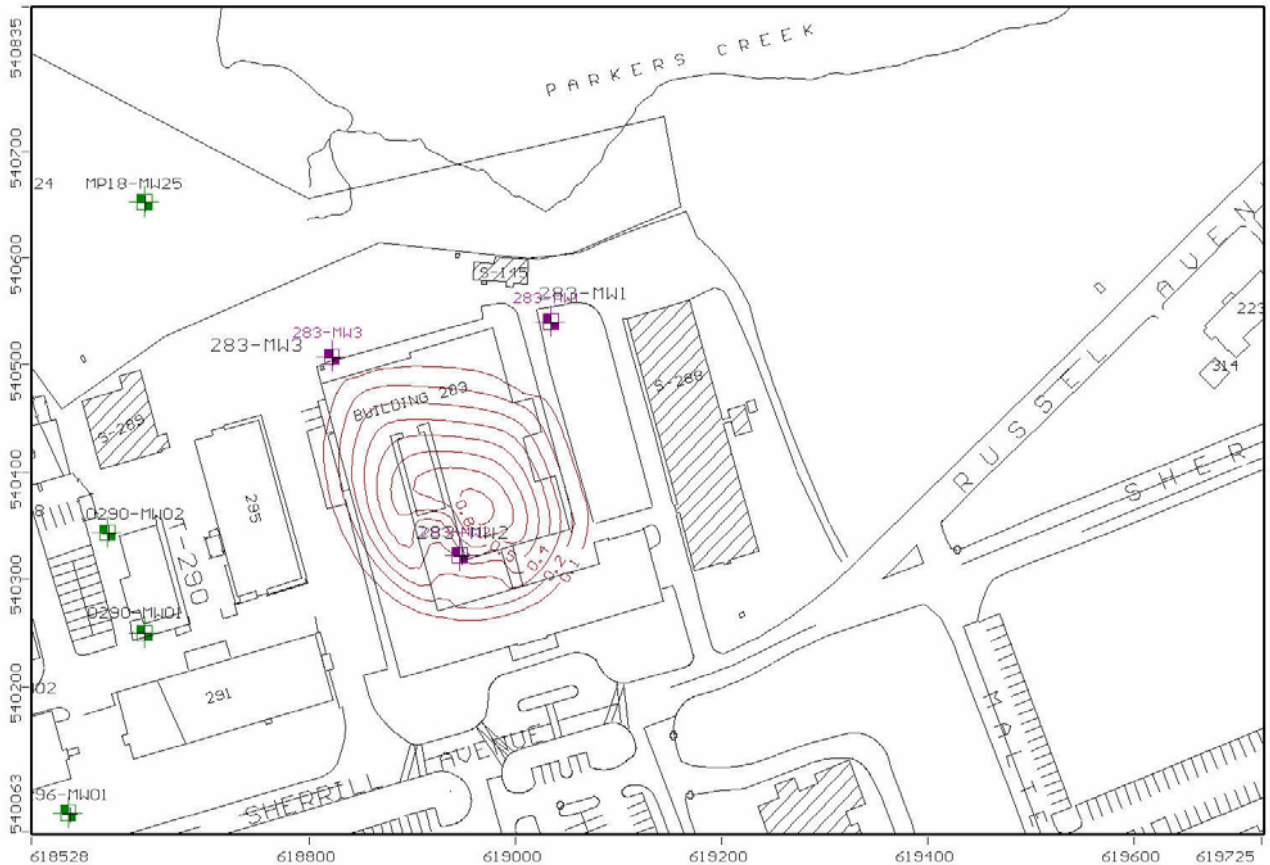
REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 7-2
SITE MAP
SITE 283
FORT MONMOUTH, NEW JERSEY

DRAWN BY: JM	DATE DRAWN: 02 JUL 01
CHECKED BY:	DATE CHECKED: 02 JUL 01
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 7-2
	FILE No.: 283 FIGURE 7-2
	SCALE: 1" = 60'
	SHEET 1 OF 1 REV.: A

Versar, Inc.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955



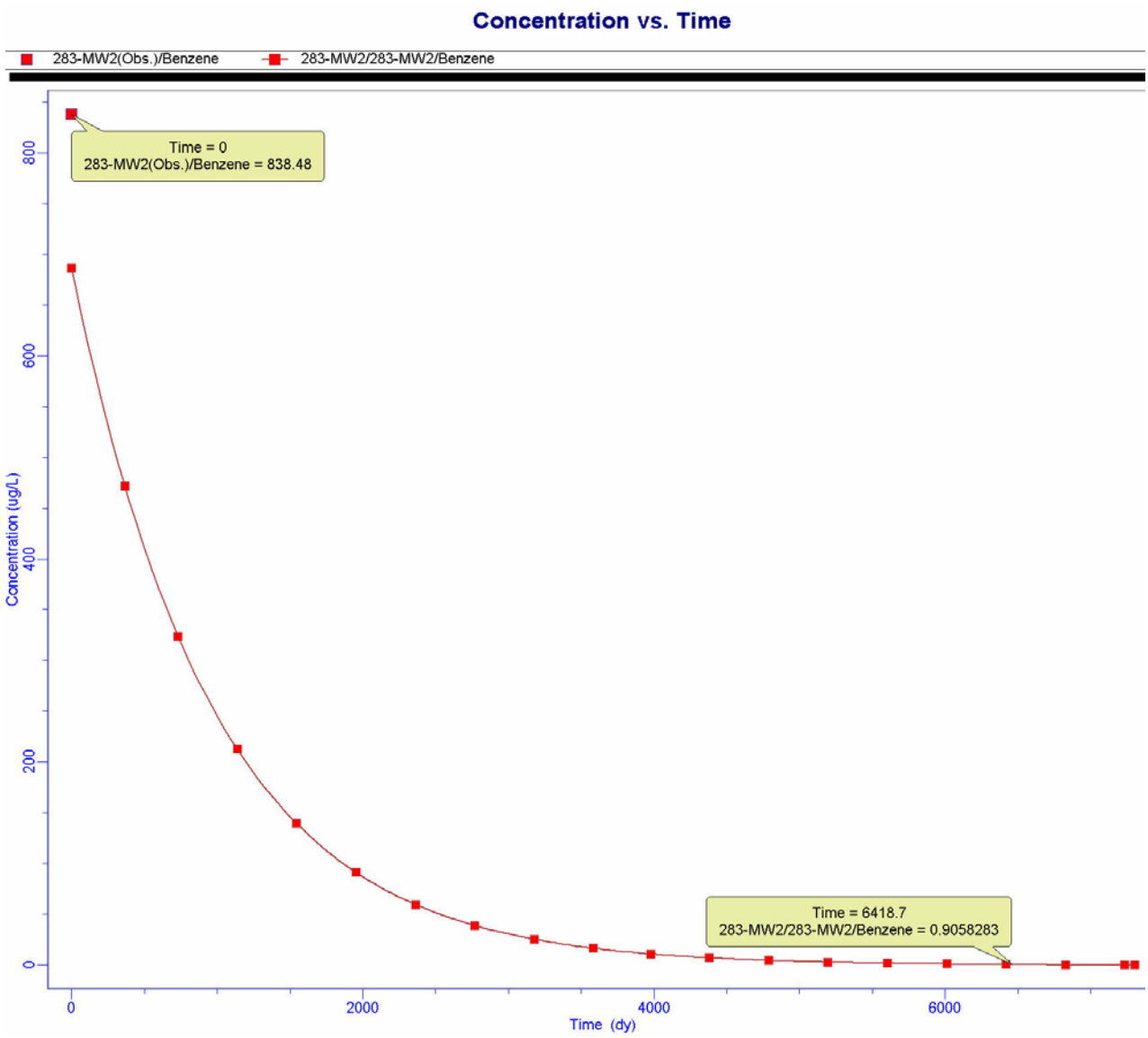
Notes:

1) Isoconcentration contours represent predicted benzene concentrations at 19 years for Layer 2 (depth of 10 feet below ground surface).
2) The NJDEP groundwater quality criteria for benzene is 1.0 ug/L.
3) Monitoring wells for Site 283 are shown in purple. Other monitoring wells are shown in green.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 7-3a

Predicted Benzene Concentration
19 Years – Map View
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

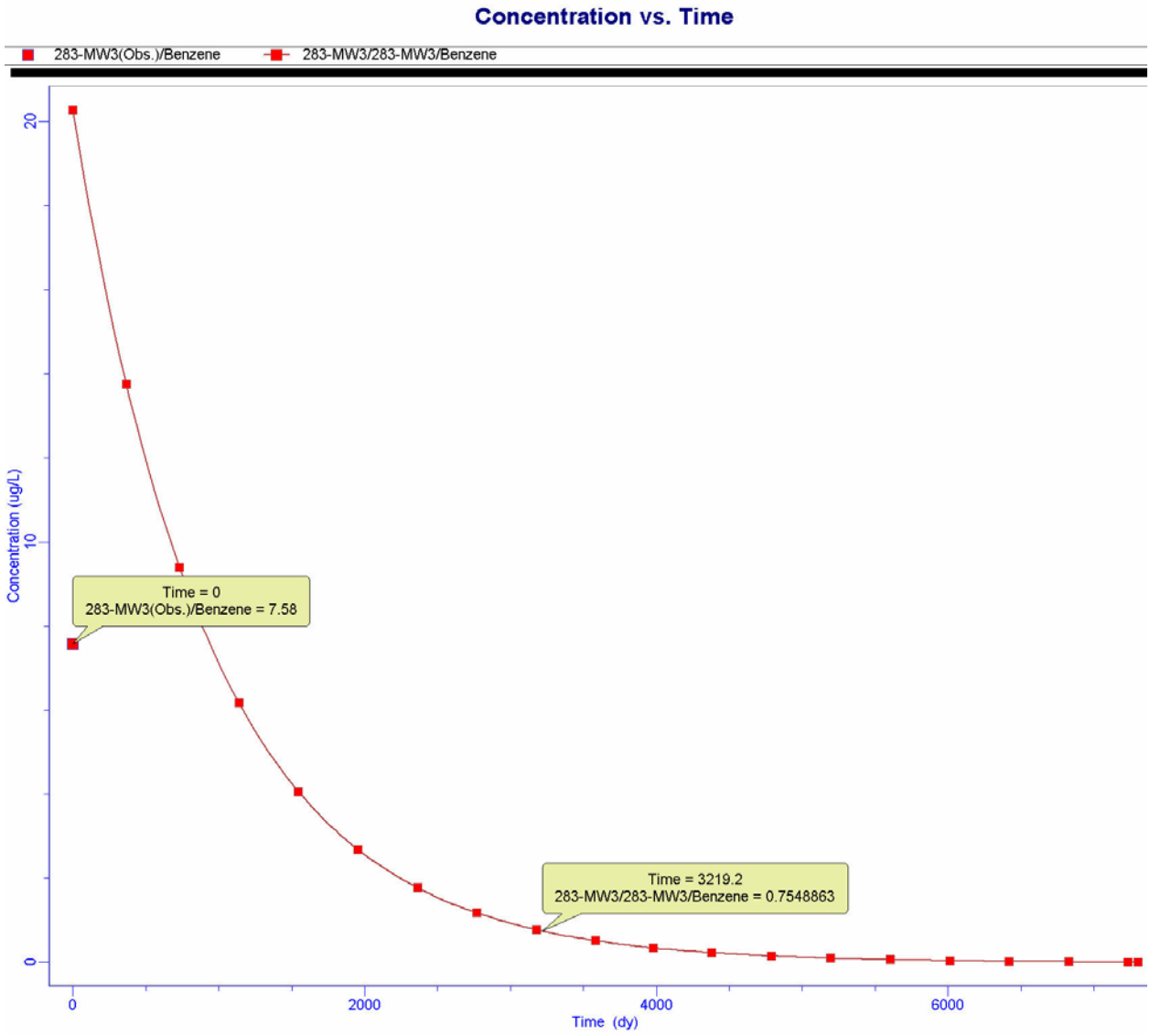


Notes:
1) NJDEP groundwater criteria for benzene is 1.0 ug/L.
2) Time for compliance is estimated from this graph to be approximately 17.6 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 7-3b

Predicted Benzene Concentration Versus Time at Well 283-MW2
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

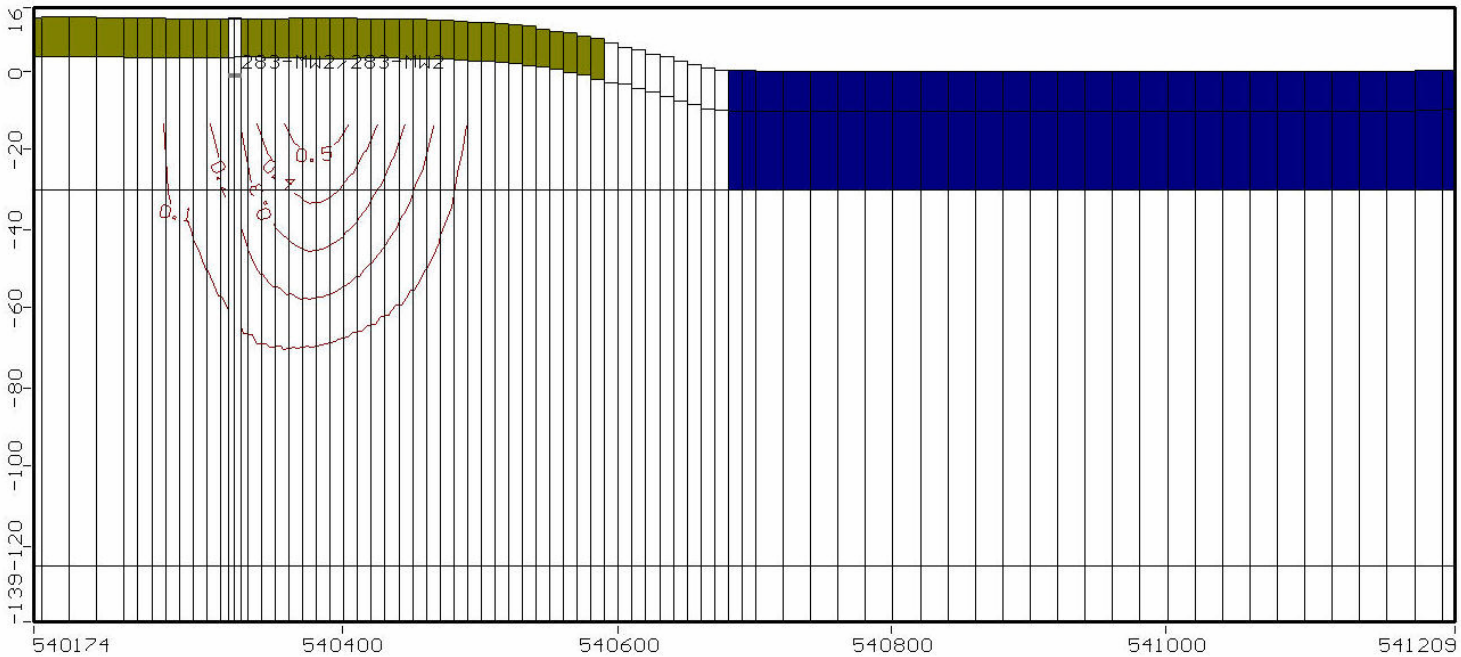


Notes:
1) NJDEP groundwater criteria for benzene is 1.0 ug/L.
2) Time for compliance at well 283-MW3 was estimated to be approximately 8.8 years.
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 7-3c

Predicted Benzene Concentration Versus Time at Well 283-MW3
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



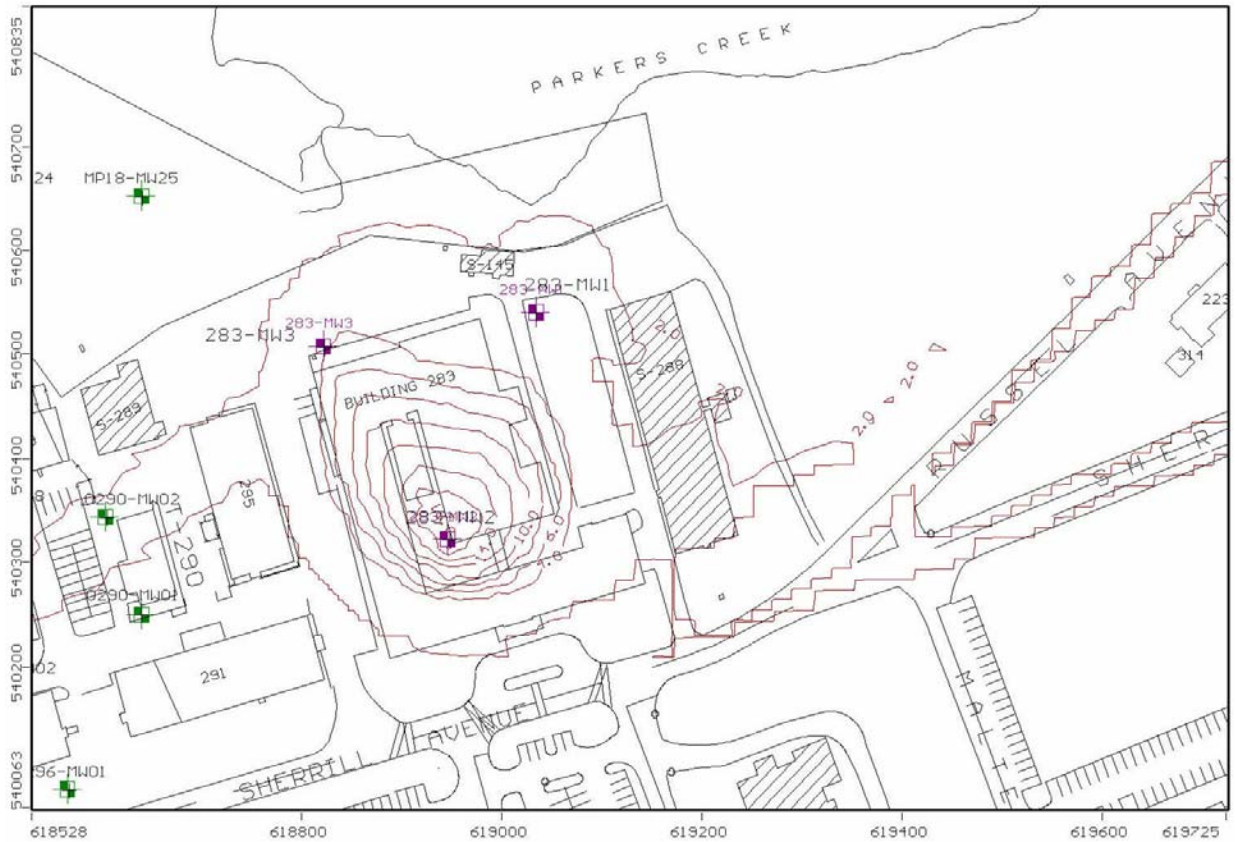
Notes:

1) Isoconcentration contours represent predicted benzene concentrations at 19 years in cross-section view (through well 283-MW2).
2) The NJDEP groundwater quality criteria for benzene is 1.0 ug/L.
3) Grid cells representing Parkers Creek shown in blue.
4) Grid cells that are dry are shown as olive-green.
5) Coordinates shown represent NAD-83 survey feet.
6) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 7-3d

Predicted Benzene Concentration
19 Years – Cross Section View
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



Notes:
1) Isoconcentration contours represent predicted lead concentrations at 20 years.
2) The NJDEP groundwater quality criteria for lead is 10 ug/L.
3) Monitoring wells for Site 283 are shown in purple. Other monitoring wells are shown in green.
4) Coordinates shown represent NAD-83 survey feet.
5) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

FIGURE 7-4a

Predicted Lead Concentration
At 20 Years
Site 283
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

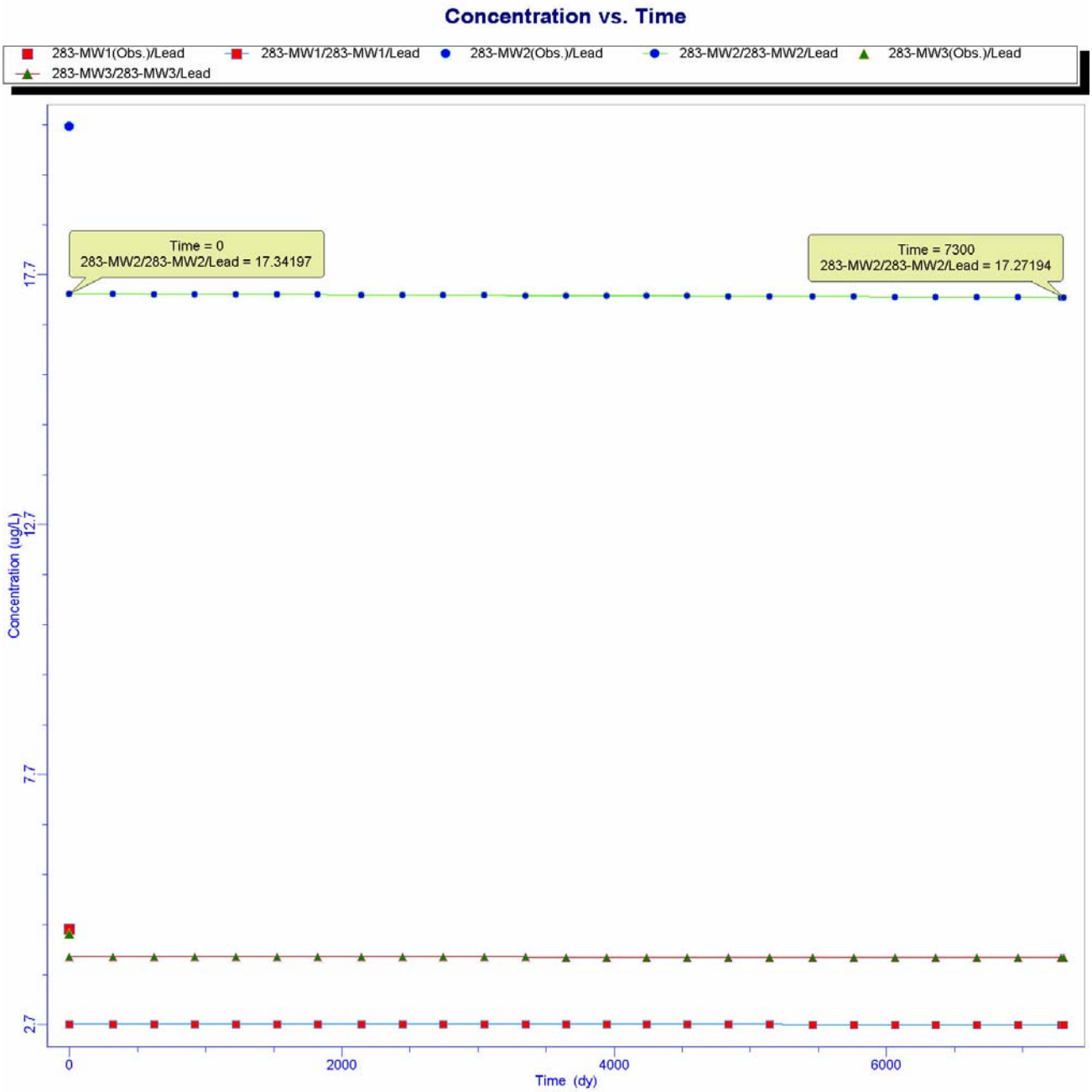
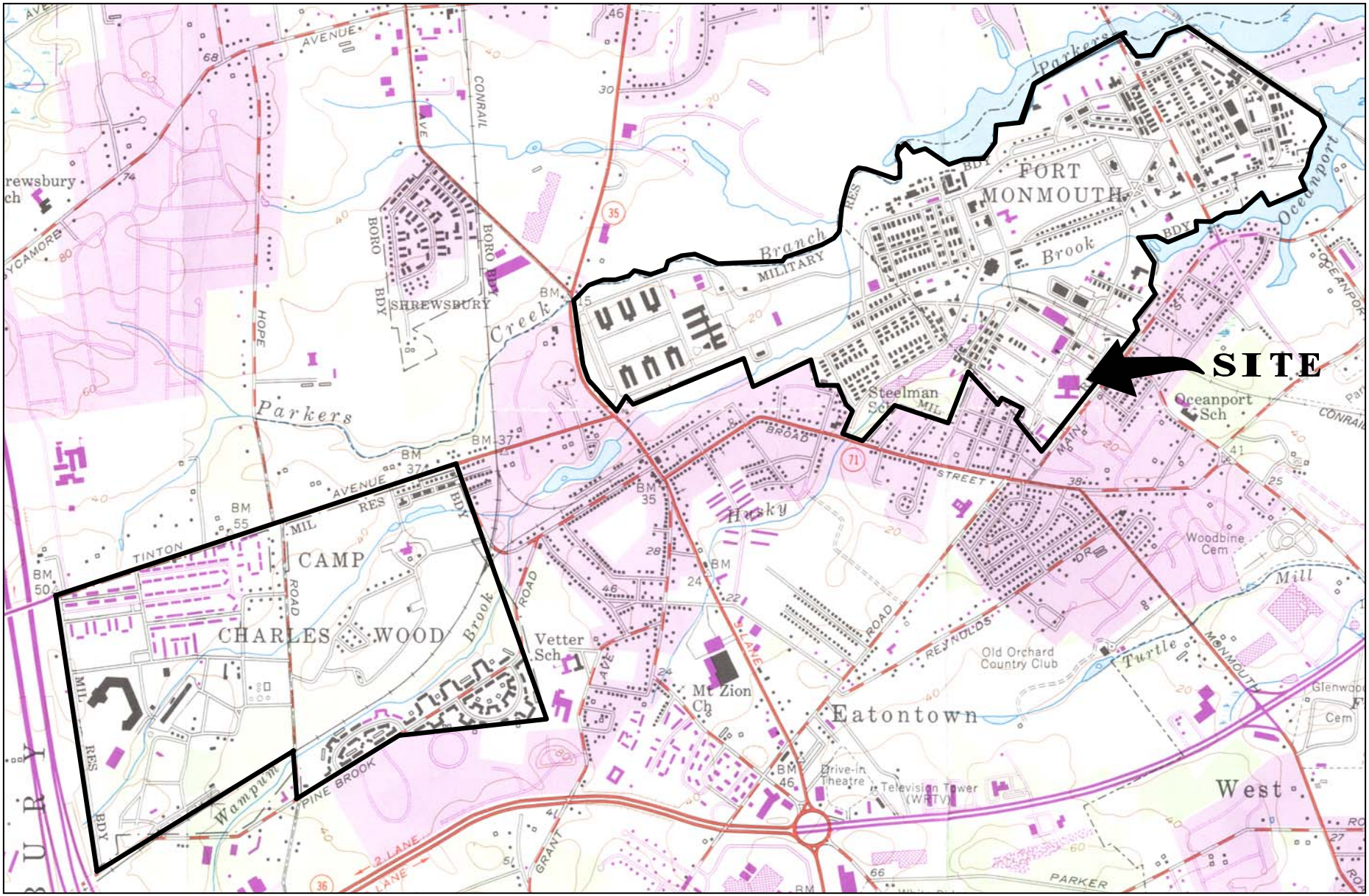


FIGURE 7-4b

Predicted Lead Concentration Versus Time at Well 283-MW2
Site 283
Fort Monmouth, New Jersey

Notes:
1) NJDEP groundwater criteria for lead is 10 ug/L.
2) Time for compliance at well 283-MW2 was undetermined in the MODFLOW simulation (greater than 1,000 years).
3) Modeling Software: *Visual MODFLOW Version 2.8.2*, Waterloo Hydrogeologic, Inc., 2000.

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



NEW JERSEY

QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

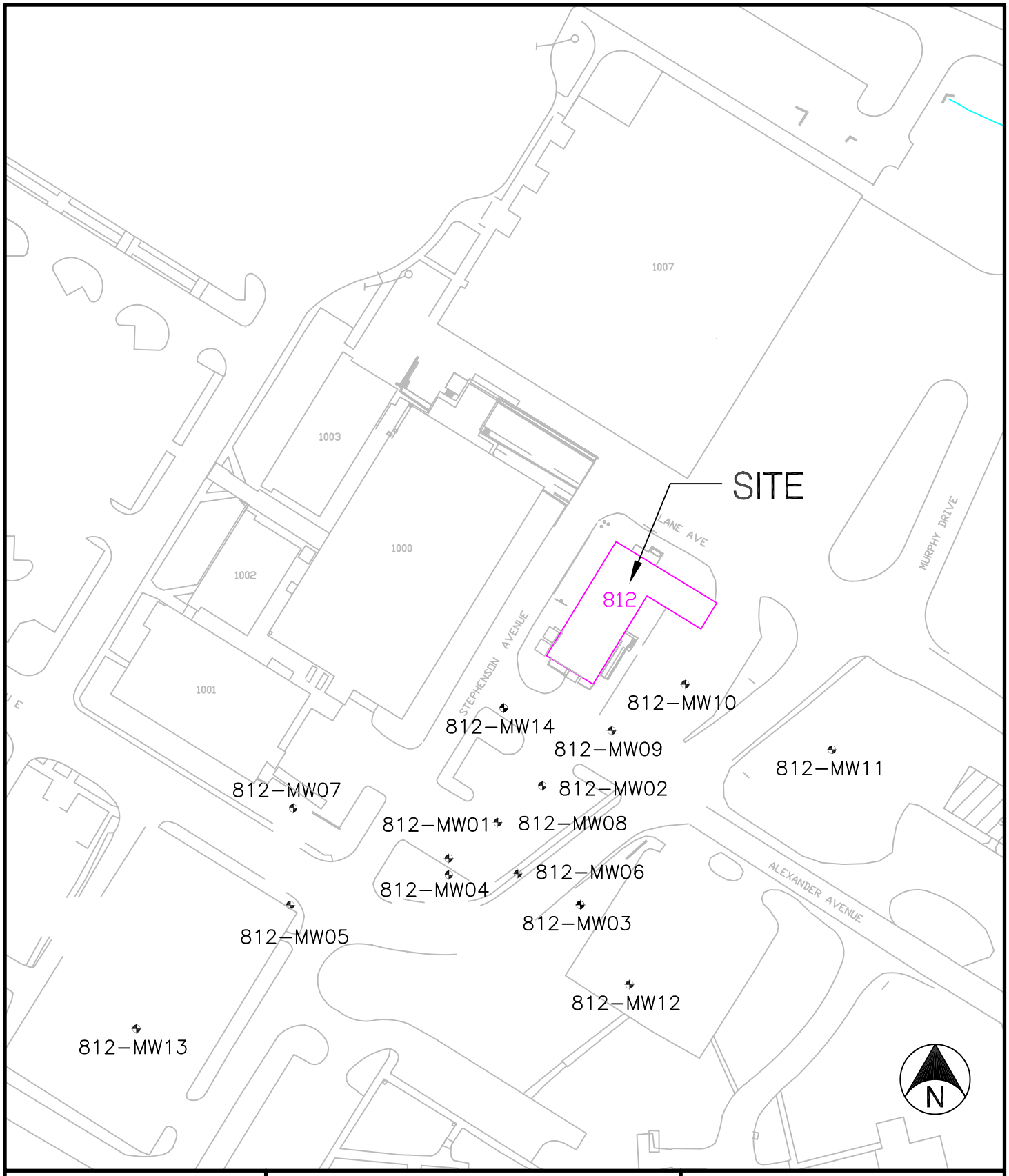
PHOTOREVISED 1981

DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 8-1
Site Location Map
Site 812
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955



Versar INC.
ARCHITECTURE • ENGINEERING • CONSTRUCTION
201 GIBRALTAR ROAD, SUITE 100, HORSHAM, PA 19044
TEL: 215.957.0955 FAX: 215.957.0497

FIGURE 8–2
SITE MAP

SITE 812
FORT MONMOUTH, NEW JERSEY

CLIENT NO.: 110571.0571.308	
DRAWING REF. NO.: 202	
SCALE 1:100	DATE: 17–APR–03
REVISION 0	SKETCH NO. B-2

N

812–MW14
812–MW10
812–MW09
812–MW11
812–MW02
812–MW08
812–MW07
812–MW01
812–MW04
812–MW06
812–MW05
812–MW03
812–MW12
812–MW13

MH
HYD
CB
CB.

GROUNDWATER FLOW DIRECTION

80 0 80
scale feet

LEGEND

VOC	NJDEP GWQC
1,1,1–TRICHLOROETHANE (1,1,1–TCA)	30 ug/L

812–MW04 ⊗ MONITORING WELL LOCATION

ESTIMATED/MODELED MAXIMUM EXTENT OF 1,1,1–TCA PLUME

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 8–3
PREDICTED 1,1,1–TRICHLOROETHANE PLUME
SITE 812
FORT MONMOUTH, NEW JERSEY

DRAWN BY:	DATE DRAWN: 10 OCT 00
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIG 8-3
	FILE No.: FIG 8-3
	SCALE: 1" = 60'
	SHEET OF REV.: A

Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957–0955

N

812–MW10
812–MW14
812–MW09
812–MW11
812–MW02
812–MW07
812–MW08
812–MW01
812–MW04
812–MW06
812–MW05
812–MW03
812–MW12
812–MW13

MH
HYD
CB.
CB
GROUNDWATER FLOW DIRECTION

LEGEND

VOC	NJDEP GWQC
BENZENE	1 (ug/L)

812–MW04 MONITORING WELL LOCATION

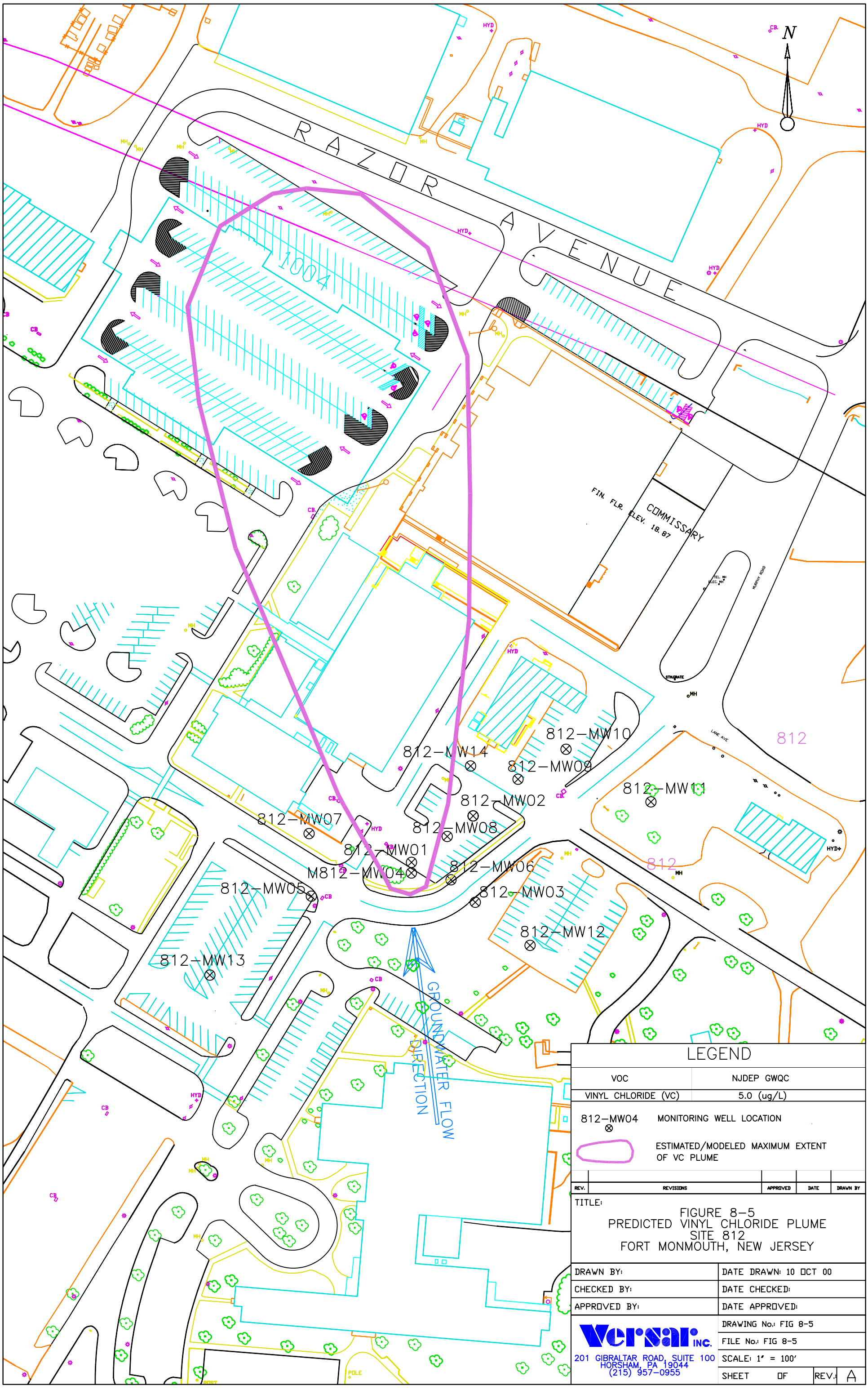
ESTIMATED/MODELED MAXIMUM EXTENT OF BENZENE PLUME

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

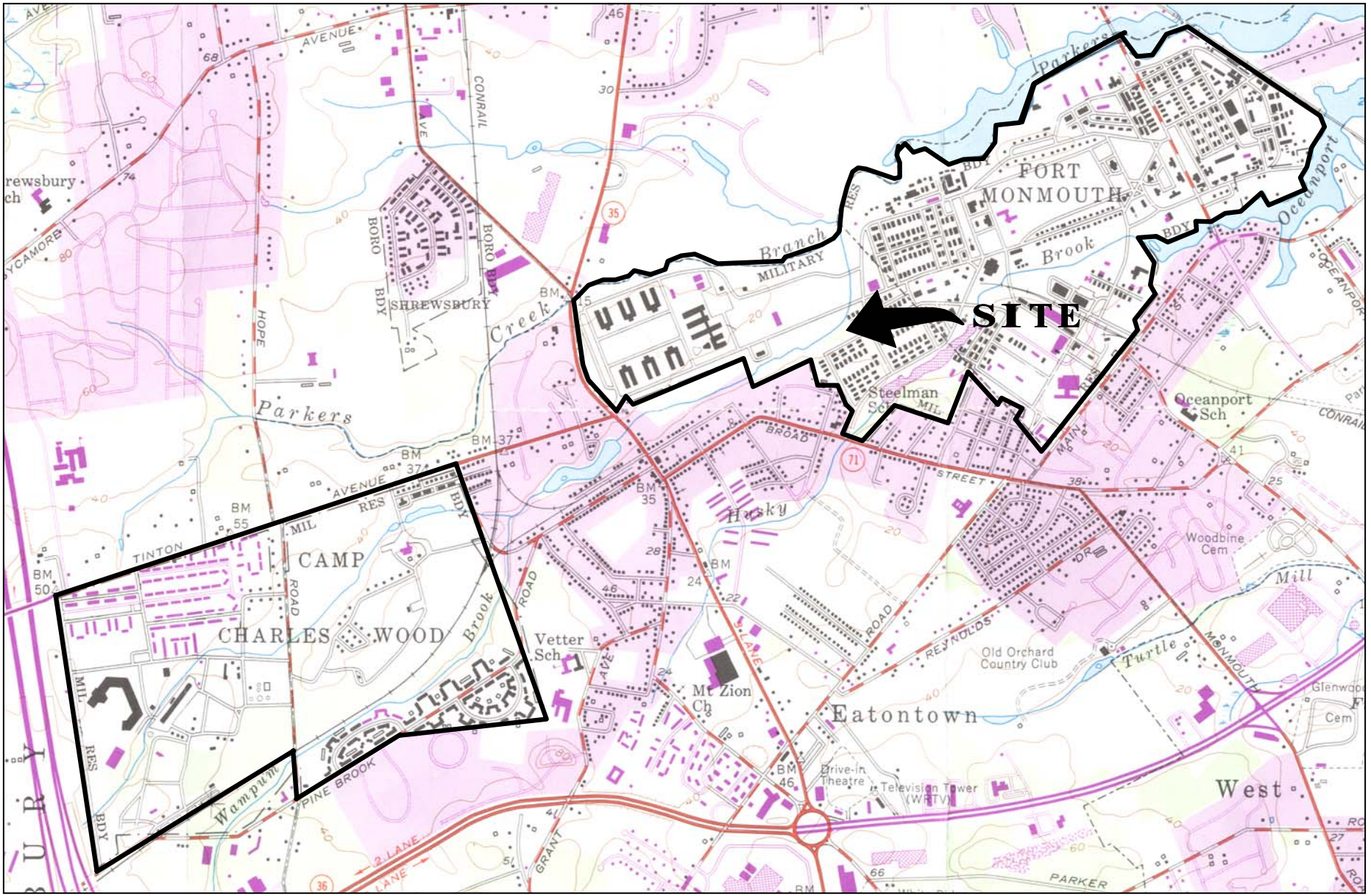
TITLE:
FIGURE 8–4
PREDICTED BENZENE PLUME
SITE 812
FORT MONMOUTH, NEW JERSEY

DRAWN BY:	DATE DRAWN: 10 OCT 00
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIG 8-4
	FILE No.: FIG 8-4
	SCALE: 1" = 60'
	SHEET OF REV.: A

Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957–0955



Versar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955



NEW JERSEY

QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

PHOTOREVISED 1981

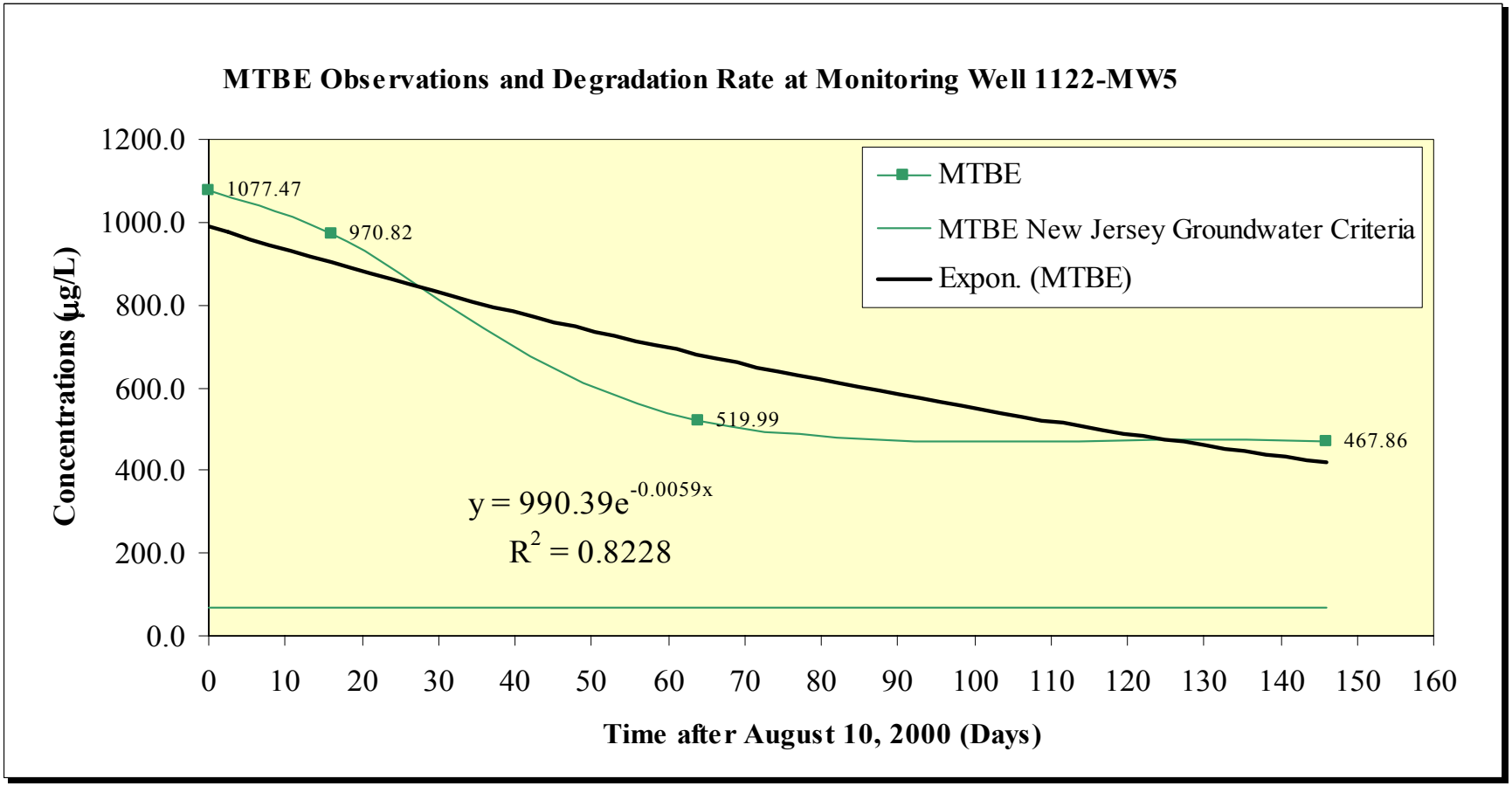
DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 9-1
Site Location Map
Site 1122
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

Ver-Sal INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955

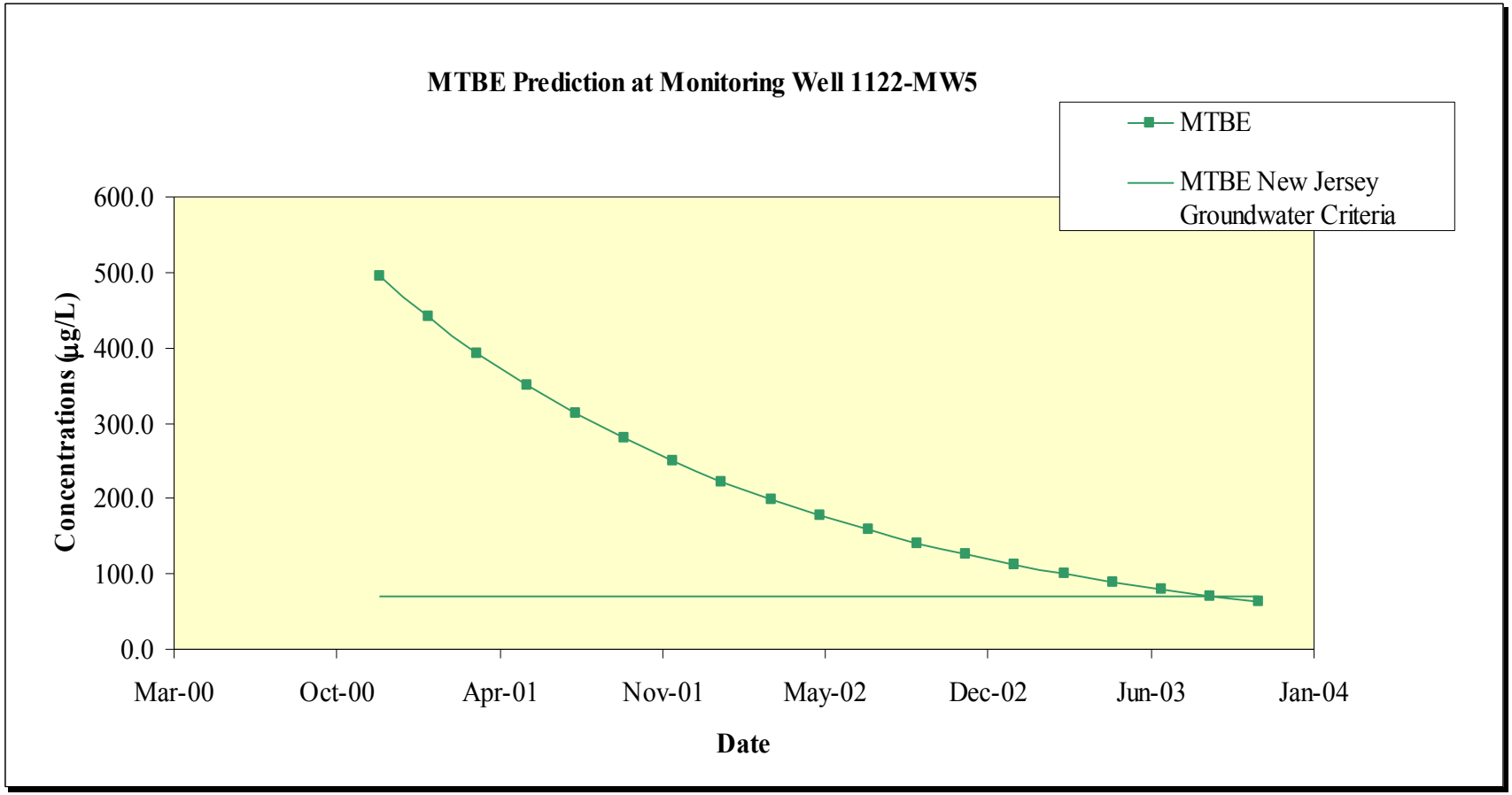


Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Observed MTBE concentrations at well 1122-MW5 are shown starting on August 10, 2000.
3) The calculated half-life for MTBE is 117 days based on the rate constant (k) of 0.0059 obtained through the logarithmic regression shown above.
4) The published half-life for MTBE of 365 days (Howard, 1991) was used in order to make a more conservative prediction for MTBE concentrations at well 1122-MW5.

FIGURE 9-3a

MTBE Observations and Degradation at Well 1122-MW5
Site 1122
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

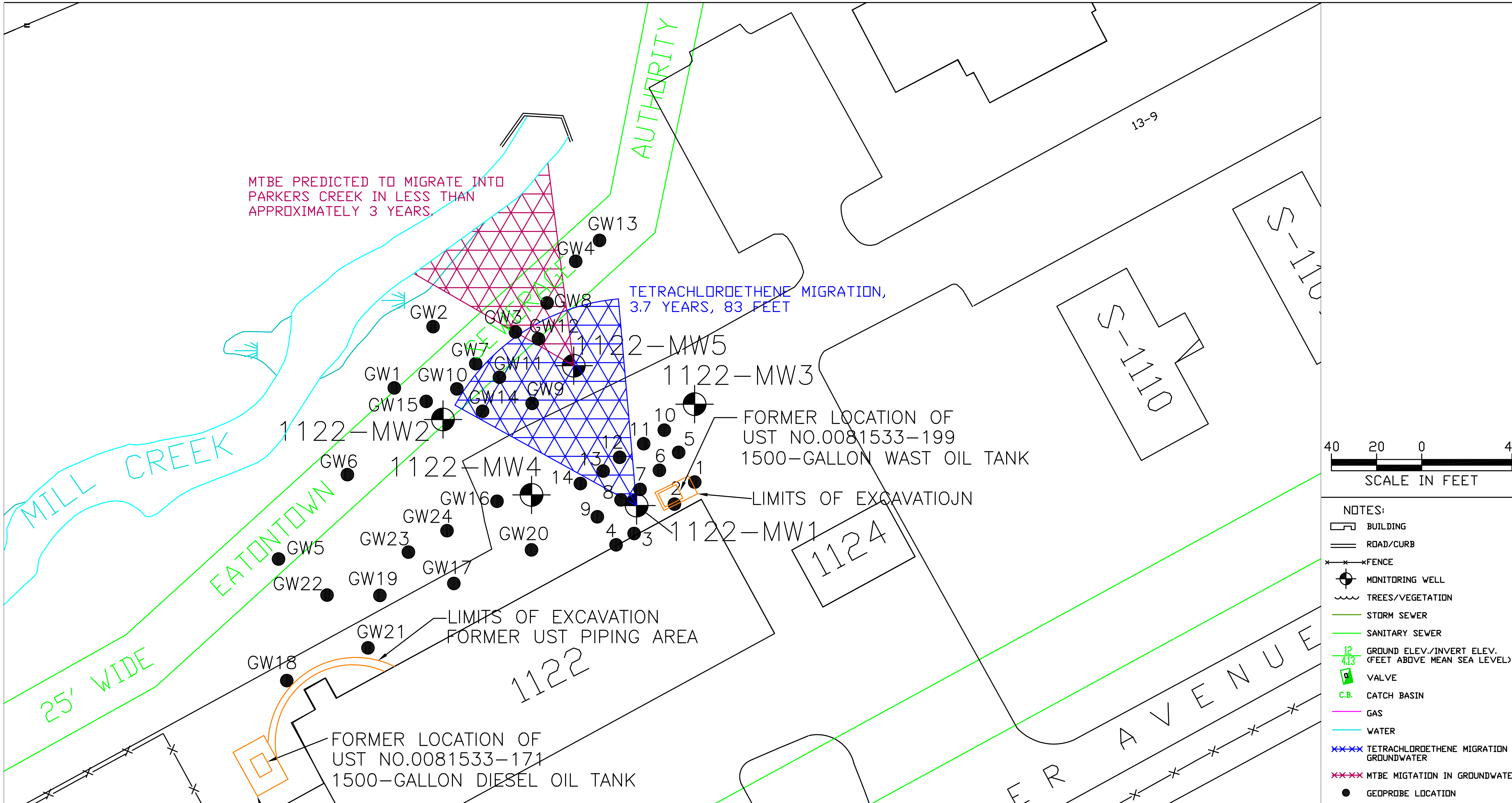


Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Initial MTBE concentration at well 1122-MW5 was considered to be 493.93 ug/L on November 23, 2000 (average of analytical results for 10/13/00 and 01/03/01).
3) The published half-life of 365 days from Howard (1991) was used to predict future concentrations of MTBE.
4) Estimated time for NJDEP compliance is 3.0 years.

FIGURE 9-3b

MTBE Prediction
Well 1122-MW5
Site 1122
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



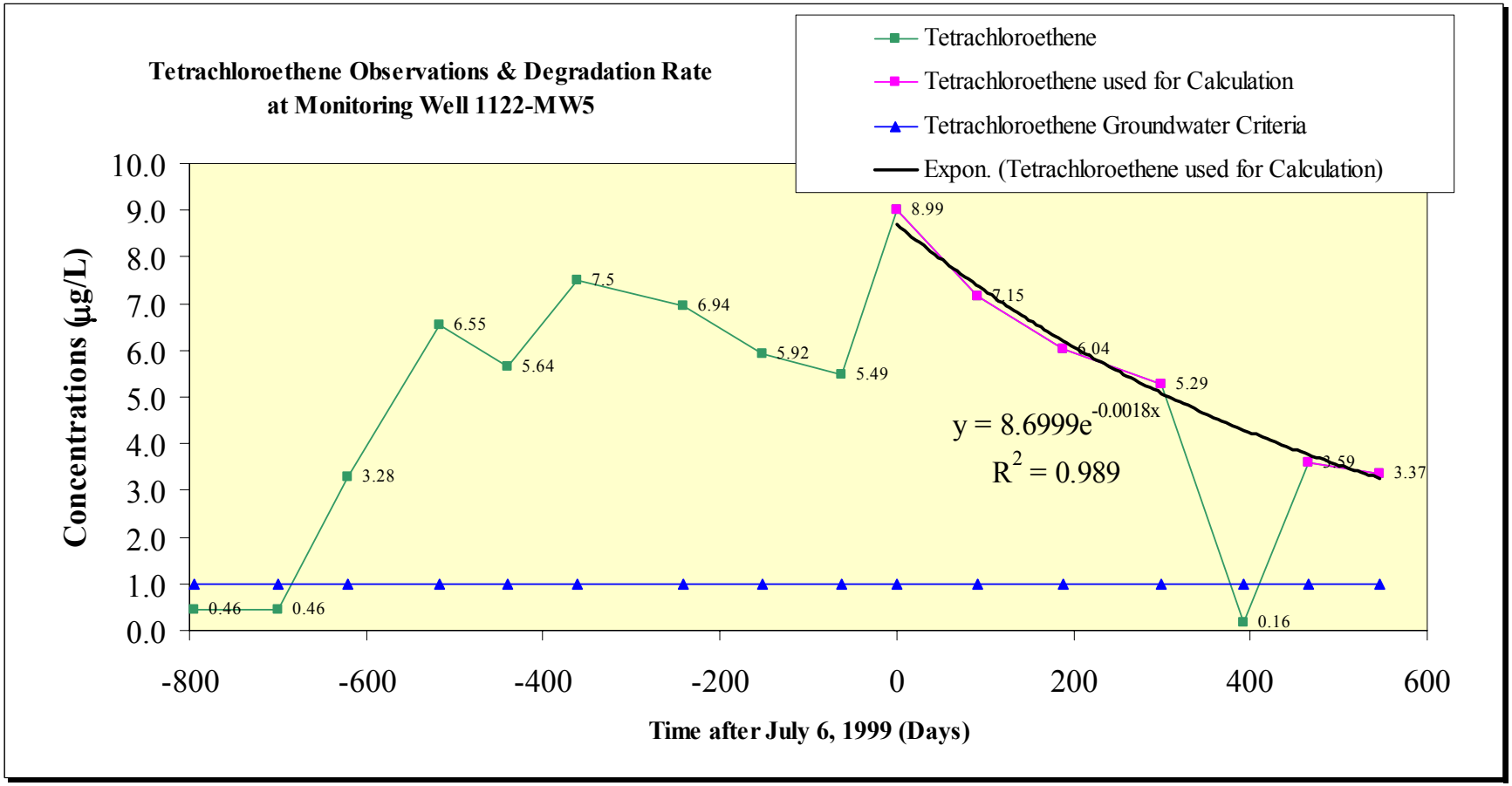
MTBE PREDICTED TO MIGRATE INTO
PARKERS CREEK IN LESS THAN
APPROXIMATELY 3 YEARS.
TETRACHLOROETHENE MIGRATION,
3.7 YEARS, 83 FEET
MILL CREEK
AUTHORITY
EATONTOWN
25' WIDE
13-9
S-1110
GW1
GW2
GW3
GW4
GW5
GW6
GW7
GW8
GW9
GW10
GW11
GW12
GW13
GW14
GW15
GW16
GW17
GW18
GW19
GW20
GW21
GW22
GW23
GW24
1122-MW1
1122-MW2
1122-MW3
1122-MW4
1122-MW5
FORMER LOCATION OF
UST NO.0081533-199
1500-GALLON WAST OIL TANK
LIMITS OF EXCAVATIOJN
LIMITS OF EXCAVATION
FORMER UST PIPING AREA
1122
1124
FORMER LOCATION OF
UST NO.0081533-171
1500-GALLON DIESEL OIL TANK
LIMITS OF EXCAVATION
ALEXANDER AVENUE
HYD13-16
40 20 0 40
SCALE IN FEET
NOTES:
BUILDING
ROAD/CURB
FENCE
MONITORING WELL
TREES/VEGETATION
STORM SEWER
SANITARY SEWER
GROUND ELEV./INVERT ELEV.
(FEET ABOVE MEAN SEA LEVEL)
VALVE
C.B.
CATCH BASIN
GAS
WATER
TETRACHLOROETHENE MIGRATION IN
GROUNDWATER
MTBE MIGTATION IN GROUNDWATER
GEOPROBE LOCATION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 9-4
MIGRATION POTENTIAL OF COCs IN GROUNDWATER
SITE 1122
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 11 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
Versar INC. 201 GIBRALTAR ROAD, SUITE 100 HORSHAM, PA 19044 (215) 957-0955	DRAWING No.: FIGURE 9-4
	FILE No.: 283 FIGURE 9-4
	SCALE: 1" = 40'
	SHEET 1 OF 1 REV.: A



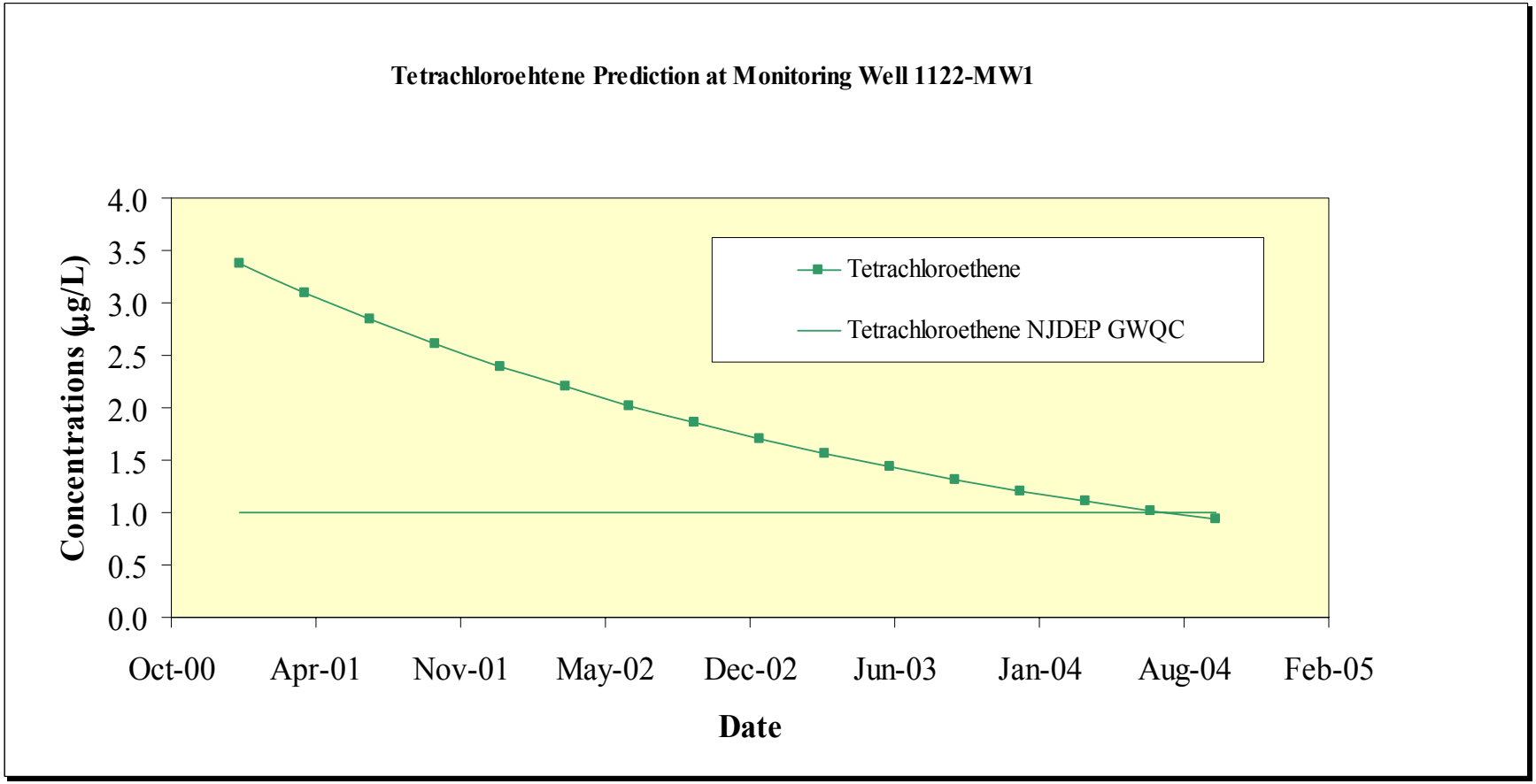
Notes:

1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Observed tetrachloroethene concentrations at well 1122-MW1 are shown starting on May 2, 1997.
3) Non-detections are replaced by ½ the respective laboratory method detection limits (MDLs).
4) The calculated half-life for tetrachloroethene is 385 days based on observations at well 1122-MW1 starting on July 6, 1999, and a rate constant (k) of 0.0018 obtained through the logarithmic regression shown above. The non-detection of PCB at well 1122-MW1 on August 1, 2000 was omitted from this calculation.
5) The site-specific half-life for tetrachloroethene of 730 days (Howard, 1991) was used in order to make a more conservative prediction for tetrachloroethene concentrations at well 1122-MW5.

FIGURE 9-5a

Tetrachloroethene Observations & Degradation at Well 1122-MW1
Site 1122
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955

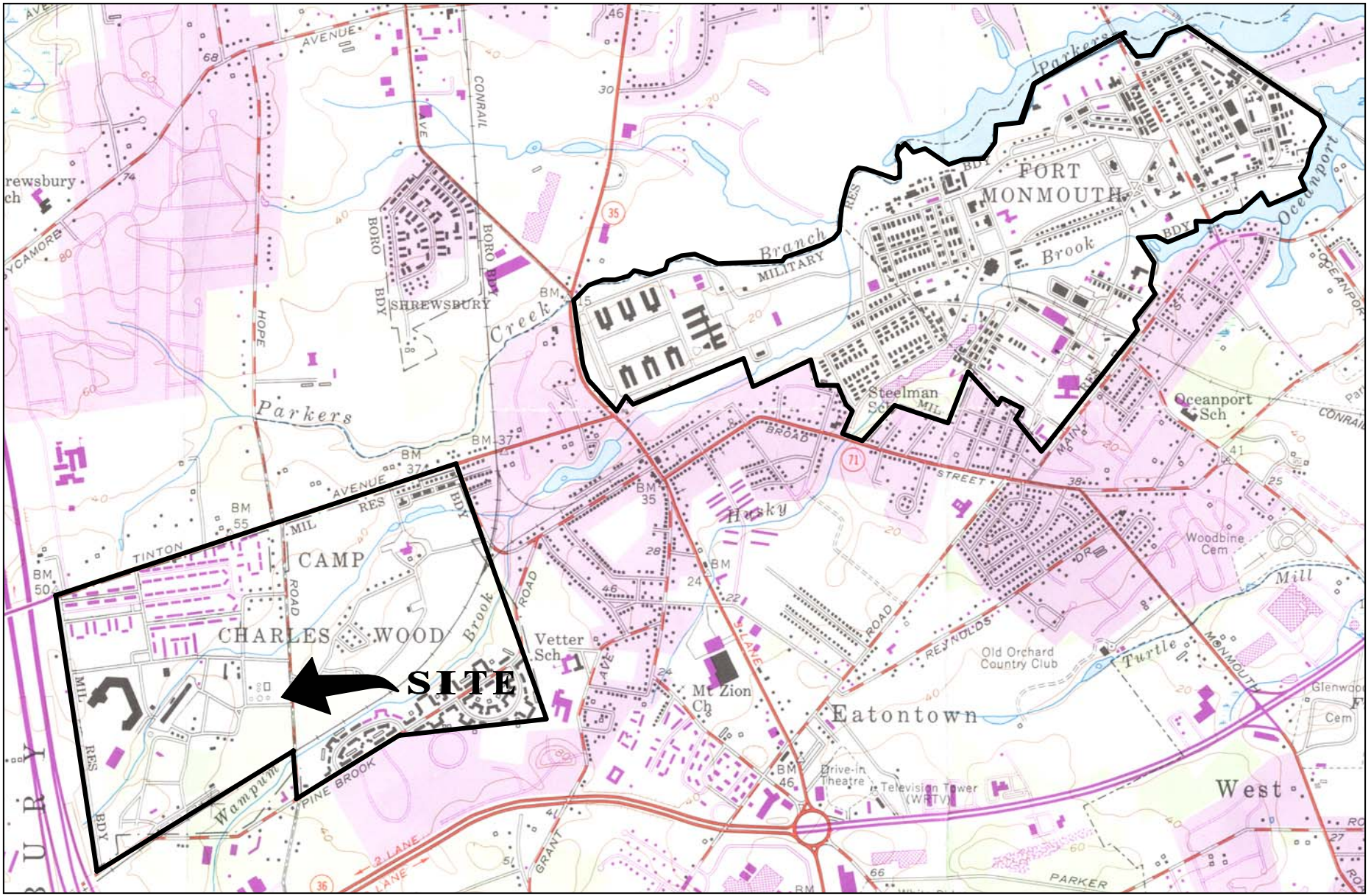


Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Initial tetrachloroethene concentration at well 1122-MW1 was considered to be 3.37 ug/L on January 3, 2001.
3) The published half-life of 730 days from Howard (1991) was used to predict future concentrations of tetrachloroethene.
4) Estimated time for NJDEP compliance is 3.7 years.

FIGURE 9-5b

Tetrachloroethene Prediction
Well 1122-MW1
Site 1122
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



NEW JERSEY

QUADRANGLE LOCATION

LONG BRANCH, N. J.

40073-C8-TF-024

1954

PHOTOREVISED 1981

DMA 6164 I SE-SERIES V822

Mapped, edited and published by the Geological Survey

Figure 10-1
Site Location Map
Site 2567
Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Road, Suite 100
Horsham, PA 19044
(215) 957-0955

N

YOUTH ACTIVITIES CENTER

2566

2567

2567–MW4

2567–MW2

2567–MW1

2567–MW3

LABORATORY ROAD

MH

2567–MW7

2567–MW6

2567–MW5

VERY DENSE TREES

TRIBUTARY/DRAINAGE TO WAMPUM BROOK

HOPE ROAD

VERY DENSE TREES

TEE

GREE

15

VERY DENSE TREE

ROAD (PAVED)		WOODED AREA	
ROAD/TRAILS (UNPAVED)		TREE/BUSH	
FENCE	— x —	LIGHT POLE	
BUILDING		UTILITY POLE	
APPROXIMATE BOUNDARY		BROOK/CREEK	
BASE BOUNDARY		MARSHY AREA	

NOTES:

= MONITORING WELL LOCATION

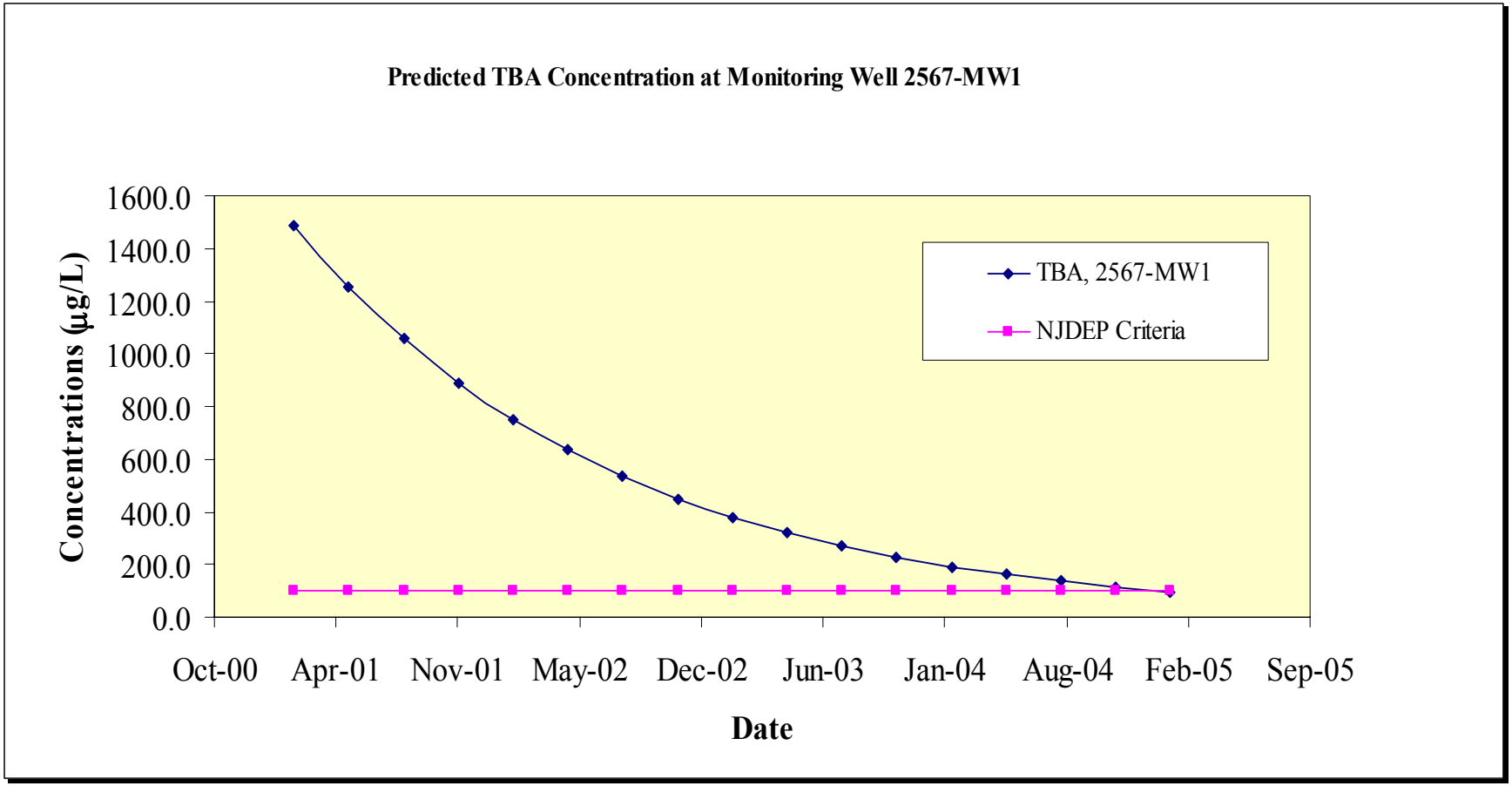
REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 10–2
SITE MAP
SITE 2567
FORT MONMOUTH, NEW JERSEY

DRAWN BY: JM	DATE DRAWN: 02 JUL 01
CHECKED BY:	DATE CHECKED: 02 JUL 01
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 10–2
	FILE No.: FIGURE 10–2
	SCALE: 1" = 60'
	SHEET 1 OF 1 REV.: A

Versar, Inc.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957–0955

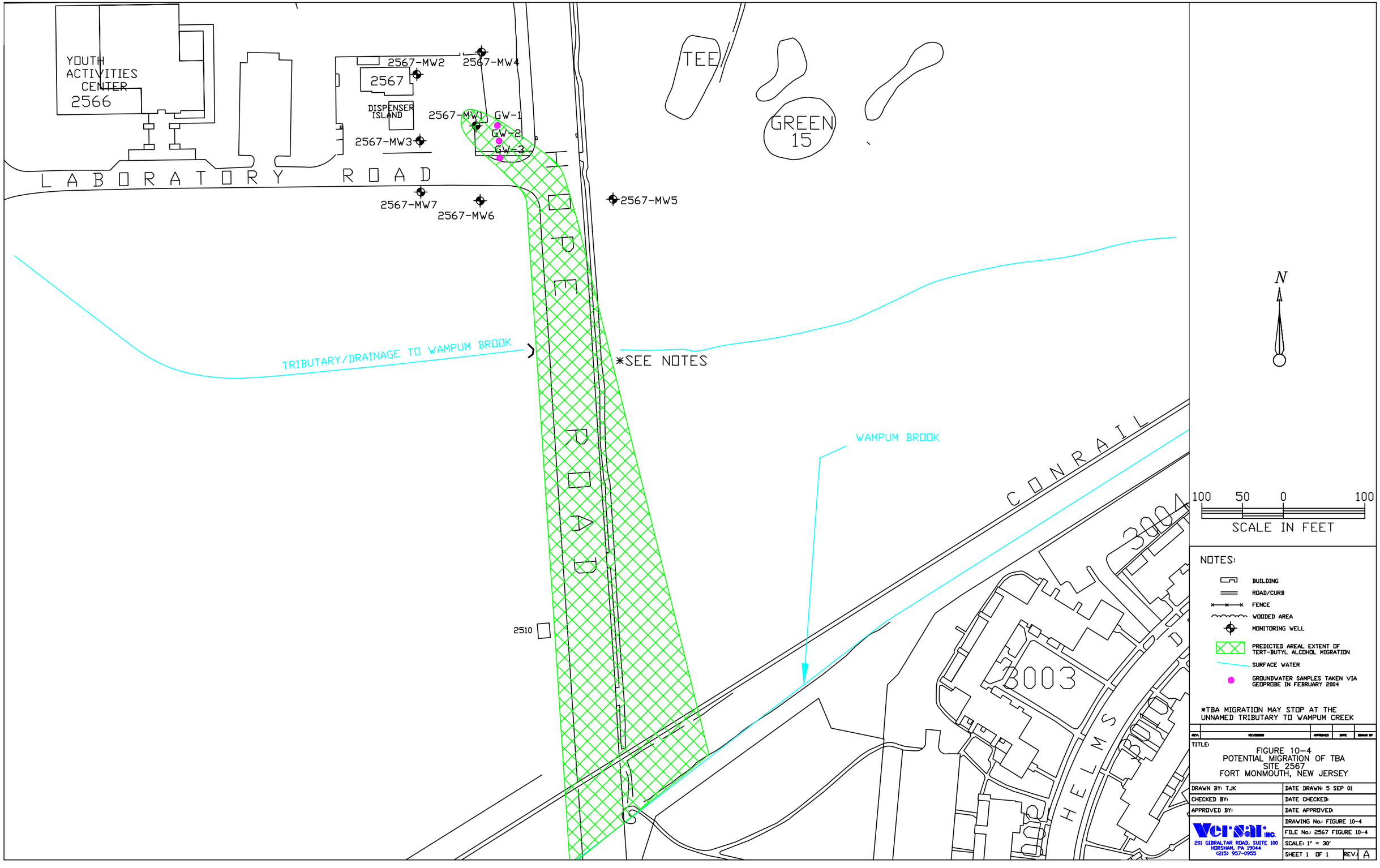


Notes:
1) Concentration is shown in micrograms per liter (ug/L), equivalent to parts per billion
2) Initial TBA concentration at well 2567-MW1 was considered to be 1488.05 ug/L on February 9, 2001.
3) Estimated time for NJDEP compliance is 3.9 years.

FIGURE 10-3

Predicted TBA Concentration at Well 2567-MW1 Site 2567 Fort Monmouth, New Jersey

Versar INC.
201 Gibraltar Rd., Suite 100
Horsham, PA 19044
(215) 957-0955



NOTES:

- BUILDING
- ROAD/CURB
- FENCE
- WOODED AREA
- MONITORING WELL
- PREDICTED AREAL EXTENT OF TERT-BUTYL ALCOHOL MIGRATION
- SURFACE WATER
- GROUNDWATER SAMPLES TAKEN VIA GEOPROBE IN FEBRUARY 2004

*TBA MIGRATION MAY STOP AT THE UNNAMED TRIBUTARY TO WAMPUM CREEK

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 10-4
POTENTIAL MIGRATION OF TBA
SITE 2567
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 SEP 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 10-4
	FILE No.: 2567 FIGURE 10-4
	SCALE: 1" = 30'
	SHEET 1 OF 1 REV.: A

VerSar INC.
201 GIBRALTAR ROAD, SUITE 100
HORSHAM, PA 19044
(215) 957-0955

APPENDICES

Appendix A

CEA Fact Sheet: M-12 Landfill Site

APPENDIX A

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Landfill M-12 (FTMM-12)

4. Street address: Murphy Dr., Main Post

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 110

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

The M-12 Landfill site was a former historic fill site located on the central portion of the Main Post south of Husky Brook and west of Murphy Drive. The M-12 Landfill site consists of two areas, a northwest area and a southwest area. The approximate size of the northeast area is 60,100 ft^2 (1.4 acres). The approximate size of the southwest area is 29,200 ft^2 (0.7 acre). The Roy F. Weston Site Investigation report (1995) showed that the M-12 Landfill site was suspected to contain domestic and industrial wastes and was used for the disposal of old automobile wastes. The period of operation of the M-12 Landfill site is unknown.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 110

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Arsenic	52.9	8.0	0.017
Lead	82.9	10.0	5.0

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figures 3-3a, 3-3b and 3-4a

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

M-12 Landfill: Arsenic (Figure 3-3a)

Northing	Easting	Latitude	Longitude
539450.00	621065.00	40° 18' 48.63"	74° 02' 15.36"
539450.00	621290.00	40° 18' 48.62"	74° 02' 12.46"
539605.00	621290.00	40° 18' 50.15"	74° 02' 12.45"
539605.00	621200.00	40° 18' 50.15"	74° 02' 13.61"
539528.00	621065.00	40° 18' 49.40"	74° 02' 15.36"

M-12 Landfill: Arsenic (Figure 3-3b)

Northing	Easting	Latitude	Longitude
538987.01	619847.12	40° 18' 44.11"	74° 02' 31.11"
538987.01	620013.46	40° 18' 44.11"	74° 02' 28.97"
539129.52	620013.46	40° 18' 45.51"	74° 02' 28.96"
539129.52	619973.08	40° 18' 45.52"	74° 02' 29.48"
539049.52	619847.12	40° 18' 44.73"	74° 02' 31.11"

M-12 Landfill: Lead (Figure 3-4a)

Northing	Easting	Latitude	Longitude
539071.11	620048.57	40° 18' 44.94"	74° 02' 28.51"
539071.11	620172.86	40° 18' 44.93"	74° 02' 26.91"
539160.00	620172.86	40° 18' 45.81"	74° 02' 26.90"
539160.00	620048.57	40° 18' 45.81"	74° 02' 28.51"

6. Estimated size of the proposed ground water classification exception area:

2.1 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): 4,500 years

   b. Expiration date (as calendar date): the year 6504

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix B

CEA Fact Sheet: M-18 Landfill Site

APPENDIX B

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Landfill M-18 (FTMM-18); includes Bldgs. 290/296 (FTMM-55/54)

4. Street address: Sherrill Ave., Main Post

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 110

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

The M-18 Landfill site consists of a historic fill site and Buildings 290 and 296, which had UST closures performed at each facility. The M-18 Landfill site is located in the northern portion of the Main Post, between Parkers Creek to the north and Sherrill Avenue to the south. The approximate area of the M-18 Landfill site is 177,300 ft^2 (4.1 acres). The landfill area at the M-18 Landfill site was used after 1919 as an Army Signal School Training Area. Diesel and gasoline generators, situated approximately 150 meters from Parkers Creek, were used to support field exercises. It was suspected that numerous fuel spills that occurred in the area of the generator had impacted the area. A riot control agent was also used in this area for troop protective mask training. During Weston's site inspection in 1993, there was a suspected debris disposal area used for building rubble in the area north of Building 289.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 110

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Benzene	29.18	1.0	0.15
Arsenic	221	8.0	0.017
Cadmium	630.7	4.0	10.0
Chromium	1,344	100	160
Lead	836	10.0	5.0

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figures 4-4, 4-5a, 4-6a, 4-7a and 4-8a

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

M-18 Landfill: Benzene (Figure 4-4)

Northing	Easting	Latitude	Longitude
540418.62	618306.88	40° 18' 58.34"	74° 02' 50.91"
540510.47	618459.45	40° 18' 59.24"	74° 02' 48.93"
540715.89	618340.52	40° 19' 01.28"	74° 02' 50.45"
540701.91	618289.21	40° 19' 01.14"	74° 02' 51.12"
540650.86	618252.96	40° 19' 00.64"	74° 02' 51.59"
540587.79	618234.85	40° 19' 00.02"	74° 02' 51.82"
540454.75	618278.13	40° 18' 58.70"	74° 02' 51.28"

M-18 Landfill: Arsenic (Figure 4-5a)

Northing	Easting	Latitude	Longitude
540078.67	618345.45	40° 18' 54.98"	74° 02' 50.43"
540078.67	618724.68	40° 18' 54.96"	74° 02' 45.54"
540724.44	618724.68	40° 19' 01.34"	74° 02' 45.49"
540724.44	618345.45	40° 19' 01.36"	74° 02' 50.39"

M-18 Landfill: Cadmium (Figure 4-6a)

Northing	Easting	Latitude	Longitude
540063.75	618359.44	40° 18' 54.83"	74° 02' 50.25"
540063.75	618691.67	40° 18' 54.81"	74° 02' 45.96"
540370.00	618691.67	40° 18' 57.84"	74° 02' 45.94"
540370.00	618359.44	40° 18' 57.86"	74° 02' 50.23"

M-18 Landfill: Chromium (Figure 4-7a)

Northing	Easting	Latitude	Longitude
539986.53	618328.00	40° 18' 54.07"	74° 02' 50.66"
539986.53	618642.67	40° 18' 54.05"	74° 02' 46.60"
540367.57	618642.67	40° 18' 57.82"	74° 02' 46.58"
540367.57	618328.00	40° 18' 57.84"	74° 02' 50.64"

M-18 Landfill: Lead (Figure 4-8a)

Northing	Easting	Latitude	Longitude
540063.66	618337.31	40° 18' 54.83"	74° 02' 50.54"
540063.66	618647.76	40° 18' 54.82"	74° 02' 46.53"
540376.67	618647.76	40° 18' 57.91"	74° 02' 46.51"
540376.67	618337.31	40° 18' 57.92"	74° 02' 50.52"

6. Estimated size of the proposed ground water classification exception area:

4.1 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): greater than 1,000 years

   b. Expiration date (as calendar date): sometime after 3004

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix C

CEA Fact Sheet: Site 80/166

APPENDIX C

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Bldg. 80 (FTMM-56)

4. Street address: Riverside Ave., Main Post (East)

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 105

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 80/166 is located in the eastern part of the Main Post Area of Fort Monmouth, north of Riverside Avenue and south of Building 166. Site 80/166 is located approximately 500 feet northwest of Oceanport Creek.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 105

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
a-Chlordane	1.625	0.5	0.0043
g-Chlordane	2.719	0.5	0.0043
Arsenic	71.6	8.0	0.017
Lead	84.1	10.0	5.0

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 5-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

Site 80/166: g-Chlordane (Figure 5-3a)

Northing	Easting	Latitude	Longitude
540895.51	623434.56	40° 19' 02.79"	74° 01' 44.67"
540970.92	623507.03	40° 19' 03.53"	74° 01' 43.73"
540895.51	623579.95	40° 19' 02.78"	74° 01' 42.80"
540825.16	623507.03	40° 19' 02.09"	74° 01' 43.74"

Site 80/166: Arsenic (Figure 5-4a)

Northing	Easting	Latitude	Longitude
540994.80	623452.11	40° 19' 03.77"	74° 01' 44.44"
540994.80	623775.18	40° 19' 03.75"	74° 01' 40.27"
540698.21	623775.18	40° 19' 00.82"	74° 01' 40.29"
540698.21	623452.11	40° 19' 00.84"	74° 01' 44.46"

Site 80/166: Lead (Figure 5-5a)

Northing	Easting	Latitude	Longitude
540916.47	623545.80	40° 19' 02.99"	74° 01' 43.24"
540916.47	623723.49	40° 19' 02.98"	74° 01' 40.94"
540709.70	623723.49	40° 19' 00.94"	74° 01' 40.96"
540709.70	623545.80	40° 19' 00.95"	74° 01' 43.25"

6. Estimated size of the proposed ground water classification exception area:

3.29 acres

7. Projected duration and expiration date of the proposed classification exception area:

a. Duration (in years and or days): greater than 1,000 years

b. Expiration date (as calendar date): sometime after the year 3004

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix D

CEA Fact Sheet: Site 108

APPENDIX D

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Site 108 (FTMM-57)

4. Street address: Riverside Ave., Main Post (East)

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 105

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 108 is located in the eastern part of the Main Post Area of Fort Monmouth, east of Riverside Avenue in the vicinity of buildings 63, 484 and 488. Site 108 is located approximately 400 feet northwest of Oceanport Creek and approximately 180 feet west of the New Jersey Transit Railroad.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 105

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Arsenic	63.2	8.0	0.017

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 6-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

	Northing	Easting	Latitude	Longitude
Site 108: Arsenic (Figure 6-3a)	541785.55	623656.87	40° 19' 11.57"	74° 01' 41.74"
	541785.55	623887.43	40° 19' 11.56"	74° 01' 38.77"
	541598.45	623887.43	40° 19' 09.71"	74° 01' 38.78"
	541598.45	623656.87	40° 19' 09.72"	74° 01' 41.76"

6. Estimated size of the proposed ground water classification exception area:

1.0 acres

7. Projected duration and expiration date of the proposed classification exception area:

a. Duration (in years and or days): greater than 1,000 years

b. Expiration date (as calendar date): sometime after the year 3004

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix E

CEA Fact Sheet: Site 283

APPENDIX E

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Bldg. 283 (FTMM-61)

4. Street address: Sherrill Ave., Main Post

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 110

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 283 is located in the north part of the Main Post Area of Fort Monmouth, on the north side of Sherrill Avenue. Site 283 is located approximately 200 feet south of Parkers Creek.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 110

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Benzene	1,009.73	1.0	0.15
Ethylbenzene	1,160.45	700	3,030
Total Xylenes	5,960.7	1,000	NA
Naphthalene	223.45	100	NA
Lead	33.1	10.0	5.0

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 7-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

Site 283: Benzene (Figure 7-3a)

Northing	Easting	Latitude	Longitude
540252.78	618803.53	40° 18' 56.68"	74° 02' 44.51"
540252.78	619082.35	40° 18' 56.66"	74° 02' 40.91"
540508.33	619082.35	40° 18' 59.19"	74° 02' 40.89"
540508.33	618803.53	40° 18' 59.20"	74° 02' 44.49"

Site 283: Lead (Figure 7-4a)

Northing	Easting	Latitude	Longitude
540205.56	618528.00	40° 18' 56.22"	74° 02' 48.07"
540205.56	619361.76	40° 18' 56.18"	74° 02' 37.30"
540641.18	619361.76	40° 19' 00.49"	74° 02' 37.27"
540641.18	618528.00	40° 19' 00.53"	74° 02' 48.04"

6. Estimated size of the proposed ground water classification exception area:

10.0 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): 210 years

   b. Expiration date (as calendar date): 2214

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix F

Groundwater Modeling Information and BIOCHLOR spreadsheets for Site 812

APPENDIX F

Determination of the Duration and Arial Extent of the CEAs

A. Introduction

Versar used the NJDEP's analytical solution option (1998) to estimate the duration and downgradient extent of the proposed CEAs for Site 812 (the Site). The model describes the one-dimensional transport of decaying solute species under natural attenuation conditions.

B. Components of the Model

The degradation of chlorinated solvents (i.e., PCE and TCE) results in the production of some less chlorinated daughter products (i.e., PCE \ TCE \ DCE \ VC) that are also subject to GWQCs. In order to accurately represent the fate and transport of the chlorinated VOCs detected in the monitoring wells at the site, the governing model transport equation for each chlorinated solvent was linked with the governing equations for the appropriate parent and daughter species. In this manner, the degradation of one parent species results in the production of its associated daughter product. The fate and transport of each parent and daughter species, as controlled by the natural attenuation processes in ground water flow was modeled for each well source.

In determining the extent and duration of the CEA for the Site, the NJDEP's analytical solution option (1998) was modified to account for the decay and production of parent/daughter constituents. The mass conversion of parent species (e.g., PCE) to daughter species (e.g., TCE) was calculated for each constituent as a function of the appropriate constituent half-life over the simulation time step. Mass of decaying parent species is converted to mass of daughter product by accounting for differing molecular weights of constituents.

In the model, the source is assumed to be located at the well of interest. Initial concentrations of the chlorinated solvents at the source are assumed to be equal to the concentrations measured during the most recent round of ground water sampling at the site (1998). Since the model assumes a uniform flow - isotropic and homogeneous, and a known flow direction, the CEA area is semi-circular in plan view.

Species migrate away from the source at a rate that is primarily governed by advection. The model used is conservative since it does not account for species attenuation by hydrodynamic dispersion and adsorption, but only by biodegradation. In the model, biodegradation is represented by a first-order decay process in accordance with the biodegradation half-life of each species. The key assumptions used in the model are as follows:

- X The aquifer is homogeneous and isotropic.
- X The ground water velocity is uniform and constant.
- X The biodegradation rate of the chlorinated solvents is proportional to concentration and may be represented by a first-order biodegradation rate expression.
- X To be conservative, chlorinated solvent losses through molecular diffusion, hydrodynamic dispersion and volatilization are neglected.

C. Input Parameters

The model relies on site-specific data for parameter input values. The model input data are described below.

1. First Order Decay Constants

The first order decay constants describe the rate at which compounds are biodegraded in the aquifer. They are determined in laboratory and field experiments, and are specific to each compound. Decay constants are in units of 1/time. The decay constants are related to the half-lives as described in the following equation.

$$\text{Decay constant} = ((\ln 0.5)/\text{half-life}) = (0.693/\text{half-life})$$

The model requires first order decay constants. The decay constants were derived from literature (Howard, 1991).

2. Uniform Ground Water Seepage Velocity

The uniform ground water seepage velocity is calculated from Darcy=s law as:

$$V_s = K * i/n_e$$

where:

V_s = seepage velocity;
K = hydraulic conductivity;
i = hydraulic gradient; and
n_e = effective porosity.

The hydraulic conductivity has units of length/time, and the hydraulic gradient and effective porosity are dimensionless, so the seepage velocity has units of length/time.

Versar determined the hydraulic conductivity at the Site by conducting single-well aquifer tests (slug tests and bail tests) in May 2000 (see Appendix D of Site 812 Remedial Investigation Report & Remedial Action Workplan). Versar used the arithmetic mean of these values for modeling.

The hydraulic gradient was determined for the aquifer based on the measured ground water elevations (see Table 4).

An effective porosity of 0.25 was used in the model for the shallow aquifer, based on values provided by the USGS (1982) for this formation.

3. Retardation Factor

The retardation factor is a dimensionless parameter that describes the effect of chemical adsorption on the aquifer material. This process slows the migration of dissolved chemicals in ground water. The retardation factor is calculated as:

$$R_d = 1 + (K_{oc} * f_{oc} * \rho_b/n_e)$$

where:
R_d = retardation factor;
K_{oc} = soil sorption coefficient;
f_{oc} = fraction of organic carbon;
ρ_b = bulk density of formation; and
n_e = effective porosity.

Versar obtained literature values for these parameters. The soil sorption coefficient is compound-specific and is expressed in units of milliliters of solute per gram of aquifer material (USEPA 1996b). The fraction of organic carbon of 0.001 was used in the model as recommended by the USEPA (1996a) for the sites at which no specific data are available. The bulk density values were obtained from a range of values for similar geologic materials (USEPA 1985). The effective porosity was selected as described above.

D. Modeling Results

Tables A-1, A-2 and A-3 present detailed CEA calculations for each well of concern at the site (i.e., MW-04, MW-05, and MW-07). Graphical depictions of the model output for each contaminant from each source well are provided in Figures A-1 through A-3. These results and their relationship to the proposed CEAs are discussed in the text of the report.

E. References

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko. 1991. *Handbook of Environmental Degradation Rates.* Chelsea, Michigan: Lewis Publishers.

United States Department of the Interior Geological Survey. 1982. *Physical Properties of Rocks*. Reston, Virginia. Open-File Report 82-166.

United States Environmental Protection Agency. 1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part II.* (Revised 1985). EPA/600/6-85/002b.

United States Environmental Protection Agency (USEPA). 1996a. *BIOSCREEN: Natural Attenuation Decision Support System. User=s Manual*. Version 1.3. Office of Research and Development. Washington, D.C. EPA/600/R-96/087.

United States Environmental Protection Agency (USEPA). 1996b. *Soil Screening Guidance: Technical Background Document*. Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/R-95/128.

Figure A-1
1,1,1-trichloroethane Concentrations at Wells 812-MW05 and 812-MW07
Site 812
Fort Monmouth, New Jersey

CEA Duration

Input

Parameters / Constituents		1,1,1-trichloroethane
Δt	days	6.5
k	$days^{-1}$	0.00251
$T_{1/2}$	days	276
5/26/00 Average Concentration for MW-05 & MW-07	µg/L	41.84
6/9/00 Average Concentration for MW-05 & MW-07	µg/L	43.71
Initial Concentration, C	µg/L	42.78
AVERAGE OF 5/26/00 & 6/9/00 DATA	µg/L	42.78

Calculation and Results

Time (days)	Date	Predicted Concentrations, C (µg/L)
0	June 2, 2000	42.78
7	June 8, 2000	42.08
13	June 15, 2000	41.40
20	June 21, 2000	**40.73**
26	June 28, 2000	40.08
33	July 4, 2000	39.43
39	July 11, 2000	38.79
46	July 17, 2000	38.16
52	July 24, 2000	37.55
59	July 30, 2000	36.94
65	August 6, 2000	36.34
72	August 12, 2000	35.76
78	August 19, 2000	35.18
85	August 25, 2000	34.61
91	September 1, 2000	34.05
98	September 7, 2000	33.50
104	September 14, 2000	32.96
111	September 20, 2000	32.42
117	September 27, 2000	31.90
124	October 3, 2000	31.39
130	October 10, 2000	30.88
137	October 16, 2000	30.38
143	October 23, 2000	29.89

CEA will extend until approximately:

143	**October 23, 2000**	**29.89**
NJDEP GWQC	**µg/L**	**30**

Notes:

NJDEP GWQC = New Jersey Department of Environmental Protection Ground Water Quality Criterion

Parent Constituent Predicted Concentration: $C_p(t) = C_p(t-1) * e^{-k\Delta t}$

Daughter Constituent Predicted Concentration: $C_d(t) = C_d(t-1) * e^{-k\Delta t} + (Cp(t-1)-Cp(t))*Md/Mp$

Time to reach NJDEP GWQC $= T_{NJDEP\ GWQC}$

Reaction Rate Constant = $k = -\ln(0.5)/t_{1/2}$

Length of CEA

Input Data

Hydraulic Conductivity(3) (K)	**cm/s**	**1.60E-03**
Hydraulic Gradient(4) (i):	**ft/ft**	**0.01923**
Effective Porosity(5) (n_e):	**---**	**0.25**
Bulk Density of Formation(5) (ρ_b)	**kg/L**	**1.6**
n-Octanol/Carbon Partition(6) (K_{oc}):	**L/kg**	**426**
Fraction of Organic Carbon(7) (f_{oc})	**---**	**0.001**

Calculation and Results

Seepage Velocity (ft/day)	vs = K*i/ne =	0.35
Retardation Factor	Rd = 1 + (Koc * foc* rb / ne) =	3.73
Pollutant Transport Rate (ft/day)	vpt = vs/Rd =	0.094
or (ft/year)		34.17
T_{NJGWQC} (days)	**Determined above**	**143**
T_{NJGWQC} (years)		**0.4**
Length of CEA (ft)	**vpt * TGWQS =**	**13**

Notes:

(1) Initial concentration (Co) is the average concentration of the last two sampling events: 5/26/00 & 6/9/00

(2) Half-Life data reference: Geometric mean of the minimum and maximum half-life published by Howard, 1991

(3) Hydraulic conductivity, K = 1.6 cm/sec - Average K for Shresbury Hydrogeologic Unit (Slug Test on May 19, 2000)

(4) Hydraulic gradient (i) derived from ground water elevation contours generated by Vasar for the May 30, 2000 measurements.

(5) Effective porosity, n = 0.25; Bulk Density, Rhob = 1.6 (characteristic value for sands at the Site)

(6) K_{oc} data reference: Biochlore or Bioscreen

(7) f_{oc} = 0.001 (default value - conservative).

Figure A-2
Benzene Concentrations at Well 812-MW04
Site 812
Fort Monmouth, New Jersey

CEA Duration

Input

Parameters / Constituents		Benzene
Δt	days	13
k	$days^{-1}$	0.00817
$T_{1/2}$	days	85
5/26/00 Concentration	µg/L	8.84
6/9/00 Concentration	µg/L	9.99
Initial Concentration, C	µg/L	9.42
AVERAGE OF 5/26/00 & 6/9/00 DATA	µg/L	

Calculation and Results

Time (days)	Date	Predicted Concentrations, C (µg/L)
0	June 2, 2000	9.42
13	June 15, 2000	8.47
26	June 28, 2000	7.61
39	July 11, 2000	**6.85**
52	July 24, 2000	6.16
65	August 6, 2000	5.54
78	August 19, 2000	4.98
91	September 1, 2000	4.48
104	September 14, 2000	4.03
117	September 27, 2000	3.62
130	October 10, 2000	3.26
143	October 23, 2000	2.93
156	November 5, 2000	2.63
169	November 18, 2000	2.37
182	December 1, 2000	2.13
195	December 14, 2000	1.91
208	December 27, 2000	1.72
221	January 9, 2001	1.55
234	January 22, 2001	1.39
247	February 4, 2001	1.25
260	February 17, 2001	1.13
273	March 2, 2001	1.01
286	March 15, 2001	0.91

CEA will extend until approximately:

286	**March 15, 2001**	**0.91**
NJDEP GWQC	**µg/L**	**1**

Notes:

NJDEP GWQC = New Jersey Department of Environmental Protection Ground Water Quality Criterion

Parent Constituent Predicted Concentration: $C_p(t) = C_p(t\text{-}1) * e^{-k\Delta t}$

Daughter Constituent Predicted Concentration: $C_d(t) = C_d(t\text{-}1) * e^{-k\Delta t} + (Cp(t\text{-}1)\text{-}Cp(t))*Md/Mp$

Time to reach NJDEP GWQC $= T_{NJDEP\ GWQC}$

Reaction Rate Constant = $k = -\ln(0.5)/t_{1/2}$

Length of CEA

Input Data

Hydraulic Conductivity[3] (K)	**cm/s**	**1.60E-03**
Hydraulic Gradient[4] (i):	**ft/ft**	**0.01923**
Effective Porosity[5] (n_e):	**---**	**0.25**
Bulk Density of Formation[5] (ρ_b)	**kg/L**	**1.6**
n-Octanol/Carbon Partition[6] (K_{oc}):	**L/kg**	**426**
Fraction of Organic Carbon[7] (f_{oc})	**---**	**0.001**

Calculation and Results

Seepage Velocity (ft/day)	vs = K*i/ne =	0.35
Retardation Factor	Rd = 1 + (Koc * foc* rb / ne) =	3.73
Pollutant Transport Rate (ft/day)	vpt = vs/Rd =	0.094
or (ft/year)		34.17
T_{NJGWQC} (days)	**Determined above**	**286**
T_{NJGWQC} (years)		**1**
Length of CEA (ft)	**vpt * TGWQS =**	**27**

Notes:

(1) Initial concentration (Co) is the average concentration of the last two sampling events: 5/26/00 & 6/9/00

(2) Half-Life data reference: Geometric mean of the minimum and maximum half-life published by Howard, 1991

(3) Hydraulic conductivity, K = 1.6 cm/sec - Average K for Shresbury Hydrogeologic Unit (Slug Test on May 19, 2000)

(4) Hydraulic gradient (i) derived from ground water elevation contours generated by Vasar for the May 30, 2000 measurements.

(5) Effective porosity, n = 0.25; Bulk Density, Rhob = 1.6 (characteristic value for sands at the Site)

(6) K_{oc} data reference: Biochlore or Bioscreen

(7) f_{oc} = 0.001 (default value - conservative).

Figure A-3
Tetrachloroethene and Daughter Product Concentrations at Well 812-MW04
Site 812
Fort Monmouth, New Jersey

CEA Duration

Input

Parameters / Constituents		PCE	TCE	1,2-DCE	VC
Molecular Weight, M	g/mol	165.8	131.4	96.9	62.5
Δt	days	257			
k	$days^{-1}$	0.00135	0.00095	0.00174	0.00174
$T_{1/2}$	days	513	726	399	399
5/26/00 Concentration	µg/L	2.35	5.25	11,013.56	126.45
6/9/00 Concentration	µg/L	2.64	4.70	10,886.24	147.57
Initial Concentration, C	µg/L	2.50	4.98	10,949.90	137.01
AVERAGE OF 5/26/00 & 6/9/00 DATA	µg/L				

Calculation and Results

Time (days)	Date	Predicted Concentrations, C (µg/L)			
0	June 2, 2000	2.50	4.98	10949.90	137.01
257	February 14, 2001	1.76	4.47	7011.41	2628.54
514	October 29, 2001	1.25	3.91	4489.74	3309.84
771	July 13, 2002	**0.88**	3.35	2875.16	3160.91
1,028	March 27, 2003	0.62	2.83	1841.34	2690.91
1,285	December 9, 2003	0.44	2.36	1179.36	2150.10
1,542	August 22, 2004	0.31	1.94	755.46	1650.25
1,799	May 6, 2005	0.22	1.59	483.99	1231.86
2,056	January 18, 2006	0.15	1.30	310.13	901.00
2,313	October 2, 2006	0.11	1.05	198.77	648.82
2,570	June 16, 2007	0.08	0.85	127.43	461.53
2,827	February 28, 2008	0.05	0.68	81.72	325.06
3,084	November 11, 2008	0.04	**0.55**	52.43	227.08
3,341	July 26, 2009	0.03	0.44	33.66	157.55
3,598	April 9, 2010	0.02	0.35	21.62	108.68
3,855	December 22, 2010	0.01	0.28	13.90	74.60
4,112	September 5, 2011	0.01	0.22	**8.94**	50.99
4,369	May 19, 2012	0.01	0.17	5.76	34.72
4,626	January 31, 2013	0.00	0.14	3.72	23.56
4,883	October 15, 2013	0.00	0.11	2.40	15.95
5,140	June 29, 2014	0.00	0.09	1.55	10.77
5,397	March 13, 2015	0.00	0.07	1.01	7.26
5,654	November 25, 2015	0.00	0.05	0.66	**4.88**
CEA will extend until approximately:					
5,654	**November 25, 2015**	**0.00**	**0.05**	**0.66**	**4.88**
NJDEP GWQC	**µg/L**	**1**	**1**	**10**	**5**

Notes:

NJDEP GWQC = New Jersey Department of Environmental Protection Ground Water Quality Criterion

Parent Constituent Predicted Concentration: $C_p(t) = C_p(t-1) * e^{-k\Delta t}$

Daughter Constituent Predicted Concentration: $C_d(t) = C_d(t-1) * e^{-k\Delta t} + (Cp(t-1)-Cp(t))*Md/Mp$

Time to reach NJDEP GWQC $= T_{NJDEP\ GWQC}$

Reaction Rate Constant $= k = -\ln(0.5)/t_{1/2}$

Length of CEA

Input Data

Hydraulic Conductivity[3] (K)	cm/s	1.60E-03			
Hydraulic Gradient[4] (i):	ft/ft	0.01923			
Effective Porosity[5] (n_e):	---	0.25			
Bulk Density of Formation[5] (ρ_b)	kg/L	1.6			
n-Octanol/Carbon Partition[6] (K_{oc}):	L/kg	426	130	125	30
Fraction of Organic Carbon[7] (f_{oc})	---	0.001			

Calculation and Results

Seepage Velocity (ft/day)	vs = K*i/ne =	0.35			
Retardation Factor	Rd = 1 + (Koc * foc* rb / ne) =	3.73	1.83	1.80	1.19
Pollutant Transport Rate (ft/day)	vpt = vs/Rd =	0.094	0.190	0.194	0.293
or (ft/year)		34.17	69.51	70.74	106.83
T_{NJGWQC} (days)	Determined above	771	3,084	4,112	5,654
T_{NJGWQC} (years)		2	8	11	15
Length of CEA (ft)	vpt * TGWQS =	72	587	797	1,655

Notes:

(1) Initial concentration (Co) is the average concentration of the last two sampling events: 5/26/00 & 6/9/00

(2) Half-Life data reference: Geometric mean of the minimum and maximum half-life published by Howard, 1991

(3) Hydraulic conductivity, K = 1.6 cm/sec - Average K for Shresbury Hydrogeologic Unit (Slug Test on May 19, 2000)

(4) Hydraulic gradient (i) derived from ground water elevation contours generated by Vasar for the May 30, 2000 measurements.

(5) Effective porosity, n = 0.25; Bulk Density, Rhob = 1.6 (characteristic value for sands at the Site)

(6) K_{oc} data reference: Biochlore or Bioscreen

(7) f_{oc} = 0.001 (default value - conservative).

Appendix G

CEA Fact Sheet: Site 812

APPENDIX G

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Site 812 (FTMM-64)

4. Street address: Murphy Dr., Main Post

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Oceanport

   b. Block and Lots: Block 1; Lot 110

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 812 is located in the south-central portion of the Main Post near the Main Street entrance to Fort Monmouth. Site 812 is bordered by Murphy Drive to the east and south and to the northwest by an access road, Building 1000 (the Post Exchange or

PX), and Building 1001 (the Four Seasons Store). "Building" 812, the Army Community Service Center and associated parking areas, currently occupies the area defined as Site 812, which encompasses approximately 2.75 acres. Specific historical information is not available regarding previous operations and conditions at Site 812. Reportedly, Site 812 is the former location of a gasoline station with underground fuel storage.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Oceanport

b. Block and Lots: Block 1; Lot 110

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Benzene	9.99	1.0	0.15
Cis-1,2-dichloroethene	10,436.18	70	NA
1,1-dichloroethene	8.11	2.0	4.81
Tetrachloroethene	2.64	1.0	0.388
Trans-1,2-dichloroethene	615.87	100	592
Trichloroethene	5.25	1.0	1.09
1,1,1-trichloroethane	43.71	30	127
Vinyl Chloride	147.57	5.0	0.083

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 8-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

Site 812:1,1,1-trichloroethane (Figure 8-3)

Northing	Easting	Latitude	Longitude
537989.54	620469.19	40° 18' 34.23"	74° 02' 23.15"
537989.54	620530.69	40° 18' 34.22"	74° 02' 22.36"
537884.54	620530.69	40° 18' 33.18"	74° 02' 22.37"
537774.54	620469.19	40° 18' 32.10"	74° 02' 23.17"

Site 812: Benzene (Figure 8-4)

Northing	Easting	Latitude	Longitude
620590.62	537946.56	40° 32' 13.41"	74° 20' 06.47"
620646.83	537948.20	40° 32' 13.97"	74° 20' 06.45"
620629.75	537891.38	40° 32' 13.80"	74° 20' 07.19"
620611.55	537890.65	40° 32' 13.62"	74° 20' 07.20"

Site 812: Vinyl Chloride (Figure 8-5)

Northing	Easting	Latitude	Longitude
537884.56	620521.02	40° 18' 33.19"	74° 02' 22.49"
538581.94	620299.40	40° 18' 40.09"	74° 02' 25.31"
538716.14	620436.71	40° 18' 41.41"	74° 02' 23.52"
538716.14	620547.01	40° 18' 41.40"	74° 02' 22.10"
538612.27	620722.12	40° 18' 40.37"	74° 02' 19.85"
537885.89	620710.28	40° 18' 33.19"	74° 02' 20.05"

6. Estimated size of the proposed ground water classification exception area:

2.75 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): 11 years

   b. Expiration date (as calendar date): 2015

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix H

CEA Fact Sheet: Site 1122

APPENDIX H

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Bldg. 1122 (FTMM-59)

4. Street address: Semaphore Ave., Main Post

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Eatontown

   b. Block and Lots: Block 1; Lot 3

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 1122 is approximately 1.5 acres and is located in the southwestern part of the Main Post Area of Fort Monmouth, north of Alexander Avenue and just south of Mill Creek.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Eatontown

b. Block and Lots: Block 1; Lot 3

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Methyl tert-butyl ether	1,077.47	70	NA
Tetrachloroethene	8.99	1.0	0.388

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 9-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

Site 1122: MTBE (Figure 9-4)

Northing	Easting	Latitude	Longitude
538394.02	617423.28	40° 18' 38.38"	74° 03' 02.45"
538474.36	617412.98	40° 18' 39.17"	74° 03' 02.57"
538461.05	617400.98	40° 18' 39.04"	74° 03' 02.73"
538430.69	617359.32	40° 18' 38.74"	74° 03' 03.27"

Site 1122: Tetrachloroethene (Figure 9-4)

Northing	Easting	Latitude	Longitude
538337.44	617448.39	40° 18' 37.82"	74° 03' 02.13"
538420.50	617441.15	40° 18' 38.64"	74° 03' 02.21"
538409.74	617406.98	40° 18' 38.53"	74° 03' 02.66"
538377.99	617375.77	40° 18' 38.22"	74° 03' 03.06"

6. Estimated size of the proposed ground water classification exception area:

0.26 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): 3.7 years

   b. Expiration date (as calendar date): 2008

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.

Appendix I

CEA Fact Sheet: Site 2567

APPENDIX I

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: N/A

2. Program Interest Number (Preferred ID): N/A

3. Program Interest Name: Bldg. 2567 (FTMM-58)

4. Street address: Laboratory Rd., Charles Woods

5. City: Ft. Monmouth

6. County: Monmouth

7. Block and Lots of the site (duplicate if the site is located in more than one municipality):

   a. Name of the municipality in which the site is located: Tinton Falls

   b. Block and Lots: Block 1; Lot 101

   c. Year of tax map: Federal (exempt)

8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as Exhibit A.

9. Site Contact:

   a. Name of contact person: Joseph Fallon – Lead Environmental Specialist

   b. Company name: US Army Garrison, Directorate of Public Works

   c. Mailing address: Att: SELFM-PW-EV, Bldg. 173, Ft. Monmouth, NJ 07703

   d. Phone number: (732) 532-6223

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

Site 2567 is located in the Charles Wood Area of Fort Monmouth at the northwest corner of the intersection between Laboratory Road and Hope Road. Site 2567 includes Building 2567, two gasoline dispenser islands located within the paved area south of the building and dense wooded areas located to the south and east of the site.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Tinton Falls

b. Block and Lots: Block 1; Lot 101

c. Year of tax map: Federal (exempt)

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Navesink-Hornerstown Confining Unit	125 ft	Class III-A

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Tert-butyl alcohol	1,488.05	100	NA

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as Exhibit B.

See Figure 10-2

Vertical: As stated in B.3., above.

See Figure 2-4

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

	Northing	Easting	Latitude	Longitude
Site 2567: TBA (Figure 10-4)	532102.87	609646.66	40° 17' 36.58"	74° 04' 43.22"
	532222.48	609808.01	40° 17' 37.76"	74° 04' 41.13"
	532911.67	609632.75	40° 17' 44.58"	74° 04' 43.35"
	532975.97	609531.82	40° 17' 45.22"	74° 04' 44.65"
	532893.75	609579.47	40° 17' 44.40"	74° 04' 44.04"

6. Estimated size of the proposed ground water classification exception area:

5.5 acres

7. Projected duration and expiration date of the proposed classification exception area:

   a. Duration (in years and or days): 3.9 years

   b. Expiration date (as calendar date): 2007

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information was collected for submittal to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.