FINAL

Remedial Investigation Report

CW-3A Landfill Site

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

Directorate of Public Works

January 7, 2005

201 Gibraltar Road, Suite 100
Horsham, Pennsylvania 19044

Contract No. DACA51-00-D-0004
Delivery Order No. 16

United States Army
Fort Monmouth, New Jersey

Remedial Investigation Report

CW-3A Landfill Site

Fort Monmouth, New Jersey

January 7, 2005

REMEDIAL INVESTIGATION REPORT
FOR THE CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

PREPARED FOR:

UNITED STATES ARMY FORT MONMOUTH
DIRECTORATE OF PUBLIC WORKS
BUILDING 167
FORT MONMOUTH, NJ 07703

PREPARED BY:

Versar INC.

January 7, 2005

VERSAR PROJECT NO. 4936.116

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Appendix A	CW-3A Site Investigation, Roy F. Weston, Inc., 1995
Appendix B	Soil Boring Logs and Monitoring Well Construction Records
Appendix C	Current Conditions Site Photographs
Appendix D	Soil Laboratory Data Sheets
Appendix E	Groundwater Laboratory Data Sheets

EXECUTIVE SUMMARY

VERSAR, Inc. (VERSAR) has been contracted by the United States (U.S.) Army Installation, Fort Monmouth (Fort Monmouth), Directorate of Public Works (DPW), Fort Monmouth, New Jersey to prepare a Remedial Investigation Report (RIR) for the CW-3A Landfill site based on work conducted by VERSAR in 2001, TECOM-Vinnell Services (TVS) in 1997-2001 and Roy F. Weston, Inc. (Weston) in 1995. This report addresses the Remedial Investigation (RI) activities conducted at the CW-3A Landfill site to investigate soil and groundwater conditions from December 1997 through January 2001.

The CW-3A Landfill site consists of a former historic landfill in the Charles Wood Area. It is bounded by Pearl Harbor Avenue to the west, an unnamed tributary of Wampum Brook to the north, a wooded area to the east and the Pulse Power Facility to the south. The approximate area of the CW-3A Landfill site is 116,000 ft^2 (2.6 acres). The unnamed tributary of Wampum Brook flows along the northern boundary of the CW-3A Landfill site for a distance of approximately 600 feet. The tributary is choked with thick vegetation and fallen trees with man-made debris scattered along its banks.

The Weston Site Investigation (SI) report, *Site Investigation, Fort Monmouth, New Jersey, Main Post and Charles Wood Areas, Site Investigation Report* (December 1995), presents the results of field investigation activities that were conducted at 13 sites at the Main Post Area and eight sites at the Charles Wood Area. The results of the investigation of the CW-3A Landfill site are included in the Weston SI report. Initial field investigation activities were conducted between November 1994 and March 1995. The field investigation activities included surface geophysical investigations, surface and subsurface soil sampling, groundwater monitoring well installation and sampling and tidal monitoring. The Weston SI report was used as the basis for the supplemental remedial investigations of the CW-3A Landfill site described in the following sections of this report.

The 1995 Weston SI report indicated that the CW-3A Landfill site was originally planned to be sampled as part of Weston's field investigation activities at the Main Post and Charles Wood areas between November 1994 and March 1995. These activities included surface geophysical investigations, surface and subsurface soil sampling, groundwater monitoring well installation and sampling and tidal monitoring. However, the 1995 Weston SI report noted that the presence of construction debris prevented any sampling from being completed at the CW-3A Landfill site. Consequently, to determine if historic subsurface disposal had occurred at the CW-3A Landfill site, Weston conducted geophysical investigations utilizing magnetic measurements (MAG), electromagnetic measurements (EM), and ground penetrating radar (GPR). These geophysical investigations revealed various "anomalies" indicative of buried ferrous materials at a depth of 2-3 feet below ground surface (bgs). As a result, Weston recommended that exploratory trenching be conducted at the CW-3A Landfill site to verify the presence of subsurface metallic debris (Weston, 1995).

Fort Monmouth DPW conducted exploratory trenching on September 25, 1997. Several test pits were excavated that revealed debris consisting of concrete, asphalt, brick, wood, glass, coal ash and assorted scrap metals. Four monitoring wells were installed by the DPW in December 1997.

The Weston SI report also presented a DPW proposal for a long-term monitoring program at the CW-3A Landfill site that was subsequently implemented by the DPW. This long-term monitoring program was developed utilizing four monitoring wells installed by the DPW in December 1997 at the CW-3A Landfill site.

The DPW conducted remedial investigation activities at the CW-3A Landfill site, including monitoring well installation, subsurface soil sampling, a quarterly groundwater sampling program, and two additional low-flow groundwater sampling rounds. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of the CW-3A Landfill site. Remedial investigation activities were conducted from December 1997 through January 2001.

Soil sampling was conducted by the DPW on December 17, 1997, during the construction of the four monitoring wells at the CW-3A Landfill site. A total of 12 subsurface soil samples were collected from four borehole locations at depths ranging from 0-6 inches, 18-24 inches and immediately above the groundwater table. In addition, one sample of coal/ash was collected from a test pit at the CW-3A Landfill site. The soil samples were analyzed by the Fort Monmouth Environmental Testing Laboratory (FMETL) for volatile organic compounds (VOCs) plus 15 parameters, semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals and cyanide.

A total of four monitoring wells comprise the quarterly groundwater monitoring program conducted by the DPW. As a part of the remedial investigation, a quarterly groundwater sampling program was conducted by the DPW at the CW-3A Landfill site. Groundwater samples were collected during 14 quarterly sampling events and analyzed for VOCs, SVOCs, pesticides, PCBs, ammonia, cyanide and TAL metals.

The soil sample analytical results from the 12 samples and one coal ash sample collected from the CW-3A Landfill site indicate that the five SVOCs were detected in soils at concentrations in excess of their respective RDCSCC criteria. However, based on the low levels of detection of these five SVOCs in soils, there are no COCs for soils at the CW-3A Landfill site. Therefore, NFA is required regarding soils at the CW-3A Landfill site.

Based on the results of the groundwater quality evaluation, no VOCs, SVOCs, pesticides or PCBs were detected above the NJDEP GWQC. The analytical results indicate 17 TAL metals detected in groundwater samples at concentrations exceeding the NJDEP GWQC. However, none of these metals are considered to be COCs in site groundwater due to the process of elimination via categorization of background metals, reduction in concentration or non-detection of samples by low flow sampling, and elimination of isolated and marginal detections. Therefore, no COCs exist at the CW-3A Landfill site, and No Further Action (NFA) is required regarding groundwater at the CW-3A Landfill site.

1.0 INTRODUCTION

VERSAR has been contracted by the U.S. Army Installation, Fort DPW, Fort Monmouth, New Jersey to prepare an RIR for the CW-3A Landfill site based on work conducted by VERSAR in 2001, TVS in 1997-2001 and Weston in 1995. This report addresses the RI activities conducted at the CW-3A Landfill site to investigate soil and groundwater conditions from December 1997 through January 2001.

1.1 Objectives

The objective of this RIR is to determine aquifer chemical and physical characteristics and to determine whether further remedial investigation or remedial action is required within the CW-3A Landfill site. The remedial investigation of the CW-3A Landfill site was conducted in accordance with New Jersey Administrative Code (NJAC) 7:26E - *Technical Requirements for Site Remediation* (July 1999).

The remedial investigation encompassed the following:

- Characterization of surface and subsurface site soils in December 1997.
- Characterization of groundwater quality over time through quarterly groundwater sampling events conducted between December 1997 and January 2001.
- Comparison of the results of the groundwater and soil quality monitoring programs with the NJDEP Ground Water Quality Criteria (GWQC) and Residential Direct Contact Soil Cleanup Criteria (RDCSCC).
- Investigation and evaluation of the designated aquifer uses, the associated aquifer classification, and the appropriate groundwater quality criteria for groundwater resources beneath the CW3A Landfill site. The NJDEP Ground Water Quality Standards (GWQS) specify the quality criteria and designated uses for groundwater and also contain technical and general policies to ensure that the designated uses can be adequately protected.
- Formulation of an NFA proposal regarding soil and groundwater contamination at the CW-3A Landfill site, for consideration by the NJDEP. This proposal is based on the results of field and laboratory investigations and the hydrogeologic conditions at the site. The rationale for the NFA proposal is presented in this RIR.

1.2 Report Organization

The findings of the Weston report entitled, *Site Investigation, Fort Monmouth, New Jersey, Main Post and Charles Wood Areas, Site Investigation Reports* (December 1995), were used as the basis for this remedial investigation program. **Section 2.0** provides background information and a general description of the CW-3A Landfill site located at the Charles Wood Area of Fort

Monmouth (Weston, 1995). **Section 3.0** describes and summarizes the RI field activities conducted at the CW-3A Landfill site, including the groundwater and soil sampling. **Section 4.0** presents the physical characterization of the CW-3A Landfill site including the lithology and groundwater conditions at the CW-3A Landfill site. The chemical characterization of the CW-3A Landfill site is presented in **Section 5.0,** which includes soil and groundwater sampling results. Conclusions and recommendations regarding the CW-3A Landfill site are discussed in **Section 6.0**. References used to prepare this RIR are listed in **Section 7.0**.

2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

The following sections describe the background and environmental setting of the area surrounding Fort Monmouth and the CW-3A Landfill site. Included is a description of the CW-3A Landfill site location, background, current conditions 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 Charles Wood Area is located one mile west of the Main Post and is comprised of approximately 511 acres. The Charles Wood Area is used primarily for research and development, testing and personnel housing units. 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.

The CW-3A Landfill site consists of a former historic landfill in the Charles Wood Area (**Figure 2-2**). It is bounded by Pearl Harbor Avenue to the west, an unnamed tributary of Wampum Brook to the north, a wooded area to the east and the Pulse Power Facility (Building No. 2707) to the south. The approximate area of the CW-3A Landfill site is 116,000 ft^2 (2.6 acres). The unnamed tributary of Wampum Brook flows along the northern boundary of the CW-3A Landfill site for a distance of approximately 600 feet. The tributary is choked with thick vegetation and fallen trees with man-made debris scattered along its banks.

2.2 Site Background

The U.S. Army Corps of Engineers (USACE), Baltimore District, initially contracted Weston to perform a field investigation at Fort Monmouth, New Jersey. This investigation was conducted at two separate areas of Fort Monmouth, the Main Post and the Charles Wood areas. Suspected hazardous waste sites were initially identified at Fort Monmouth in a report prepared by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA, 1980). The USATHAMA report identified 37 sites with known or suspected waste materials on the Main Post and the two subposts (Charles Wood and Evans Area). A background investigation was conducted by Weston of the 37 sites and eight additional sites that were identified by Fort Monmouth and the NJDEP. Weston's findings were described in a report titled, *Investigation of Suspected Hazardous Waste Sites at Fort Monmouth, New Jersey* (1993). In this background report, additional investigations (including sampling and other field work) were recommended at 22 of the sites on the Main Post and Charles Wood areas, including the CW-3A Landfill site. NJDEP approved the recommendations on April 20, 1995. Additional investigations were also

recommended at the Evans Area, and such investigations are being completed under the Base Realignment and Closure (BRAC) program.

Background sampling was performed to characterize site conditions identified in the report *The Investigation of Suspected Hazardous Waste Sites at Fort Monmouth, New Jersey* (Weston, 1993). The purpose of the collection of background characterization data was to identify levels of chemicals that are naturally occurring.

The Weston SI report, *Site Investigation, Fort Monmouth, New Jersey, Main Post and Charles Wood Areas, Site Investigation Report* (December 1995), presents the results of field investigation activities that were conducted at 13 sites at the Main Post Area and eight sites at the Charles Wood Area. The results of the investigation of the CW-3A Landfill site are included in the Weston SI report. Initial field investigation activities were conducted between November 1994 and March 1995. The field investigation activities included surface geophysical investigations, surface and subsurface soil sampling, groundwater monitoring well installation and sampling and tidal monitoring. The Weston SI report was used as the basis for the supplemental remedial investigations of the CW-3A Landfill site described in the following sections of this report.

The 1995 Weston SI report indicated that the CW-3A Landfill site was originally planned to be sampled as part of Weston's field investigation activities at the Main Post and Charles Wood areas between November 1994 and March 1995 (**Appendix A**). These activities included surface geophysical investigations, surface and subsurface soil sampling, groundwater monitoring well installation and sampling and tidal monitoring. However, the 1995 Weston SI report noted that the presence of construction debris prevented any sampling from being completed at the CW-3A Landfill site. Consequently, to determine if historic subsurface disposal had occurred at the CW-3A Landfill site, Weston conducted geophysical investigations utilizing MAG, EM measurements, and GPR. These geophysical investigations revealed various "anomalies" indicative of buried ferrous materials at a depth of 2-3 feet bgs. As a result, Weston recommended that exploratory trenching be conducted at the CW-3A Landfill site to verify the presence of subsurface metallic debris (Weston, 1995).

Fort Monmouth DPW conducted exploratory trenching on September 25, 1997. Several test pits were excavated that revealed debris consisting of concrete, asphalt, brick, wood, glass, coal ash and assorted scrap metals. Four monitoring wells were installed by the DPW in December 1997 (**Appendix B**). The Weston SI report also presented a DPW proposal for a long-term monitoring program at the CW-3A Landfill site that was subsequently implemented by the DPW. This long-term monitoring program was developed utilizing four monitoring wells installed by the DPW in December 1997 at the CW-3A Landfill site. The groundwater monitoring program and subsurface soil sampling activities are described in **Section 3.0**.

2.3 Current Conditions

VERSAR conducted a site walk on June 20, 2001, to assess current conditions at the CW-3A Landfill site. The CW-3A Landfill site consisted of a partially wooded lot with tall grass in the center and trees to the north, east and west. A parking area for the Pulse Power Facility is

located to the south of the CW-3A Landfill site. The site photograph is provided in **Appendix C**.

2.4 Environmental Setting

The following is a description of the geological/hydrogeological setting of the area surrounding the CW-3A Landfill site. Included is a description of the regional geology and hydrogeology of the area surrounding Fort Monmouth, as well as descriptions of the local geology and hydrogeology of the CW-3A area. The Charles Wood Area is located one mile from the Main Post and regional geologic/hydrogeologic conditions are similar.

2.4.1 Regional Geology

Monmouth County lies within the New Jersey Section of the Atlantic Coastal Plain physiographic province. The CW-3A Landfill site is located in what may be referred to as the Outer Coastal Plain subprovince, or the Outer Lowlands. The geologic map of New Jersey is provided in **Figure 2-3**.

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 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).

As presented in the *Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, prepared by Weston (1995), several natural and anthropogenic factors contribute to the wide range in concentrations of metals in soils, which further impact the concentration of metals in groundwater. Soils derived from the glauconitic sands contain abundant aluminum, calcium, potassium, iron, magnesium and manganese (among others), which are likely to be present at elevated concentrations in the groundwater, particularly when sediments are entrained in the collected groundwater samples.

The boring logs from monitoring wells installed by the DPW in December 1997, indicate that the lithology consists of a thin soil cover (0.4 feet) underlain by alternating layers of reworked sand, silt and broken concrete gravel pieces with interbedded plant/root fragments. Borehole logs also represent a lithology consisting of orange-olive-brown coarse to fine sand with little silt at this site. Groundwater saturation was observed 6-12 feet bgs at each well location during drilling activities. Further discussion of the subsurface conditions is presented in **Section 4.0.** Boring logs and monitoring well construction records are presented in **Appendix B**.

2.4.2 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 in the Main Post Area 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, 1984).

Wells installed in the Red Bank and Tinton Sands produce 2-25 gallons per minute (gpm) (Jablonski, 1968). Groundwater is typically encountered at the Main Post and in the surrounding

areas at shallow depths below ground surface (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 the site is underlain by a Class III-A aquifer. A formal presentation of this finding was made to the NJDEP on April 17, 2001. 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 2.4.3.**

Shallow groundwater may be locally influenced within the Main Post Area by the following factors:

- Tidal influence (based on proximity to the Atlantic Ocean, rivers, and tributaries)
- Topography
- Nature of the fill material within the Main Post Area
- 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. The groundwater flow in the vicinity of the CW-3A Landfill site is assumed to be north towards the unnamed tributary of Wampum Brook.

2.4.3 Aquifer Classification

On review of the NJDEP GWQS (N.J.A.C. 7:9-6), January 7, 1993, the CW-3A Landfill site is found to be underlain by a Class III-A aquifer (**Figure 2-4**). The primary designated use for Class III-A ground water 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 2-5**, 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 (see **Section 2.4.2**).

  - **Figure 2-6** also 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 area of Fort Monmouth is greater than 100 acres.

2.4.4 Soils

According to the U.S. Department of Agriculture (USDA), Soil Conservation Service, Monmouth County Soil Survey, the majority of the Main Post and Charles Wood areas are covered by urban land (**Figure 2-8**). The soil survey describes urban land as areas where concrete, asphalt, buildings, shopping centers, airports or other impervious surfaces cover 80 percent or more of the surface. In addition, the survey indicated that the natural subsurface soils have largely been replaced with artificial or foreign fill materials (developed land with disturbed soils). The following soil series and classification units are mapped in the Main Post and Charles Wood areas:

- DoB Downer sandy loam (with 2-5 percent slopes);
- FrB Freehold sandy loam (with 2-5 percent slopes);
- FUB Freehold sandy loam/urban land complex (with 0-10 percent slopes);
- HV Humaquepts, frequently flooded;
- KvA Kresson loam (with 0-5 percent slopes);
- PT Pits, Sand and Gravel;
- UA Udorthents, smoothed; and
- UD Udorthents – urban land complex (with 0-3 percent slopes).

The Downer series soils are well-drained soils that are found on uplands and terraces. The soils are formed in acid, silty coastal plain sediments. The Freehold soils are also well drained and are formed in acid, loamy, coastal plain sediments that, by volume, are 1-10 percent glauconite and are found on uplands. The Humaquepts soils are somewhat poorly- to very poorly- drained soils that are formed in stratified, sandy, or loamy sediments of fluvial origins. The Humaquepts soils are located on the floodplain and are subject to flooding several times each year. The Kresson

loam is a nearly level to gently sloping soil and is somewhat poorly drained. The soil is found on low divides and in depressions. The Udorthents soils have been altered by excavation or filling activities. In filled areas, these soils consist of loamy material that is more than 20 inches thick. The filled areas include floodplain, tidal marshes and areas with moderately, well drained to very poorly drained soils. Some Udorthent soils contain concrete, asphalt, metal and glass. The soils in the vicinity of the CW-3A Landfill site are classified as FUB – Freehold sandy loam/urban land complex (with 0-10 percent slopes).

2.4.5 Topography and Surface Drainage

Over the last 80 years, the natural topography of Fort Monmouth has been altered by excavation and filling activities conducted by the military. The CW-3A Landfill site is located on the floodplain of Wampum Brook. The USGS topographic map (**Figure 2-1**) shows that the land surface of the CW-3A Landfill Site is relatively flat at an elevation of 30-60 feet above mean sea level (amsl).

Surface water bodies in the vicinity of the Charles Wood Area include two unnamed tributaries of Wampum Brook. Wampum Brook is joined by several unnamed tributaries east of Charles Wood, prior to becoming Wampum Lake. Wampum Lake discharges into Mill Creek, which flows toward the Main Post Area.

The U.S Fish and Wildlife Service (FWS) National Wetland Inventory Long Branch quadrangle maps indicate the presence of several wetlands at the Main Post and Charles Wood areas. However, in the vicinity of the CW-3A Landfill site, the golf course lake is classified as palustrine open water/unknown bottom, and several areas along the unnamed tributaries of Wampum Brook are classified as palustrine forested wetland, broad-leaved deciduous. Based on the topography at the CW-3A Landfill site, surface water runoff is expected to flow north toward the unnamed tributary of Wampum Brook.

3.0 SITE ACTIVITIES

The DPW conducted remedial investigation activities at the CW-3A Landfill site, including monitoring well installation, subsurface soil sampling, a quarterly groundwater sampling program, and two additional low-flow groundwater sampling rounds. The purpose of these supplemental investigations was to define the areal extent of potential pollutants and evaluate impacts to groundwater in the vicinity of the CW-3A Landfill site. Remedial investigation activities were conducted from December 1997 through January 2001. These activities were managed by the DPW, conducted by TVS and reported by VERSAR. The details of remedial investigation activities that occurred at the CW-3A Landfill site are described in the following sections.

3.1 Soil Sampling Activities

Soil sampling was conducted by the DPW on December 17, 1997, during the construction of the four monitoring wells at the CW-3A Landfill site. A total of 12 subsurface soil samples were collected from four borehole locations (CW3A-MW1, CW3A-MW2, CW3A-MW3 and CW3A-MW4) at depths ranging from 0-6 inches, 18-24 inches and immediately above the groundwater table (encountered from 7-15 feet bgs). **Figure 3-1** shows the locations of the soil samples (monitoring well boreholes) at the CW-3A Landfill site. In addition, one sample of coal/ash was collected from a test pit at the CW-3A Landfill site. The soil samples were analyzed by the FMETL for VOCs plus 15 parameters, SVOCs, pesticides, PCBs, TAL metals and cyanide. A summary of the soil samples activities, including sample IDs, collection/analysis date, analytical parameters and analysis method is provided in **Table 3-1**. The results of these analyses are discussed in **Section 5.1**

Sampling equipment was thoroughly decontaminated before and after each use, in accordance with the *Fort Monmouth Standard Operating Procedures* (1997). The soil samples were collected using split spoons and immediately placed in laboratory-supplied bottleware. The sample containers were labeled, sealed, packed in ice and transported to the FMETL under proper chain-of-custody procedures. Copies of the chain-of-custody for the laboratory analyses of soil samples can be found in **Appendix D**.

3.2 Well Installation

A total of four monitoring wells (CW3A-MW1 through CW3A-MW4) comprise the quarterly groundwater monitoring program conducted by the DPW. These monitoring wells were installed at the CW-3A Landfill site by Lutz Environmental, Inc. for the DPW in December 1997. The wells were constructed with 4-inch diameter 20 Slot PVC ranging to depths of 13.5-20 feet bgs. The monitoring well construction details are presented in **Table 2-1.** The monitoring well locations are shown in **Figure 3-1**. Monitoring well boring logs and records are provided in **Appendix B**.

3.3 Groundwater Sampling Activities

As a part of the remedial investigation, a quarterly groundwater sampling program was conducted by the DPW at the CW-3A Landfill site from December 1997 through January 2001.

Sampling activities were conducted in accordance with the *Fort Monmouth Standard Sampling Operating Procedure* (1997). Laboratory analyses of the samples collected at the CW-3A Landfill site were conducted at the FMETL, a New Jersey certified laboratory (Certification No. 13461).

Groundwater samples were collected during 14 quarterly sampling events and analyzed for VOCs, SVOCs, pesticides, PCBs, ammonia, cyanide and TAL metals. A total of 110 groundwater samples were collected as a part of the groundwater sampling program, including 14 duplicate samples, 13 field blanks and 14 trip blanks for quality assurance/quality control (QA/QC) purposes. The groundwater samples were collected from the four 4-inch diameter monitoring wells (CW3A-MW1 through CW3A-MW4) installed at the CW-3A Landfill site in December 1997.

The analytical parameters were modified during the course of the groundwater monitoring program. The first two rounds included analytical testing for ammonia and cyanide. During the four rounds of groundwater sampling conducted from March 16, 1998 to February 23, 1999 (rounds #3 through #6), a total of 16 samples (out of the total 110 groundwater samples) were collected and analyzed for only VOCs. Rounds #7 through #14 conducted from June 1999 through January 2001 included analytical testing for VOCs, SVOCs, pesticides, PCBs and TAL metals.

As presented in the Weston SI Report (1995), several natural and anthropogenic factors contribute to the wide range in concentrations of metals in soils, which further impact the concentration of metals in groundwater. Soils derived from the glauconitic sands contain abundant aluminum, calcium, potassium, iron, magnesium and manganese (among others), which are likely to be present at elevated concentrations in the groundwater, particularly when sediments are entrained in the collected groundwater samples. A low-flow sampling methodology was proposed for use by the DPW and accepted by the NJDEP to assess the impact of entrained sediments on the dissolved phase metals concentrations at the CW-3A Landfill site. Using a low-flow sampling methodology to reduce the presence of entrained sediment has generally yielded substantial reductions in the dissolved phase concentrations of metals, such as arsenic, antimony, beryllium, cadmium, chromium, cobalt, lead, mercury, selenium, silver, thallium and vanadium at Fort Monmouth sites. Significant decreases in the concentrations of metals characteristic of glauconitic sand also were observed. These included aluminum, barium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc.

In consideration of the potential benefits of the low-flow sampling procedure, two additional rounds of low-flow sampling were conducted on August 24, 2000 (Low-Flow #1) and October 4, 2000 (Low Flow #2). A total of 12 samples (out of the total 110 groundwater samples) were collected and analyzed only for TAL metals, to determine whether elevated metal concentrations observed in the groundwater samples are due to sediments rather than groundwater. The samples were analyzed by the FMETL for TAL metals utilizing United States Environmental Protection Agency (USEPA) Methods 3120B and 3112B (**Table 3-2**). The results of these analyses are discussed in greater detail in **Section 5.1**.

Sampling equipment was thoroughly decontaminated before and after each use, in accordance with the *Fort Monmouth Standard Sampling Operating Procedure* (1997). Following collection, the groundwater samples were immediately placed in laboratory-supplied bottleware. The sample containers were labeled, sealed, packed in ice and transported to the FMETL under proper chain-of-custody procedures. Copies of the chain-of-custody for the laboratory analyses of groundwater can be found in can be found in **Appendix E.** A summary of the groundwater sampling activities, including rounds, sample IDs, collection/analysis date, analytical parameters and analysis method is provided in **Table 3-2**. The results of these analyses are discussed in **Section 5.1**.

3.4 Groundwater Depth Measurements

During each of the 16 groundwater monitoring rounds, measurements of the depth-to-water in each of the monitoring wells were recorded with an accuracy of 0.01 feet. These depth-to-water measurements, recorded from December 1997 through January 2001, are presented in **Table 3-3**. The groundwater elevation at each well was calculated as the difference between the surveyed elevation of the top of the well casing and the measured depth-to-water. The groundwater elevations are discussed in **Section 4.2**.

4.0 SITE PHYSICAL CHARACTERISTICS

The following sections represent the findings of the CW-3A Landfill site geologic and hydrogeologic characterization program. These sections include a detailed discussion of the physical properties of the unconsolidated soil, bedrock and groundwater underlying the study area. Groundwater elevation and water quality data collected by the DPW from December 1997 through January 2001 are also discussed in this report. The soil and groundwater sampling and associated laboratory analytical data comprise the long-term monitoring program that was instituted by the DPW after the Weston SI activities.

4.1 Lithology

The lithology encountered at the CW-3A Landfill site consists primarily of fill material, fine sand, silt and clay. A geologic cross section (A-A') was prepared for three monitoring wells. The cross section location map is included as **Figure 4-1**. The location of cross section A-A' is presented in map is included as **Figure 4-2**. The data used to create the cross section is presented in **Table 4-1**.

Cross section A-A' (**Figure 4-2**) depicts the profiles for monitoring wells CW3A-MW1, CW3A-MW2, CW3A-MW3 and CW3A-MW4. Wells CW3A-MW1, CW3A-MW2, CW3A-MW3 and CW3A-MW4 are projected onto the cross section line A-A' (**Figure 4-1**). The fill encountered in monitoring well borings at the CW-3A Landfill site consisted of lumber fragments, black-stained gravel fine to coarse with organics within the top five feet of the boring, ranging in depth from 2-5.5 feet bgs. Native material was encountered below the fill in all monitoring wells consisting of brown to black fine sand, silt and clay with organic material and ranged in depth from 6-20 feet bgs. The observation of sub-rounded quartz gravel led to the interpretation that the native material is representative of the Tinton Sand. Groundwater was encountered during well installation at depths ranging from 7-15 feet bgs grading toward an unnamed tributary of Wampum Brook.

As stated in **Section 2.4.2**, the wide range of concentrations of metals in soils further impact the concentration of metals in groundwater. Soils derived from glauconitic sands contain abundant aluminum, calcium, potassium, iron, magnesium and manganese (among others), which are likely to be present at elevated concentrations in the groundwater, particularly when sediments are entrant during the collection of groundwater samples.

4.2 Groundwater Flow

In accordance with NJAC 7:26E-3.13(d)2iv, 16 groundwater contour maps (**Figure 4-3a** through **4-3p**) were generated based on groundwater depth measurements collected at the CW-3A Landfill site between December 1997 and January 2001. As presented in **Table 3-3**, groundwater elevations were calculated as the difference of the surveyed top of casing measurements and groundwater depth measurements. In the most of the CW-3A Landfill site, groundwater flows northwest towards an unnamed tributary of Wampum Brook. The groundwater depth measurements also imply groundwater flow to the north and northwest in the northern part of the CW-3A Landfill site. There were no significant changes in groundwater elevation between the 16 rounds of water level measurements (see **Table 3-3**).

5.0 SITE CHEMICAL CHARACTERIZATION

This section includes a discussion of the chemical analytical characterization of the CW-3A Landfill site based on samples collected and analyzed from the site, including one round of soil sampling, 14 quarterly rounds of groundwater monitoring well samples and two rounds of low-flow groundwater sampling. DPW personnel were responsible for the collection of samples during this remedial investigation. Sample analyses were conducted by the FMETL, a New Jersey certified laboratory (Certification No. 13461).

5.1 Soil and Coal Ash Sampling Results

This section presents a summary of the laboratory analyses conducted for the one round of soil sampling (a total of 12 soil samples and one coal ash sample) on December 17, 1997 from the four groundwater monitoring well boreholes (CW3A-MW1, CW3A-MW2, CW3A-MW3 and CW3A-MW4). The coal ash sample was collected on December 17, 1997 from a test pit dug within the CW-3A Landfill site. The samples were collected from depths ranging from 0-6 inches bgs, 18-24 inches bgs and immediately above the water table (encountered at 7-15 feet bgs). The samples were analyzed by the FMETL. Four samples were analyzed for VOCs, SVOCs, TAL metals and cyanide. Four samples were analyzed for SVOCs, pesticides, PCBs, TAL metals and cyanide. Four samples were analyzed for VOCs. One sample (coal ash) was analyzed for VOCs, SVOCs, TAL metals and cyanide.

There were no detections of VOCs or cyanide in the 12 soil samples and one coal ash sample. The detections of SVOCs, pesticides and PCBs and TAL metals are discussed below in **Sections 5.1.1**, **5.1.2**, and **5.1.3**, respectively. The laboratory analytical results for soil sampling are summarized in **Table 5-1**. The results were compared to the NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC). Analytes detected above the respective NJDEP cleanup criteria in **Table 5-1** are highlighted and bold typeface. Analytes for soil samples that exceeded the RDCSCC are shown in **Figure 5-1**. The laboratory chain-of-custody forms for soil samples are provided in **Appendix D.**

5.1.1 Semi-Volatile Organic Compounds

A total of 17 SVOCs were detected in soil samples. Five SVOCs were detected at concentrations exceeding their respective NJDEP RDCSCC, and the remaining 12 SVOCs were detected at concentrations below their respective NJDEP RDCSCC. There were no SVOCs detected in the coal ash sample.

Benzo(a)anthracene was detected above the RDCSCC of 0.9 mg/kg in one soil sample (0-2') collected from one monitoring well boring location (CW3A-MW3) at a concentration of 8.2 mg/kg.

Benzo(a)pyrene was detected above the RDCSCC of 0.66 mg/kg in one soil sample (0-2') collected from one monitoring well boring location (CW3A-MW3) at a concentration of 6.2 mg/kg.

Benzo(b)flouranthene was detected above the RDCSCC of 0.9 mg/kg in one soil sample (0-2') collected from one monitoring well boring location (CW3A-MW3) at a concentration of 3.3 mg/kg.

Benzo(k)flouranthene was detected above the RDCSCC of 0.9 mg/kg in one soil sample (0-2') collected from one monitoring well boring location (CW3A-MW3) at a concentration of 4.3 mg/kg.

Indeno(1,2,3-cd)pyrene was detected above the RDCSCC of 0.9 mg/kg in one soil sample (0-2') collected from one monitoring well boring location (CW3A-MW3) at a concentration of 2.8 mg/kg.

5.1.2 Pesticides and PCBs

No pesticides or PCBs were detected above their respective RDCSCC at the site.

5.1.3 TAL Metals

A total of 21 TAL metals were detected in site soil samples. Three metals were detected at concentrations above their respective NJDEP RDCSCC, and the remaining 18 TAL metals were detected at concentrations below their respective NJDEP RDCSCC.

Barium was detected above the RDCSCC of 700 mg/kg in one soil sample (6-8') collected from one monitoring well boring location (CW3A-MW2) at a concentration of 729.8 mg/kg.

Cadmium was detected above the RDCSCC of 1.0 mg/kg in two soil samples and the coal ash sample. Concentrations ranged from 2.021 mg/kg at monitoring well boring location CW3A-MW3 (4-6') to 5.646 mg/kg in the coal ash sample.

Zinc was detected above the RDCSCC of 1,500 mg/kg in the coal/ash sample at a concentration of 1,842 mg/kg.

5.2 Groundwater Sampling Results

A total of 110 groundwater samples were collected to evaluate potential chemical impacts to groundwater from the CW-3A Landfill site. This section presents a discussion of the results of laboratory analyses collected for the 14 quarterly rounds of groundwater sampling and two additional low-flow rounds that were collected from December 1997 through January 2001 from the four monitoring wells at the CW-3A Landfill site. The four monitoring wells (CW3A-MW1, CW3A-MW2, CW3A-MW3 and CW3A-MW4) were installed on December 17, 1997. The groundwater samples were collected by the DPW and analyzed for VOCs, SVOCs, pesticides, PCBs, ammonia, cyanide and TAL metals. The two additional rounds of sampling (low-flow #1 and low-flow #2) were conducted on August 24, 2000 and October 4, 2000, using a low-flow groundwater sampling technique for TAL metals. As stated above, a low flow sampling methodology was proposed for use by the DPW and accepted by the NJDEP to assess the impact of suspended sediments on the dissolved phase metals concentrations at the CW-3A Landfill site.

As discussed in **Section 2.4.2**, Fort Monmouth is underlain by a Class III-A aquifer. The appropriate groundwater quality criteria for Class III-A are the criteria for the most stringent classification for vertically or horizontally adjacent ground waters that are not Class III-A (NJAC 7:9-6.7e). The NJDEP criteria used for comparison of groundwater analytical results were the higher of the Practical Quantitation Limits (PQLs) and the NJDEP GWQC for Class II-A aquifers (NJAC 7:9-6, Table 1).

Four VOCs were detected in site groundwater at concentrations below the NJDEP criteria. Seven SVOCs were detected in site groundwater at concentrations below the NJDEP criteria. There were no pesticides, PCBs or cyanide detected in site groundwater. A total of 23 TAL metals were detected in site groundwater. Seventeen TAL metals were detected at concentrations exceeding their respective NJDEP criteria, and the remaining six TAL metals were detected below their respective NJDEP criteria. Analytes detected in groundwater samples at concentrations above the NJDEP criteria are bold and highlighted in **Table 5-2**.

5.2.1 Volatile Organic Compounds

No VOCs were detected above their respective GWQC at the site.

5.2.2 Semi-Volatile Organic Compounds

No SVOCs were detected above their respective GWQC at the site.

5.2.3 Pesticides and PCBs

No pesticides or PCBs were detected at the site.

5.2.4 TAL Metals

During 12 groundwater sampling rounds and two low-flow sampling rounds, a total of 17 TAL metals were detected above their respective NJDEP GWQC in at least one sample at the CW-3A Landfill site. In four of the quarterly groundwater sampling rounds, TAL metals were not analyzed.

Aluminum was detected at concentrations exceeding the GWQC of 200 ug/L during 11 separate rounds of sampling collected at four separate monitoring well locations. Concentrations ranged from 214 ug/L in CW3A-MW1 (sampling round #11) to 367,000 ug/L in CW3A-MW3 (sampling round #9).

Antimony was detected at concentrations exceeding the GWQC of 20 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 27.1 ug/L (sampling round #9).

Arsenic was detected at concentrations exceeding the GWQC of 8.0 ug/L during seven separate rounds of sampling collected at four separate monitoring well locations. Concentrations ranged

from 8.12 ug/L in CW3A-MW2 (sampling round #7) to 587 ug/L in CW3A-MW3 (sampling round #9).

Barium was detected at concentrations exceeding the GWQC of 2,000 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 2,250 ug/L (sampling round #9).

Beryllium was detected at concentrations exceeding the GWQC of 20 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 26.1 ug/L (sampling round #9).

Cadmium was detected at concentrations exceeding the GWQC of 4.0 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 266 ug/L (sampling round #9).

Chromium was detected at concentrations exceeding the GWQC of 100 ug/L during three separate rounds of sampling collected at two separate monitoring well locations. Concentrations ranged from 108.5 ug/L in CW3A-MW1 (sampling round #2) to 6,190 ug/L in CW3A-MW3 (sampling round #9).

Copper was detected at concentrations exceeding the GWQC of 1,000 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 14,400 ug/L (sampling round #9).

Iron was detected at concentrations exceeding the GWQC of 300 ug/L during 12 separate rounds of sampling collected at four separate monitoring well locations. Concentrations ranged from 426 ug/L in CW3A-MW1 (sampling round #12) to 1,020,000 ug/L in CW3A-MW3 (sampling round #9).

Lead was detected at concentrations exceeding the GWQC of 10 ug/L during five separate rounds of sampling collected at three separate monitoring well locations. Concentrations ranged from 16 ug/L in CW3A-MW1 (sampling round #2) to 1,010 ug/L in CW3A-MW3 (sampling round #9).

Manganese was detected at concentrations exceeding the GWQC of 50 ug/L during 12 separate rounds of sampling collected at four separate monitoring well locations. Concentrations ranged from 61.8 ug/L in CW3A-MW1 (sampling round #1) to 9,680 ug/L in CW3A-MW3 (sampling round #9).

Mercury was detected at concentrations exceeding the GWQC of 2.0 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 5.1 ug/L (sampling round #9).

Nickel was detected at concentrations exceeding the GWQC of 100 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 1,050 ug/L (sampling round #9).

Selenium was detected at concentrations exceeding the GWQC of 50 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 73.8 ug/L (sampling round #9).

Silver was detected at concentrations exceeding the GWQC of 20 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 118 ug/L (sampling round #9).

Sodium was detected at concentrations exceeding the GWQC of 50,000 ug/L during nine separate rounds of sampling collected at three separate monitoring well locations. Concentrations ranged from 52,100 ug/L in CW3A-MW3 (sampling round #13) to 132,000 ug/L in CW3A-MW1 (sampling round #8).

Zinc was detected at concentrations exceeding the GWQC of 5,000 ug/L during one separate round of sampling collected at one separate monitoring well location (CW3A-MW3) at a concentration of 33,900 ug/L (sampling round #9).

5.2.5 Wet Chemistry

The wet chemistry analyses were performed by the FMETL during the first two quarterly sampling rounds (#1 and #2) conducted during in the remedial investigation at the CW-3A Landfill site. The wet chemical analyses included ammonia and cyanide. Cyanide was not detected at the CW-3A Landfill site.

Ammonia was detected above the NJDEP criteria of 0.10 mg/L during two separate rounds of groundwater sampling collected at four separate monitoring well locations. Concentrations ranged from 0.21 mg/L in CW3A-MW1 (sampling round #1) to 6.81 mg/L in CW3A-MW1 and CW3A-MW4 (sampling round #2).

5.3 Contaminants of Concern

Based on the soil and groundwater sample results discussed above, there are no contaminants of concern (COCs) in both soil and groundwater at the CW-3A Landfill site. The analysis that led to this result is discussed below.

5.3.1 Contaminants of Concern Analysis for Soils

There were no VOCs, pesticides or PCBs detected in the soil samples or in the coal ash sample at concentrations in excess of their respective RDCSCC criteria.

Five SVOCs were detected in one soil sample CW3A-MW3 (0.0-2.0'), at concentrations above the RDCSCC. Due to the low levels of detection of these SVOC analytes at concentrations above their respective RDCSCC, they are not considered to be COCs in soil at the CW-3A Landfill site.

Three metals were detected in soil samples collected from the CW-3A Landfill site at concentrations in excess of their respective RDCSCC criteria. Of these 3 metals, two metals are native constituents of soils at the Charles Wood Area and are not considered to be COCs. Cadmium was detected above the RDCSCC in two borehole locations (CW3A-MW2 and CW3A-MW3). Due to the low levels of detection of cadmium in soil from these two locations, cadmium is not considered to be a COC in soil at the CW-3A Landfill site.

5.3.2 Contaminants of Concern Analysis for Groundwater

There were no VOCs, SVOCs, pesticides, PCBs or cyanide detected in the groundwater samples collected from the CW-3A Landfill site at concentrations exceeding their respective NJDEP GWQC.

Ammonia was detected above the NJDEP criteria of 0.010 mg/L in two sampling rounds collected at each of the four monitoring wells at concentrations ranging from 0.21 mg/L to 6.81 mg/L. Since the ammonia concentrations are within an order of magnitude of the NJDEP GWQC, ammonia is not considered to be a COC in groundwater at the CW-3A Landfill site.

There were 17 TAL metals that were detected in the CW-3A Landfill site groundwater at concentrations exceeding their respective NJDEP GWQC. **Table 5-3** summarizes the process used to identify COCs in groundwater at the CW-3A Landfill site. These specific exceedences and the identification of each constituent as a potential COC are discussed below. None of these 17 TAL metals were found to be COCs in the groundwater at the CW-3A Landfill site.

The 17 different metals that were detected in site groundwater at concentrations exceeding the NJDEP GWQC are distinguished into background and non-native metals. The indigenous metals are compared to the Maximum Background Concentrations (MBC) for the Charles Wood Area (Weston 1995), and presented in **Tables 5-1** and **5-3.** The non-native metals are discussed in relation to the NJDEP GWQC only.

Of the 17 TAL metals detected that exceeded the NJDEP cleanup criteria, eight metals (aluminum, barium, copper, iron, manganese, nickel, sodium and zinc) are common background constituents in Monmouth County and the Charles Wood Area soils. 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. Elevated concentrations of these metals are routinely observed in groundwater samples collected at Fort Monmouth. The groundwater analytical results for aluminum, iron and manganese were compared to their respective MBCs of 121,000 ug/L, 431,000 ug/L and 331 ug/L. The groundwater analytical results for (aluminum, barium, copper, iron, manganese, nickel, sodium and zinc) were compared with the low flow sampling results to their respective MBCs. In consideration of these facts, these eight background metals are not considered to be COCs in groundwater in the CW-3A Landfill site.

There were nine non-native metals detected in site groundwater at the CW-3A Landfill site that exceeded the NJDEP GWQC (antimony, arsenic, beryllium, cadmium, chromium, lead, mercury,

selenium and silver). The groundwater analytical results are compared with the low-flow sampling results and to their respective GWQC.

The two separate rounds of low-flow sampling (August 24, 2000 and October 4, 2000) were collected during the quarterly groundwater sampling program, using the low-flow groundwater sampling technique as discussed in **Section 3.2.1**. This technique was used to determine if the detected metal concentrations observed in the groundwater samples are a function of entrained sediments suspended in the groundwater during the course of well purging and sampling activities, or an accurate representation of dissolved phase aquifer/groundwater conditions. In the two low-flow sampling rounds, there were no detections or lower concentrations of these nine uncharacteristic metals (antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, selenium and silver) above the NJDEP GWQC. Therefore, these nine non-native metals were determined not to be COCs in groundwater at the CW-3A Landfill site.

5.4 Quality Assurance/Quality Control

To verify the reliability of the analytical results, VERSAR reviewed the holding times for each sample and the results of the analysis of 17 method blanks for VOCs, 12 method blanks for SVOCs, nine method blanks for pesticides and PCBs, 12 method blanks for TAL metals, 14 trip blanks, 13 field blanks and 14 field duplicate samples. Samples were analyzed by the FMETL within the prescribed holding time requirements for each analytical method.

Method Blanks

Laboratory method blanks accompanied each batch of samples for the CW-3A Landfill site. These method blanks consist of laboratory grade water that is processed identically to the samples and analyzed with the sample batch. A total of 17 method blanks for VOCs, 12 method blanks for SVOCs, nine method blanks for pesticides and PCBs and 12 method blanks for TAL metals were analyzed with the CW-3A Landfill site samples.

Two SVOCs were detected in at least one method blank sample. These SVOCs were benzyl alcohol and di-n-butylphthalate. Neither of these SVOCs were detected at a concentration exceeding their respective NJDEP criteria. Their presence in only a few samples is not indicative of a widespread laboratory contamination problem.

Several metals were detected in at least one method blank sample, including aluminum, antimony, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc. All of the metals were detected in only a few samples at very low concentrations. Their presence in only a few samples is not indicative of a widespread laboratory contamination problem.

Trip Blanks

Fourteen trip blanks were included as part of the CW-3A Landfill site sampling program to document that volatile organics were not introduced into the samples during the handling process. The trip blanks were prepared by the FMETL and consisted of sample bottles filled with laboratory deionized water. The trip blanks remained with the sample bottles in coolers and were returned to the laboratory for analysis with the groundwater samples.

Two VOCs were detected in at least one trip blank. Chloroform was detected in four of the 14 trip blanks, with no detections exceeding the NJDEP criteria Methylene chloride was detected in one of the trip blanks at a concentration exceeded its NJDEP criteria. However, methylene chloride is a common laboratory contaminant. The detections of chloroform indicate that the sample handling procedures, including the sample glassware, may have introduced contamination into the sampling and analysis process.

Field Blanks

One field blank sample was obtained during the sampling activities each day to document the equipment decontamination procedures. A total of 13 field samples (e.g., field blanks) were collected during the CW-3A Landfill site sampling events. The field blanks were collected by rinsing deionized water, supplied by the laboratory, over the sampling equipment used for daily activities. The water was collected in clean laboratory-supplied sample jars and submitted for analysis along with the CW-3A Landfill site groundwater samples.

The results of the field blank analyses showed that two VOCs were detected in at least one field blank. Chloroform was detected in four of the 13 field blanks, all at concentrations below the NJDEP criteria. Methylene chloride was detected in one field blank at a concentration exceeding its NJDEP criteria. As noted for the trip blanks, methylene chloride is a common laboratory contaminant, and the detections of chloroform indicate that the sample handling procedures, including the sample glassware, may have introduced contamination into the sampling and analysis process. In addition, the same VOCs found in the field blanks were also found in the trip blanks, suggesting that the sampling and decontamination procedures did not introduce additional contamination.

Two SVOCs, bis(2-ethylhexyl) phthalate and di-n-butylphthalate, were each detected in at least one of the field blank samples. Both analytes were detected at low concentrations that are below their respective NJDEP criteria. In addition, di-n-butylphthalate was also identified in the method blanks; therefore, its presence in the field blank samples does not suggest that the sampling and decontamination procedures introduced additional contamination.

As noted for the method blanks, several metals were detected in at least one field blank sample, including aluminum, antimony, barium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc. All of the metals were detected in only a few samples at very low concentrations. Because these metals were also detected in the method blank samples, the sampling and decontamination procedures do not appear to have been the source of sample contamination. However, any subsequent evaluation of the metals analytical results must account for the possibility of laboratory contamination resulting in false positives for the environmental samples.

Duplicate Samples

Fourteen field duplicate samples were also collected during the CW-3A Landfill site sampling events to verify the consistency of the entire sampling and analytical procedure. The results for all of the duplicate samples were close to those obtained for the original samples. The relative percent differences (RPDs), which are the differences between the two samples being compared divided by their average, indicate the relative levels of precision maintained by the laboratory

throughout its analytical procedures. The RPDs for the soils duplicate samples was 41.4%. The RPDs for the duplicate samples VOCs ranged from 1.1% to 10.2%, and their average RPD was 7.2%. The RPDs for the duplicate samples SVOCs ranged from 14.4% to 50.5%, and their average RPD was 32.5%. These RPDs are very near the established limit of 30% for laboratory duplicate samples and indicate that a high level of precision was maintained throughout the sampling and analytical procedures.

The RPDs for the duplicate samples metals analyses ranged from 0.0% to 194.0%, however, the average RPDs for all of the metals results is 41.9%. This indicates that, overall, good precision was maintained, but that the metals results were much more varied than those for the VOCs or SVOCs. The apparent metals contamination noted in the method and field blanks may have impacted the precision of the metals analysis.

The QC sample results indicate good precision for all of the analyses. However, the presence of metals in the method blanks and field blanks indicate that contamination may have been introduced by the sampling and analysis procedures. Therefore, any subsequent evaluation of the metals analytical results must account for the possibility of laboratory contamination resulting in false positives for the environmental samples.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Geologic publications show that the CW-3A Landfill site is located within an aquitard (the Navesink-Hornerstown Confining Unit). The low hydraulic conductivity of the aquitard and the thickness of the aquitard at the site conform to the requirements of a Class III-A aquifer, as specified in the NJDEP GWQS (NJAC 7:9-6, January 7, 1993).

The soil sample analytical results from the 12 samples and one coal ash sample collected in December 1997 from the CW-3A Landfill site indicate that the five SVOCs were detected in soils at concentrations in excess of their respective RDCSCC criteria. However, based on the low levels of detection of these five SVOCs in soils, there are no COCs for soils at the CW-3A Landfill site. Therefore, NFA is required regarding soils at the CW-3A Landfill site.

The analytical results for the groundwater samples collected at the CW-3A Landfill site between December 1997 and January 2001 indicate that no COCs exist within the CW-3A Landfill site groundwater. The Class II-A criteria were used for comparison with site-specific data obtained from the various groundwater sampling rounds because the GWQS (NJAC 7:9-6.7e) state that the groundwater quality criteria to be used for Class III-A aquifers are the most stringent criteria associated with vertically or horizontally adjacent groundwaters that are not Class III-A.

Based on the results of the groundwater quality evaluation, no VOCs, SVOCs, pesticides or PCBs were detected above the NJDEP GWQC. The analytical results indicate 17 TAL metals detected in groundwater samples at concentrations exceeding the NJDEP GWQC. However, none of these metals are considered to be COCs in site groundwater due to the process of elimination via categorization of background metals, reduction in concentration or non-detection of samples by low flow sampling, and elimination of isolated and marginal detections. Therefore, no COCs exist at the CW-3A Landfill site, and NFA is required regarding groundwater at the CW-3A Landfill site.

7.0 REFERENCES

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

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 Administrative Code (NJAC) 7:26E - *Technical Requirements for Site Remediation.*

New Jersey Geological Survey Map, 1994.

TVS (TECOM-Vinnell Services), 2000. *SITE INVESTIGATION PLAN – Installation Landfill Program Sediment Sampling Plan for Nine Former Landfill Sites*.

USGS (U.S. Geological Survey), 1981. Long Branch Quadrangle Map.

WESTON (Roy F. Weston, Inc.), 1995. *Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey*, December 1995.

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

TABLES

Table 2-1
Well Construction Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

Well ID	NJDEP Permit Number	Northing	Easting	Elevation of Inner Casing Survey Mark	Elevation of Ground Surface	Hole Diameter	Total Depth of Well	Depth to Top of Screen	Screen Length	Screen Diameter	Screen Material	Date of Construction
Units	**--**	**ft**	**ft**	**ft (amsl)[1]**	**ft (amsl)[1]**	**in**	**ft (bgs)[2]**	**ft (bgs)[2]**	**ft**	**in**	**--**	**--**
CW3A-MW1	29-38021	531317.33	606944.408	68.75	65.47	12	20.0	5.0	15.0	4.0	20 Slot PVC	12/17/1997
CW3A-MW2	29-38022	531456.756	606902.808	63.88	60.77	12	17.0	5.0	12.0	4.0	20 Slot PVC	12/17/1997
CW3A-MW3	29-38023	531581.771	606976.104	61.60	58.45	12	13.5	3.5	10.0	4.0	20 Slot PVC	12/17/1997
CW3A-MW4	29-38024	531534.05	607057.983	63.02	59.96	12	16.0	5.0	12.0	4.0	20 Slot PVC	12/17/1997

Notes:
[1]amsl = above mean sea level
[2]bgs = below ground surface
Where a difference in reported data exists between a monitoring well permit and the corresponding boring log, data from the permit was used.

Table 3-1
Soil Sampling Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

Sample ID	Field Location/Depth	Date Collected	Date Analysis Started	Matrix	Sample Type	Analytical Parameters	Analysis Method
3231.01	MW-1(11.5'-12.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.02	MW-1(0.0-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.03	MW-1 (1.5'-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, ,Pesticides, PCBs and TAL Metals	Method 8260; 8270; 8080A; 3120B, 3112B
3231.04	MW-2 (0.0-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.05	MW-2 (1.5'-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, ,Pesticides, PCBs and TAL Metals	Method 8260; 8270; 8080A; 3120B, 3112B
3231.06	MW-2 (6.0'-8.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.07	MW-3 (0.0'-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.08	MW-3 (1.5'-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, ,Pesticides, PCBs and TAL Metals	Method 8260; 8270; 8080A; 3120B, 3112B
3231.09	MW-3 (4.0'-6.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.10	MW-4 (0.0-2.0")	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3231.11	MW-4 (1.5'-2.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, ,Pesticides, PCBs and TAL Metals	Method 8260; 8270; 8080A; 3120B, 3112B
3231.12	MW-4 (4.0'-6.0')	12/17/1997	12/19/1997	Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B
3229.01	SAMPLE #1	12/17/1997	12/19/1997	Coal Ash/Soil	Solid	VOCs, SVOCs, Pesticides, PCBs,TAL Metals, CN	Method 8260; 8270; 8080A; 3120B, 3112B

Notes:
"Sample #1" was a coal ash sample collected from a test pit at the CW-3A Landfill site.
VOCs: Volatile Organic Compounds
SVOCs: Semi Volatile Organic Compounds
PCB: Polychloronated Biphenols
TAL: Total Analyte List
CN: Cyanide

Table 3-2
Groundwater Sampling Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

Round #	Sample ID	Monitoring Well ID	Date Collected	Date Analysis Started	Matrix	Sample Type	Analytical Parameters	Analysis Method
	3250.03	MW-1	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3250.04	MW-2	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3250.05	MW-3	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
1	3250.06	MW-4	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3250.01	Trip	12/22/1997	12/30/97	Aqueous	GW	VOCs	Method 624
	3250.02	Field Blank	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3250.07	Duplicate	12/22/1997	12/30/97	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3276.03	MW-1	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3276.04	MW-2	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3276.05	MW-3	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
2	3276.06	MW-4	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3276.01	Trip	01/12/98	01/15/98	Aqueous	GW	VOCs	Method 624
	3276.02	Field Blank	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3276.07	Duplicate	01/12/98	01/15/98	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	3411.03	MW-1	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3411.04	MW-2	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3411.05	MW-3	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
3	3411.06	MW-4	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3411.01	Trip	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3411.02	Field Blank	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3411.07	Duplicate	03/16/98	03/16/98	Aqueous	GW	VOCs	Method 624
	3787.03	MW-1	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	3787.04	MW-2	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	9787.05	MW-3	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
4	3787.06	MW-4	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	3787.01	Trip	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	3787.02	Field Blank	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	3787.07	Duplicate	08/05/98	08/13/98	Aqueous	GW	VOCs	Method 624
	4129.01	MW-1	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4129.02	MW-2	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4129.03	MW-3	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
5	4129.04	MW-4	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4132.01	Trip	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4132.02	Field Blank	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4132.03	Duplicate	12/09/98	12/14/98	Aqueous	GW	VOCs	Method 624
	4293.03	MW-1	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
	4293.04	MW-2	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
	4293.05	MW-3	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
6	4293.06	MW-4	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
	4293.01	Trip	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
	4293.02	Field Blank	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624
	4293.07	Duplicate	02/23/99	02/26/99	Aqueous	GW	VOCs	Method 624

Table 3-2
Groundwater Sampling Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

Round #	Sample ID	Monitoring Well ID	Date Collected	Date Analysis Started	Matrix	Sample Type	Analytical Parameters	Analysis Method
7	4536.03	MW-1	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4536.04	MW-2	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4536.05	MW-3	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4536.06	MW-4	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4536.01	Trip	06/08/99	06/09/99	Aqueous	GW	VOCs	Method 624
	4536.02	Field Blank	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4536.07	Duplicate	06/08/99	06/09/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
8	4727.03	MW-1	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4727.03	MW-2	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4727.05	MW-3	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4727.06	MW-4	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4727.01	Trip	08/17/99	08/19/99	Aqueous	GW	VOCs	Method 624
	4727.02	Field Blank	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4727.07	Duplicate	08/17/99	08/19/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
9	4948.04	MW-1	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4948.05	MW-2	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4948.06	MW-3	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4948.07	MW-4	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4948.01	Trip	11/16/1999	11/24/99	Aqueous	GW	VOCs	Method 624
	4948.02	Field Blank	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	4948.07	Duplicate	11/16/1999	11/24/99	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
10	5176.01	MW-1	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5176.02	MW-2	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5176.03	MW-3	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5176.04	MW-4	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5175.01	Trip	02/15/00	02/16/00	Aqueous	GW	VOCs	Method 624
	5175.02	Field Blank	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5175.03	Duplicate	02/15/00	02/16/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
11	5394.04	MW-1	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5394.05	MW-2	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5394.06	MW-3	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5394.07	MW-4	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5394.01	Trip	05/04/00	05/09/00	Aqueous	GW	VOCs	Method 624
	5394.02	Field Blank	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5394.03	Duplicate	05/04/00	05/09/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
12	5597.04	MW-1	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5597.05	MW-2	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5597.06	MW-3	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5597.07	MW-4	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5597.01	Trip	08/03/00	08/14/00	Aqueous	GW	VOCs	Method 624
	5597.02	Field Blank	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5597.03	Duplicate	08/03/00	08/14/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B

Table 3-2
Groundwater Sampling Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

Round #	Sample ID	Monitoring Well ID	Date Collected	Date Analysis Started	Matrix	Sample Type	Analytical Parameters	Analysis Method
13	5791.04	MW-1	10/16/2000	10/20/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5791.05	MW-2	10/16/2000	10/20/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5791.06	MW-3	10/16/2000	10/20/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5791.07	MW-4	10/16/2000	10/20/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5791.01	Trip	10/19/2000	10/24/00	Aqueous	GW	VOCs	Method 624
	5791.02	Field Blank	10/19/2000	10/24/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	5791.03	Duplicate	10/19/2000	10/24/00	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
14	174	MW-1	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	175	MW-2	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	176	MW-3	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	177	MW-4	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	167	Trip	01/12/01	01/18/01	Aqueous	GW	VOCs	Method 624
	168	Field Blank	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
	169	Duplicate	01/12/01	01/18/01	Aqueous	GW	VOCs; SVOCs; PCB/Pesticides; and TAL Metals	Method 624; 625; 608; 3120B, 3112B
Low Flow 1	5659.02	MW-1	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5659.03	MW-2	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5659.04	MW-3	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5659.05	MW-4	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5659.01	Field Blank	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5659.06	Duplicate	8/24/2000	8/24/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
Low Flow 2	5767.02	MW-1	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5767.04	MW-2	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5767.05	MW-3	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5767.06	MW-4	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5767.01	Field Blank	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B
	5767.03	Duplicate	10/4/2000	10/4/2000	Aqueous	GW	TAL Metals	Method 3120B and 3112B

Notes:
GW : Groundwater
VOCs: Volatile Organic Compounds
SVOCs: Semi Volatile Organic Compounds
PCBs: Polychloronated Biphenols
*Low Flow Sampling Method was used to collect sample
Samples: 4293.06 and 3787.03 were tested as duplicates.

Table 3-3
Groundwater Elevation Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

		#1			#2			#3			#4		
Well ID	Elev. of Inner Casing Survey Mark	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.
CW3A-MW1	68.75	12/22/97	14.95	53.8	01/12/98	14.3	54.45	03/16/98	12.16	56.59	08/05/98	13.82	54.93
CW3A-MW2	63.88	12/22/97	9.5	54.38	01/12/98	8.7	55.18	03/16/98	7.75	56.13	08/05/98	8.97	54.91
CW3A-MW3	61.60	12/22/97	7	54.6	01/12/98	6.4	55.2	03/16/98	6.24	55.36	08/05/98	4.23	57.37
CW3A-MW4	63.02	12/22/97	10.5	52.52	01/12/98	9.95	53.07	03/16/98	7.9	55.12	08/05/98	9.53	53.49

Notes:
1) Elev.: Elevation in feet
above mean sea level.
2) Depth to water: depth in feet
from the inner casing survey mark.
3) NS: Not Sampled

Table 3-3
Groundwater Elevation Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

		#5			#6			#7			#8		
Well ID	Elev. of Inner Casing Survey Mark	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.
CW3A-MW1	68.75	12/09/98	15.77	52.98	02/23/99	14.36	54.39	06/08/99	14.37	54.38	08/17/99	15.53	53.22
CW3A-MW2	63.88	12/09/98	10.79	53.09	02/23/99	9.04	54.84	06/08/99	9.18	54.70	08/17/99	10.6	53.28
CW3A-MW3	61.60	12/09/98	6.7	54.9	02/23/99	6.53	55.07	06/08/99	7.13	54.47	08/17/99	7.91	53.69
CW3A-MW4	63.02	12/09/98	11.27	51.75	02/23/99	9.98	53.04	06/08/99	9.93	53.09	08/17/99	11.09	51.93

Notes:
1) Elev.: Elevation in feet
above mean sea level.
2) Depth to water: depth in feet
from the inner casing survey mark.
3) NS: Not Sampled

Table 3-3
Groundwater Elevation Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

		#9			#10			#11			#12		
Well ID	Elev. of Inner Casing Survey Mark	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.
CW3A-MW1	68.75	11/16/99	15.25	53.5	02/15/00	14.92	53.83	5/4/2000	13.98	54.77	08/03/00	14.65	54.1
CW3A-MW2	63.88	11/16/99	10.04	53.84	02/15/00	9.05	54.83	5/4/2000	8.48	55.40	08/03/00	8.97	54.91
CW3A-MW3	61.60	11/16/99	6.85	54.75	02/15/00	5.78	55.82	5/4/2000	6.64	54.96	08/03/00	6.95	54.65
CW3A-MW4	63.02	11/16/99	10.81	52.21	02/15/00	10.34	52.68	5/4/2000	9.53	53.49	08/03/00	10.25	52.71

Notes:
1) Elev.: Elevation in feet
above mean sea level.
2) Depth to water: depth in feet
from the inner casing survey mark.
3) NS: Not Sampled

Table 3-3
Groundwater Elevation Summary
CW-3A Landfill Site
Fort Monmouth, New Jersey

		Low-flow #1			#13			Low-flow #2			#14		
Well ID	Elev. of Inner Casing Survey Mark	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.	Date	Depth to Water	Ground-water Elev.
CW3A-MW1	68.75	08/24/00	14.38	54.37	10/04/00	14.48	54.27	10/16/00	14.69	54.06	01/12/01	14.98	53.77
CW3A-MW2	63.88	08/24/00	9.05	54.83	10/04/00	8.05	55.83	10/16/00	9.17	54.71	01/12/01	9.18	54.7
CW3A-MW3	61.60	08/24/00	6.97	54.63	10/04/00	6.85	54.75	10/16/00	7.13	54.47	01/12/01	6.81	54.79
CW3A-MW4	63.02	08/24/00	10.05	52.97	10/04/00	10.15	52.87	10/16/00	10.17	52.85	01/12/01	10.46	52.56

Notes:
1) Elev.: Elevation in feet
above mean sea level.
2) Depth to water: depth in feet
from the inner casing survey mark.
3) NS: Not Sampled

Table 4-1
Data for Geologic Cross-Section A-A'
CW-3A Landfill Site
Fort Monmouth, New Jersey

Well ID	Units	CW3A-MW1	CW3A-MW2	CW3A-MW4	CW3A-MW3
Elevation of Top of Casing	ft (amsl)	68.75	63.88	63.02	61.6
Elevation of Ground Surface	ft (amsl)	65.47	60.77	59.96	58.45
Elevation of Top of Screen	ft (amsl)	63.75	58.88	58.02	58.1
Elevation of Groundwater (1/12/01)	ft (amsl)	53.77	54.7	52.56	54.79
Elevation of Top of Unit 2	ft (amsl)	60.47	NA	54.21	54.79
Elevation of Bottom of Log	ft (amsl)	53.77	52.77	51.96	52.47
Elevation of Bottom of Well	ft (amsl)	48.75	46.88	47.02	48.1
Distance from Point A on Cross-Section	ft	0	138	228	268

Surface Materials (Fill):
Unit 1 (not in table) = Orange-brown to dark brown sand with lenses of black angular gravel, lumber fragments, etc.
Native Material (Tinton Sand Formation):
Unit 2 = Light orange-brown fine sand, trace sub-rounded gravel; and green to brown fine sand and silt.

Notes:
All measurements in feet
amsl: above mean sea level
NA: Not Available (Top of layer 2 is estimated on cross-section.)

Table 5-1
Soil Sampling Results
CW-3A Landfill Site
Fort Monmouth, New Jersey

Field Sample Location Lab Sample ID Sample Date	NJDEP RDCSSC (mg/kg)	MW-1(11.5'-12.0') 3231.01 12/17/1997	MW-1(0.0-2.0') 3231.02 12/17/1997	MW-1 (1.5'-2.0') 3231.03 12/17/1997	MW-2 (0.0-2.0') 3231.04 12/17/1997	MW-2 (1.5'-2.0') 3231.05 12/17/1997	MW-2 (6.0'-8.0') 3231.06 12/17/1997	MW-3 (0.0'-2.0') 3231.07 12/17/1997	MW-3 (1.5'-2.0') 3231.08 12/17/1997	MW-3 (4.0'-6.0') 3231.09 12/17/1997	MW-4 (0.0-2.0") 3231.10 12/17/1997	MW-4 (1.5'-2.0') 3231.11 12/17/1997	MW-4 (4.0'-6.0') 3231.12 12/17/1997	SAMPLE #1 3229.01 12/17/1997
Volatiles (mg/kg)														
		ND	NS	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	ND
Semi-Volatiles (mg/kg)														
Acenaphthene	3400	ND	ND	NS	ND	NS	ND	1.1 J	NS	ND	ND	NS	ND	ND
Fluorene	2300	ND	ND	NS	ND	NS	ND	2.9 J	NS	ND	ND	NS	ND	ND
naphthalene	230	ND	ND	NS	ND	NS	ND	0.590 J	NS	ND	ND	NS	ND	ND
Di-n-butylphthalate	5700	ND	ND	NS	ND	NS	ND	ND	NS	ND	ND	NS	1.1 J	ND
bis(2-Ethylhexyl)phthalate	49	ND	ND	NS	ND	NS	16	ND	NS	ND	ND	NS	.610 J	ND
2-Methylnaphthalene	100	ND	ND	NS	ND	NS	ND	0.630 J	NS	ND	ND	NS	ND	ND
Phenanthrene	100	ND	ND	NS	ND	NS	ND	19	NS	1.4 J	ND	NS	ND	ND
Anthracene	10000	ND	ND	NS	ND	NS	ND	3.1 J	NS	ND	ND	NS	ND	ND
Flouranthene	2300	ND	ND	NS	ND	NS	ND	12	NS	1.4 J	ND	NS	ND	ND
Pyrene	1700	ND	ND	NS	ND	NS	ND	25	NS	2.2 J	ND	NS	ND	ND
Benzo(a)anthracene	0.9	ND	ND	NS	ND	NS	ND	**8.2**	NS	ND	ND	NS	ND	ND
Benzo(b)flouranthene	0.9	ND	ND	NS	ND	NS	ND	**3.3 J**	NS	ND	ND	NS	ND	ND
Benzo(k)flouranthene	0.9	ND	ND	NS	ND	NS	ND	**4.3 J**	NS	ND	ND	NS	ND	ND
Benzo(a)pyrene	0.66	ND	ND	NS	ND	NS	ND	**6.2**	NS	ND	ND	NS	ND	ND
Indeno(1,2,3-cd)pyrene	0.9	ND	ND	NS	ND	NS	ND	**2.8 J**	NS	ND	ND	NS	ND	ND
Benzo(g,h,I)perylene	25	ND	ND	NS	ND	NS	ND	3.8 J	NS	ND	ND	NS	ND	ND
Chrysene	9	ND	ND	NS	ND	NS	ND	8.8	NS	ND	ND	NS	ND	ND
PCBs/Pesticides (mg/kg)														
4,4'-DDE	2	ND	0.004	NS	0.0008	NS	0.012	0.026	NS	ND	0.026	NS	ND	ND
4,4'-DDT	2	ND	0.004	NS	0.0004	NS	0.94	0.048	NS	ND	0.014	NS	ND	ND
4,4'-DDD	3	ND	ND	NS	ND	NS	0.188	0.019	NS	ND	0.075	NS	ND	ND
Metals (mg/kg)														
Antimony	14	1.176	0.863	NS	0.426	NS	3.737	0.682	NS	1.732	0.412	NS	0.404	2.207
Aluminum	NLE	3057	4617	NS	4587	NS	6583	3465	NS	9479	2619	NS	3490	8410
Arsenic	20	1.953	3.884	NS	3.424	NS	9.71	3.341	NS	9.617	2.204	NS	2.454	12.28
Barium	700	3.766	10.09	NS	10.18	NS	**729.8**	22.08	NS	164.6	13.95	NS	21.24	476.6
Beryllium	1	0.288	0.325	NS	0.307	NS	0.575	0.254	NS	0.861	0.197	NS	0.275	0.395
Cadmium	1	0.364	0.548	NS	0.526	NS	**2.741**	0.636	NS	**2.021**	0.491	NS	0.369	**5.646**
Calcium	NLE	252.2	489.8	NS	698.6	NS	2584	957.3	NS	4055	176.1	NS	900.1	8402
Chromium	NLE	38.33	30.07	NS	26.89	NS	47.54	30.49	NS	55.04	17.86	NS	24.74	43.31
Copper	600	ND	1.096	NS	2.118	NS	301.6	14.4	NS	37.2	9.157	NS	1.937	342.3
Iron	NLE	7589	10620	NS	9895	NS	19510	7691	NS	15920	6319	NS	6444	46970
Lead	400	2.794	7.837	NS	10.19	NS	374.7	47.4	NS	82.17	26.06	NS	5.314	337.7
Manganese	NLE	10.37	26.88	NS	25.73	NS	166.3	40.32	NS	79.78	14.82	NS	15.74	980.3
Magnesium	NLE	645.4	788.7	NS	753.9	NS	1612	884.1	NS	1853	427.2	NS	552.6	1095
Mercury	14	ND	ND	NS	0.022	NS	0.184	0.033	NS	0.233	0.043	NS	0.031	0.43
Nickel	250	2.646	2.962	NS	2.808	NS	12.24	8.945	NS	22.15	2.155	NS	2.446	26.3
Potassium	NLE	1640	1164	NS	997.5	NS	3383	1596	NS	2791	741.5	NS	989.4	1968
Selenium	63	ND	ND	NS	ND	NS	1.217	0.348	NS	1.413	ND	NS	ND	1.454
Silver	110	ND	ND	NS	ND	NS	20.19	ND	NS	3.619	ND	NS	ND	0.832
Sodium	NLE	174.4	73.28	NS	276.4	NS	227.1	147.7	NS	504.5	85.75	NS	145.7	574.1
Thallium	2	ND	ND	NS	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND
Vanadium	370	36.69	24.59	NS	22.49	NS	30.03	20.05	NS	35.74	14.39	NS	17.06	18.88
Zinc	1500	11.4	17.47	NS	19.37	NS	593.4	60.72	NS	208.6	27.68	NS	17.62	**1842**
Wet Cemistry (mg/kg)														
Cyanide	1100	ND	ND	NS	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND

Notes:
All concentrations in milligrams per kilogram (mg/kg)
E = Value exceeded linear range
D = Value from dilution
B = Compound in related blank
NS:= Not Sampled
ND:= Analyte not detected in sample
NLE:= No cleanup standard exists for this analyte
J = Estimated Value
N = Presumptive evidence of a compound
Sample #1 = Coal/Ash Sample

Table 5-2
Groundwater Sampling Results
CW-3A Landfill Site
Fort Monmouth, New Jersey

Monitoring Well CW3A-MW1 NJDEP#29-38021

Field Sample Location Lab Sample ID Sample Date	NJDEP Criteria	Site Specific MBC[1]	CW3A-MW1 3250.03 12/22/97	CW3A-MW1 3276.03 01/12/98	CW3A-MW1 3411.03 03/16/98	CW3A-MW1 3787.03 08/05/98	CW3A-MW1 4129.01 12/09/98	CW3A-MW1 4293.03 02/23/99	CW3A-MW1 4536.03 06/08/99	CW3A-MW1 4727.03 08/17/99	CW3A-MW1 4948.04 11/16/99	CW3A-MW1 5176.01 02/15/00	CW3A-MW1 5394.04 05/04/00	CW3A-MW1 5597.04 08/03/00	CW3A-MW1 5659.02 08/24/00	CW3A-MW1 5767.02 10/04/00	CW3A-MW1 5791.04 10/16/00	CW3A-MW1 174 01/12/01
Round Number			1	2	3	4	5	6	7	8	9	10	11	12	LF #1[2]	LF #2[2]	13	14
Volatiles (ug/L)																		
Acetone	**700**	**N/A**	ND	ND	ND	8.90	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	11.83
2-Butanone	**300**	**N/A**	ND	ND	ND	2.88	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	6.18
Toluene	**1000**	**N/A**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
MTBE[3]	**70**	**N/A**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Semi-Volatiles (ug/L)																		
Benzoic Acid[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
bis(2-Ethylhexyl)phthalate	**30**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Di-n-butylphthalate	**900**	**N/A**	11.72	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Isophorone	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenol	**4000**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenanthrene[3]	**100**	**N/A**	3.54	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
4-Methylphenol[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
naphthalene[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Pesticide/PCB (ug/kg)																		
			ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Metals (ug/L)																		
Aluminum	**200**	**121000**	**2769**	**9721**	NS	NS	NS	NS	**516**	**7760**	**4680**	**1680**	**214**	101	**433**	41.8	**322**	**347**
Antimony	**20**	**N/A**	ND	4	NS	NS	NS	NS	ND	ND	3.09	ND	ND	ND	ND	ND	ND	ND
Arsenic	**8**	**N/A**	ND	**19**	NS	NS	NS	NS	ND	**9.85**	**9.39**	ND	ND	ND	ND	ND	ND	2.4
Barium	**2000**	**699**	22	40.9	NS	NS	NS	NS	4.18	16.7	7.96	1.81	4.68	9.4	27.3	12.8	5.99	6.92
Beryllium	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	**4**	**N/A**	1.1	ND	NS	NS	NS	NS	ND	0.755	0.717	ND	ND	ND	1.24	ND	ND	ND
Calcium	**NLE**	**45400**	9530	9960	NS	NS	NS	NS	11800	10400	4910	2980	13900	27500	17900	14100	13000	11500
Chromium	**100**	**N/A**	33.4	**108.5**	NS	NS	NS	NS	6.65	61.4	61.6	17.8	3.87	6.43	ND	4.31	9.73	6.51
Cobalt	**NLE**	**N/A**	2.4	3.9	NS	NS	NS	NS	ND	1.44	1.32	ND	ND	ND	1.14	1.7	ND	0.67
Copper	**1000**	**65.6**	12	33	NS	NS	NS	NS	ND	6.03	18.6	ND	ND	ND	ND	7.03	ND	ND
Iron	**300**	**431000**	**5119**	**27230**	NS	NS	NS	NS	**2320**	**14100**	**11600**	**4820**	**516**	**426**	**658**	**1690**	**1380**	**1240**
Lead	**10**	**N/A**	ND	**16**	NS	NS	NS	NS	ND	4.16	3.55	6.91	ND	1.52	2.12	ND	**66.8**	ND
Magnesium	**NLE**	**62700**	3260	4930	NS	NS	NS	NS	3950	4970	2730	1290	4410	9340	6920	5810	4530	4200
Manganese	**50**	**331**	**61.8**	**64.1**	NS	NS	NS	NS	2.52	27.8	10.9	12.6	2.36	3.87	45.1	48.5	8.03	16.4
Mercury	**2**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	0.2	ND	ND	ND	ND	ND	ND	0.34
Nickel	**100**	**187**	3.1	13.1	NS	NS	NS	NS	ND	3.8	2.75	3.31	ND	ND	ND	1.7	13.1	ND
Potassium	**NLE**	**137000**	4110	8140	NS	NS	NS	NS	1850	4450	3650	2100	1510	3390	3570	3460	2450	2530
Selenium	**50**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	**50000**	**21500**	ND	**76960**	NS	NS	NS	NS	38500	**132000**	**67100**	**54500**	20500	31400	**122000**	**111000**	40400	**65700**
Thallium	**10**	**N/A**	7	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	**NLE**	**N/A**	25	109	NS	NS	NS	NS	13.1	72.4	82.5	24.8	3.78	3.45	ND	0.914	7.15	6.29
Zinc	**5000**	**233**	66	311	NS	NS	NS	NS	ND	32	28.7	23.9	17.9	31.6	48	52.4	625	ND
Wet Chemistry (mg/L)																		
Ammonia (mg/L)	**0.1**	**N/A**	**0.21**	**0.58**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide (mg/L)	**0.10**	**N/A**	ND	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes

All concentrations in micrograms per liter (ug/L), equivalent to parts per billion (ppb) except for Wet Chemistry

NJDEP Criteria: Higher of Practical Quantitation Limits (PQLs) & GWQC per NJAC 7:9-6

Exceedences of NJDEP GWQS are shaded and **bold**

ND: Analyte not detected in sample

NA: Not Apllicable

[1] Maximum Background Criteria for Charles Wood area (shown for native metals only)

[2] Low Flow Sampling Method used to collect sample

[3] Interim Criteria used as NJDEP criteria

D = Value from dilution

LF: Low Flow Sampling

B = Compound in related blank

NS: Not Sampled

ND: Not detected

NLE: No cleanup standard exists for this analyte

Table 5-2
Groundwater Sampling Results
CW-3A Landfill Site
Fort Monmouth, New Jersey

Monitoring Well CW3A-MW2 NJDEP#38022

Field Sample Location Lab Sample ID Sample Date	NJDEP Criteria	Site Specific MBC[1]	CW3A-MW2 3250.04 12/22/97	CW3A-MW2 3276.04 01/12/98	CW3A-MW2 3411.04 03/16/98	CW3A-MW2 3787.04 08/05/98	CW3A-MW2 4129.02 12/09/98	CW3A-MW2 4293.04 02/23/99	CW3A-MW2 4536.04 06/08/99	CW3A-MW2 4727.04 08/17/99	CW3A-MW2 4948.05 11/16/99	CW3A-MW2 5176.02 02/15/00	CW3A-MW2 5394.05 05/04/00	CW3A-MW2 5597.05 08/03/00	CW3A-MW2 5659.03 08/24/00	CW3A-MW2 5767.04 10/04/00	CW3A-MW2 5791.05 10/16/00	CW3A-MW2 175 01/12/01
Round Number			1	2	3	4	5	6	7	8	9	10	11	12	LF #1[2]	LF #2[2]	13	14
Volatiles (ug/L)																		
Acetone	**700**	**N/A**	ND	ND	ND	14.62	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	10.41
2-Butanone	**300**	**N/A**	ND	ND	ND	4.97	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	6.86
Toluene	**1000**	**N/A**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
MTBE[3]	**70**	**N/A**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Semi-Volatiles (ug/L)																		
Benzoic Acid[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
bis(2-Ethylhexyl)phthalate	**30**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Di-n-butylphthalate	**900**	**N/A**	18.88	6.72	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Isophorone	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenol	**4000**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenanthrene[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
4-Methylphenol[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
naphthalene[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Pesticide/PCB (ug/kg)																		
			ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Metals (ug/L)																		
Aluminum	**200**	**121000**	**1162**	**242**	NS	NS	NS	NS	21.6	62.2	120	95.9	ND	28.5	193	ND	72.4	ND
Antimony	**20**	**N/A**	7	ND	NS	NS	NS	NS	2.29	ND	ND	ND	ND	6.89	2.8	ND	ND	ND
Arsenic	**8**	**N/A**	ND	ND	NS	NS	NS	NS	**8.12**	**9.47**	**9.58**	ND	ND	**11**	5.06	3.28	**18.6**	**46**
Barium	**2000**	**699**	547.1	624.1	NS	NS	NS	NS	742	755	768	412	845	534	771	679	653	638
Beryllium	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	**4**	**N/A**	2.9	ND	NS	NS	NS	NS	ND	0.923	1.16	ND	1.28	ND	ND	ND	ND	ND
Calcium	**NLE**	**45400**	95800	80650	NS	NS	NS	NS	144000	111000	120000	73800	108000	96300	144000	135000	136000	148000
Chromium	**100**	**N/A**	7.2	2.6	NS	NS	NS	NS	4.51	4.43	14	2.28	2.99	1.79	ND	3.46	3	0.902
Cobalt	**NLE**	**N/A**	ND	ND	NS	NS	NS	NS	0.852	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	**1000**	**65.6**	8	11	NS	NS	NS	NS	ND	4.16	12.8	ND	ND	ND	ND	2.96	ND	ND
Iron	**300**	**431000**	**50000**	**43570**	NS	NS	NS	NS	**48700**	**53000**	**43500**	**34600**	**60600**	**28100**	**50800**	**45200**	**39900**	**40800**
Lead	**10**	**N/A**	6	5	NS	NS	NS	NS	ND	ND	ND	ND	ND	1.17	ND	ND	ND	ND
Magnesium	**NLE**	**62700**	10600	7930	NS	NS	NS	NS	13400	11700	11900	7510	11900	9440	13300	12600	12400	14500
Manganese	**50**	**331**	**749.5**	**678**	NS	NS	NS	NS	**966**	**805**	**854**	**602**	**1050**	**651**	**999**	**987**	**975**	**1010**
Mercury	**2**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	0.1	ND	ND	ND	ND	ND	ND	0.23
Nickel	**100**	**187**	ND	3.6	NS	NS	NS	NS	ND	2.86	2.87	14	3.37	1.41	ND	ND	ND	2.03
Potassium	**NLE**	**137000**	8610	6770	NS	NS	NS	NS	10300	12200	10600	5990	8980	9250	11200	10900	10700	10300
Selenium	**50**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.4
Silver	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	**50000**	**21500**	10900	7460	NS	NS	NS	NS	12800	15000	12300	7970	11400	6720	12900	11800	11300	11800
Thallium	**10**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	**NLE**	**N/A**	ND	ND	NS	NS	NS	NS	1.98	2.33	2.67	1.85	2.36	1.52	ND	ND	0.742	1.8
Zinc	**5000**	**233**	87	227	NS	NS	NS	NS	ND	7.8	52.8	71.5	4.48	36.9	60.9	38	14.1	5.57
Wet Chemistry (mg/L)																		
Ammonia (mg/L)	**0.1**	**N/A**	**6.58**	**4.85**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide (mg/L)	**0.10**	**N/A**	ND	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes

All concentrations in micrograms per liter (ug/L), equivalent to parts per billion (ppb) except for Wet Chemistry

NJDEP Criteria: Higher of Practical Quantitation Limits (PQLs) & GWQC per NJAC 7:9-6

Exceedences of NJDEP GWQS are shaded and **bold**

ND: Analyte not detected in sample

NA: Not Apllicable

[1] Maximum Background Criteria for Charles Wood area (shown for native metals only)

[2] Low Flow Sampling Method used to collect sample

[3] Interim Criteria used as NJDEP criteria

D = Value from dilution

LF: Low Flow Sampling

B = Compound in related blank

NS: Not Sampled

ND: Not detected

NLE: No cleanup standard exists for this aNSlyte

Table 5-2
Groundwater Sampling Results
CW-3A Landfill Site
Fort Monmouth, New Jersey

Monitoring Well CW3A-MW3 NJDEP#38023

Field Sample Location Lab Sample ID Sample Date	NJDEP Criteria	Site Specific MBC[1]	CW3A-MW3 3250.05 12/22/97	CW3A-MW3 3276.05 01/12/98	CW3A-MW3 3411.05 03/16/98	CW3A-MW3 3787.05 08/05/98	CW3A-MW3 4129.03 12/09/98	CW3A-MW3 4293.05 02/23/99	CW3A-MW3 4536.05 06/08/99	CW3A-MW3 4727.05 08/17/99	CW3A-MW3 4948.06 11/16/99	CW3A-MW3 5176.03 02/15/00	CW3A-MW3 5394.06 05/04/00	CW3A-MW3 5597.06 08/03/00	CW3A-MW3 5659.04 08/24/00	CW3A-MW3 5767.05 10/04/00	CW3A-MW3 5791.06 10/16/00	CW3A-MW3 176 01/12/01
Round Number			1	2	3	4	5	6	7	8	9	10	11	12	LF #1[2]	LF #2[2]	13	14
Volatiles (ug/L)																		
Acetone	**700**	**N/A**	ND	ND	ND	22.45	ND	ND	7.76	ND	27.25	ND	ND	ND	NS	NS	ND	ND
2-Butanone	**300**	**N/A**	ND	ND	ND	7.52	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Toluene	**1000**	**N/A**	ND	ND	ND	3.13	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
MTBE[3]	**70**	**N/A**	ND	ND	ND	22.33	13.38	ND	4.19	6.85	2.37	ND	ND	32.89	NS	NS	11.72	4.84
Semi-Volatiles (ug/L)																		
Benzoic Acid[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	37.9 D	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	**30**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	**900**	**N/A**	3.32	3.48 B	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Isophorone	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	45.62 D	ND	ND	ND	ND	ND	ND	ND
Phenol	**4000**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	5.36 D	ND	ND	ND	ND	ND	ND	ND
Phenanthrene[3]	**100**	**N/A**	3.42	ND	NS	NS	NS	NS	ND	ND	14.11 D	ND	ND	ND	NS	NS	ND	ND
4-Methylphenol[3]	**100**	**N/A**	2.17	ND	NS	NS	NS	NS	ND	ND	1.72 D	ND	ND	ND	NS	NS	ND	ND
naphthalene[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Pesticide/PCB (ug/kg)																		
			ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Metals (ug/L)																		
Aluminum	**200**	**121000**	**409**	**456**	NS	NS	NS	NS	**295**	143	**367000**	59.9	**410**	**12000**	**215**	81.6	**2490**	**2110**
Antimony	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	**27.1**	3.63	ND	14.1	ND	ND	ND	3.9
Arsenic	**8**	**N/A**	ND	5	NS	NS	NS	NS	2.46	ND	**587**	ND	ND	**17**	2.72	ND	ND	**12.9**
Barium	**2000**	**699**	131.1	85.5	NS	NS	NS	NS	65.5	106	**2250**	58.4	105	96.5	312	203	219	161
Beryllium	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	**26.1**	ND	ND	0.659	ND	ND	ND	ND
Cadmium	**4**	**N/A**	1.8	ND	NS	NS	NS	NS	1.8	1.33	**266**	ND	0.728	1.71	ND	ND	ND	ND
Calcium	**NLE**	**45400**	137000	104900	NS	NS	NS	NS	63300	40100	1780000	102000	93500	143000	118000	102000	94700	136000
Chromium	**100**	**N/A**	11	15.9	NS	NS	NS	NS	5.72	5.73	**6190**	3.23	5.26	**164**	ND	5.75	39.6	22.9
Cobalt	**NLE**	**N/A**	6.2	3.6	NS	NS	NS	NS	0.987	3.39	155	0.566	ND	3.31	0.611	ND	ND	ND
Copper	**1000**	**65.6**	17	111	NS	NS	NS	NS	28.8	8.53	**14400**	ND	26.1	75.2	ND	6.61	10.8	12.8
Iron	**300**	**431000**	**8635**	**25550**	NS	NS	NS	NS	**27000**	**17700**	**1020000**	**20900**	**22600**	**50400**	**39700**	**32400**	**33400**	**24800**
Lead	**10**	**N/A**	ND	**19**	NS	NS	NS	NS	ND	ND	**1010**	ND	2.35	**26.5**	1.7	5.52	5.58	6.36
Magnesium	**NLE**	**62700**	15600	8890	NS	NS	NS	NS	11400	11400	169000	8460	9320	10400	13000	12700	12100	16400
Manganese	**50**	**331**	**980**	**727.7**	NS	NS	NS	NS	**638**	**391**	**9680**	**363**	**504**	**476**	**819**	**711**	**719**	**626**
Mercury	**2**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	**5.1**	ND	ND	ND	ND	ND	ND	ND
Nickel	**100**	**187**	14.6	22.8	NS	NS	NS	NS	3.14	8.1	**1050**	3.73	1.58	43.2	ND	ND	5.78	2.57
Potassium	**NLE**	**137000**	26100	10430	NS	NS	NS	NS	28100	16500	153000	37000	42300	29200	36500	36400	25200	38400
Selenium	**50**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	**73.8**	3.37	ND	ND	ND	ND	ND	9.53
Silver	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	**118**	ND	ND	1.99	ND	ND	ND	ND
Sodium	**50000**	**21500**	31900	15420	NS	NS	NS	NS	**57200**	**87700**	**86300**	38800	28600	23100	**69700**	**64000**	**52100**	43900
Thallium	**10**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	**NLE**	**N/A**	ND	3	NS	NS	NS	NS	2.01	1.29	2270	4.16	5.12	83.6	2.73	2.5	19.7	12.5
Zinc	**5000**	**233**	261	314	NS	NS	NS	NS	63.3	86.1	**33900**	34.3	148	709	272	42.9	147	520
Wet Chemistry (mg/L)																		
Ammonia (mg/L)	**0.1**	**N/A**	**4.2**	**1.88**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide (mg/L)	**0.10**	**N/A**	ND	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes

All concentrations in micrograms per liter (ug/L), equivalent to parts per billion (ppb) except for Wet Chemistry

NJDEP Criteria: Higher of Practical Quantitation Limits (PQLs) & GWQC per NJAC 7:9-6

Exceedences of NJDEP GWQS are shaded and **bold**

ND: Analyte not detected in sample

NA: Not Apllicable

[1] Maximum Background Criteria for Charles Wood area (shown for native metals only)

[2] Low Flow Sampling Method used to collect sample

[3] Interim Criteria used as NJDEP criteria

D = Value from dilution

LF: Low Flow Sampling

B = Compound in related blank

NS: Not Sampled

ND: Not detected

NLE: No cleanup standard exists for this aNSlyte

Table 5-2
Groundwater Sampling Results
CW-3A Landfill Site
Fort Monmouth, New Jersey

Monitoring Well CW3A-MW4 NJDEP#29-38024

Field Sample Location Lab Sample ID Sample Date	NJDEP Criteria	Site Specific MBC[1]	CW3AMW4 3250.06 12/22/97	CW3AMW4 3276.06 01/12/98	CW3AMW4 3411.06 03/16/98	CW3AMW4 3787.06 08/05/98	CW3AMW4 4129.04 12/09/98	CW3AMW4 4293.06 02/23/99	CW3AMW4 4536.06 06/08/99	CW3AMW4 4727.06 08/17/99	CW3AMW4 4948.07 11/16/99	CW3AMW4 5176.04 02/15/00	CW3AMW4 5394.07 05/04/00	CW3AMW4 5597.07 08/03/00	CW3AMW4 5659.05 08/24/00	CW3AMW4 5767.06 10/04/00	CW3AMW4 5791.07 10/16/00	CW3AMW4 177 01/12/01
Round Number			1	2	3	4	5	6	7	8	9	10	11	12	LF #1[2]	LF #2[2]	13	14
Volatiles (ug/L)																		
Acetone	**700**	**N/A**	ND	ND	ND	10.12	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
2-Butanone	**300**	**N/A**	ND	ND	ND	ND	ND	ND	ND	2.21	ND	ND	ND	ND	NS	NS	ND	ND
Toluene	**1000**	**N/A**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
MTBE[3]	**70**	**N/A**	ND	ND	31.26	ND	3.33	1.82	27.43	13.53	1.86	ND	ND	ND	NS	NS	ND	ND
Semi-Volatiles (ug/L)																		
Benzoic Acid[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
bis(2-Ethylhexyl)phthalate	**30**	**N/A**	ND	ND	NS	NS	NS	NS	1.04	ND	ND	ND	ND	ND	NS	NS	ND	ND
Di-n-butylphthalate	**900**	**N/A**	3.11	7.46 B	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Isophorone	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenol	**4000**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Phenanthrene[3]	**100**	**N/A**	4.75	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
4-Methylphenol[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
naphthalene[3]	**100**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Pesticide/PCB (ug/kg)																		
			ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Metals (ug/L)																		
Aluminum	**200**	**121000**	**1752**	**1001**	NS	NS	NS	NS	144	**341**	115	125	**256**	144	68.2	80.2	55.4	**221**
Antimony	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	3.5	3.44	ND	ND	ND
Arsenic	**8**	**N/A**	ND	ND	NS	NS	NS	NS	ND	5.31	ND	2.66	ND	ND	2.9	ND	ND	**12.9**
Barium	**2000**	**699**	143.8	110.1	NS	NS	NS	NS	162	187	134	169	147	134	130	130	124	306
Beryllium	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	**4**	**N/A**	1.7	1.9	NS	NS	NS	NS	2.99	3.34	2.21	ND	0.779	0.84	0.868	0.802	0.741	ND
Calcium	**NLE**	**45400**	58000	98340	NS	NS	NS	NS	68500	87700	31900	112000	77100	71200	69000	57500	69400	80600
Chromium	**100**	**N/A**	27.6	19.5	NS	NS	NS	NS	3.68	6.58	4.78	5.44	4.46	3.79	ND	3.14	2.94	7.75
Cobalt	**NLE**	**N/A**	7.2	5.9	NS	NS	NS	NS	3.31	3.66	5.02	ND	2.55	2.53	2.97	3.31	1.77	0.81
Copper	**1000**	**65.6**	13	11	NS	NS	NS	NS	69.1	22.9	41.6	32.5	ND	603	ND	ND	ND	169
Iron	**300**	**431000**	**5219**	**17660**	NS	NS	NS	NS	**15800**	**30300**	**3360**	**79100**	**18300**	**18200**	**11200**	**12100**	**22500**	**101000**
Lead	**10**	**N/A**	ND	5	NS	NS	NS	NS	5.29	ND	ND	ND	ND	**104**	ND	ND	ND	**32.4**
Magnesium	**NLE**	**62700**	9790	8990	NS	NS	NS	NS	8620	10200	7490	8770	9280	9230	9730	9600	8400	10400
Manganese	**50**	**331**	**279.2**	**614.3**	NS	NS	NS	NS	**357**	**378**	**185**	**560**	**420**	**300**	**343**	**293**	**366**	**401**
Mercury	**2**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	0.2	ND	0.2	ND	ND	ND	ND	0.11
Nickel	**100**	**187**	10.7	5.1	NS	NS	NS	NS	10.7	7.91	14	3.24	4.82	22.9	ND	6.97	4.53	9.95
Potassium	**NLE**	**137000**	9520	14230	NS	NS	NS	NS	9030	11700	5500	12300	13300	10100	8920	7660	9260	8350
Selenium	**50**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	**20**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	**50000**	**21500**	49500	9650	NS	NS	NS	NS	45900	**55800**	**64900**	14700	43500	36900	**65300**	**60100**	44800	**62000**
Thallium	**10**	**N/A**	ND	ND	NS	NS	NS	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	**NLE**	**N/A**	10	5	NS	NS	NS	NS	2.03	5.6	1.52	4.81	3.62	2.12	ND	ND	1.83	9.52
Zinc	**5000**	**233**	78	135	NS	NS	NS	NS	51.5	33.3	74.6	82.3	20.6	900	59.2	37	37.5	316
Wet Chemistry (mg/L)																		
Ammonia (mg/L)	**0.1**	**N/A**	**3.29**	**6.81**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide (mg/L)	**0.10**	**N/A**	ND	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes

All concentrations in micrograms per liter (ug/L), equivalent to parts per billion (ppb) except for Wet Chemistry

NJDEP Criteria: Higher of Practical Quantitation Limits (PQLs) & GWQC per NJAC 7:9-6

Exceedences of NJDEP GWQS are shaded and **bold**

ND: Analyte not detected in sample

NA: Not Apllicable

[1] Maximum Background Criteria for Charles Wood area (shown for native metals only)

[2] Low Flow Sampling Method used to collect sample

[3] Interim Criteria used as NJDEP criteria

D = Value from dilution

LF: Low Flow Sampling

B = Compound in related blank

NS: Not Sampled

ND: Not detected

NLE: No cleanup standard exists for this aNSlyte

Table 5-3
Determination of Contaminants of Concern
CW-3A Landfill Site
Fort Monmouth, New Jersey

Analyte	NJDEP Cleanup Criteria[1]	Site Specific Groundwater MBC[2]	Maximum Result	No. of NJDEP Criteria Exceedences	No. of Site Specific Maximum Background Exceedences	Comments
Metals						
Aluminum	**200**	**121,000**	**367,000**	**26**	**1**	**Not a COC: aluminum is a background metal.**
Antimony	**20**	**N/A**	**27.1**	**1**	**N/A**	**Not a COC: Low flow sampling presents no exceedences.**
Arsenic	**8**	**N/A**	**587**	**13**	**N/A**	**Not a COC: Low flow sampling presents no exceedances.**
Barium	**2000**	**699**	**2,250**	**1**	**6**	**Not a COC: barium is a background metal.**
Beryllium	**20**	**N/A**	**26.1**	**1**	**N/A**	**Not a COC: Only one exceedance in CW3A-MW3. Low flow sampling presents no exceedences.**
Cadmium	**4**	**N/A**	**266**	**1**	**N/A**	**Not a COC: Only one exceedance in CW3A-MW3. Low flow sampling presents no exceedences.**
Calcium	**NLE**	**45,400**	1,780,000	0	34	No NJDEP groundwater criteria.
Chromium	**100**	**N/A**	**6,190**	**3**	**N/A**	**Not a COC: Low flow sampling presents no exceedances.**
Cobalt	**NLE**	**N/A**	155	N/A	N/A	No NJDEP groundwater criteria.
Copper	**1000**	**65.6**	**14400**	**1**	**5**	**Not a COC: copper is a background metal.**
Iron	**300**	**431,000**	**1,020,000**	**48**	**1**	**Not a COC: iron is a background metal.**
Lead	**10**	**N/A**	**1,010**	**7**	**N/A**	**Not a COC: Low flow sampling presents no exceedences.**
Magnesium	**NLE**	**62,700**	169,000	N/A	0	No NJDEP groundwater criteria.
Manganese	**50**	**331**	**9,680**	**38**	**32**	**Not a COC: manganese is a background metal.**
Mercury	**2**	**N/A**	**5.1**	**1**	**N/A**	**Not a COC: Low flow sampling presents no exceedances. Only one exceedance in CW3A-MW3.**
Nickel	**100**	**187**	**1,050**	**1**	**1**	**Not a COC: nickel is a background metal.**
Potassium	**NLE**	**137,000**	153,000	N/A	1	No NJDEP groundwater criteria.
Selenium	**50**	**N/A**	**73.8**	**1**	**N/A**	**Not a COC: Only one exceedance in CW3A-MW3. Low flow sampling presents no exceedences.**
Sodium	**50000**	**21,500**	**132,000**	**18**	**31**	**Not a COC: sodium is not of concern due to proximity of site to seawater.**
Silver	**20**	**N/A**	**118**	**1**	**N/A**	**Not a COC: Only one exceedance in CW3A-MW3. Low flow sampling presents no exceedences.**
Thallium	**10**	**N/A**	7	0	N/A	No exceedance of NJDEP GWQC
Vanadium	**NLE**	**N/A**	2,270	N/A	N/A	No NJDEP groundwater criteria.
Zinc	**5000**	**233**	**33,900**	**1**	**10**	**Not a COC: zinc is a background metal.**

Notes:

All concentrations in micrograms per liter (ug/L), equivalent to parts per billion (ppb).

NJDEP GWQC: New Jersey Department of Environmental Protection Groundwater Quality Criteria.

N/A = Not Applicable

Exceeds NJDEP GWQC =

ND: Analyte not detected in sample

NLE: No limit established for this analyte

[1]Higher of Practical Quantitation Limits (PQLs) and Groundwater Quality Criteria (GWQC) per NJAC 7:9-6

[2]Fort Monmouth Summary of Site-specific Groundwater Maximum Background Concentrations (MBC) for the Charles Wood Area; MBCs are shown for background (native) metals only.

FIGURES

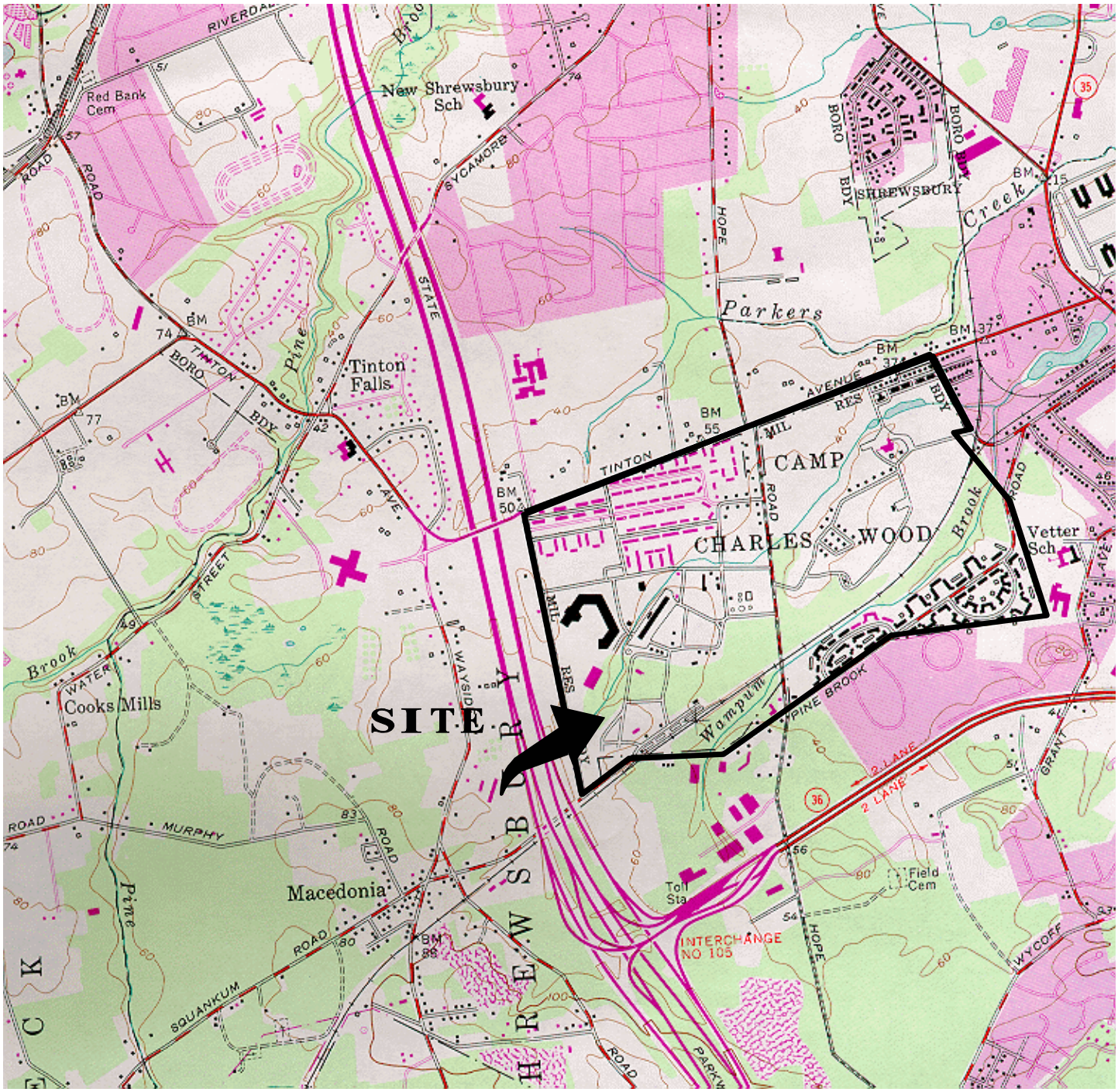


FIGURE 2-1

Site Location Map
CW-3A Landfill Site
Fort Monmouth, New Jersey

LONG BRANCH, N. J.
40073-C8-TF-024
1954
PHOTOREVISED 1981
DMA 6164 I SE-SERIES V822

NEW JERSEY
QUADRANGLE LOCATION

Mapped, edited and published by the Geological Survey

Versar INC.

Scale: 1" = 2000'

Date: Feb.2002

N

CW-3A LANDFILL

NEWA RBOR ALLEY

BRUSH

BRUSH

BRUSH

BRUSH

SIGN

SHRUBS

SH

SHRUBS

2713

MH

SH

SH

SH

SH

CB

2707

2712

CB

2711

2629

CONCRE

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:

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 2-2
SITE MAP
CW-3A LANDFILL SITE
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.: CW-3A FIG. 2-2
	FILE No.: CW-3A FIG. 2-2
	SCALE: 1" = 60'
	SHEET OF REV.: A

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

Geologic Map of New Jersey

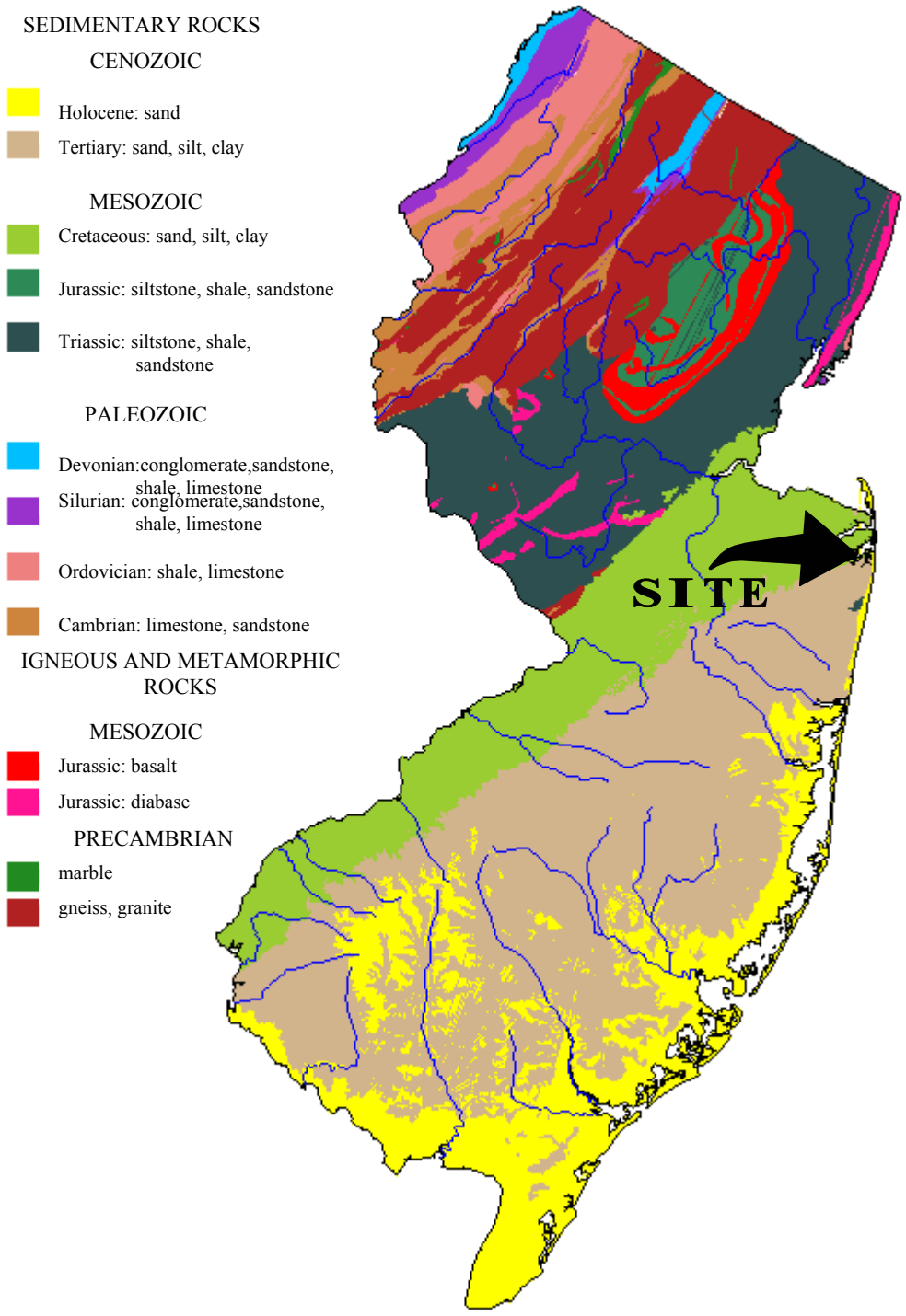
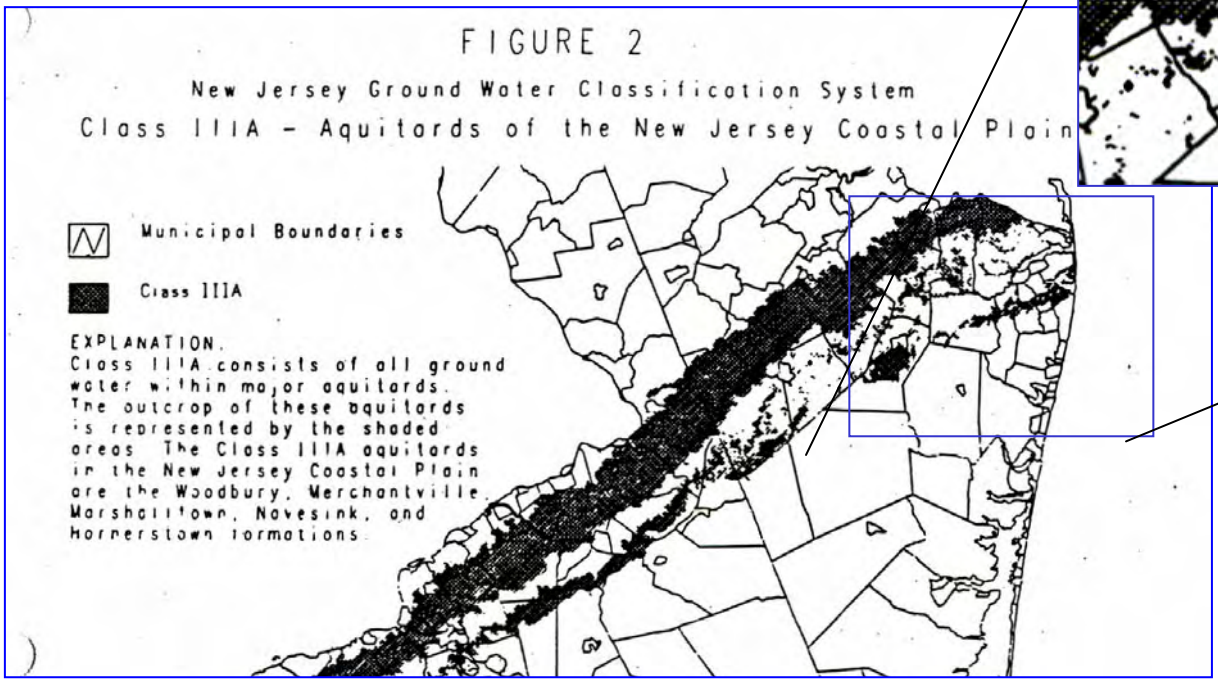
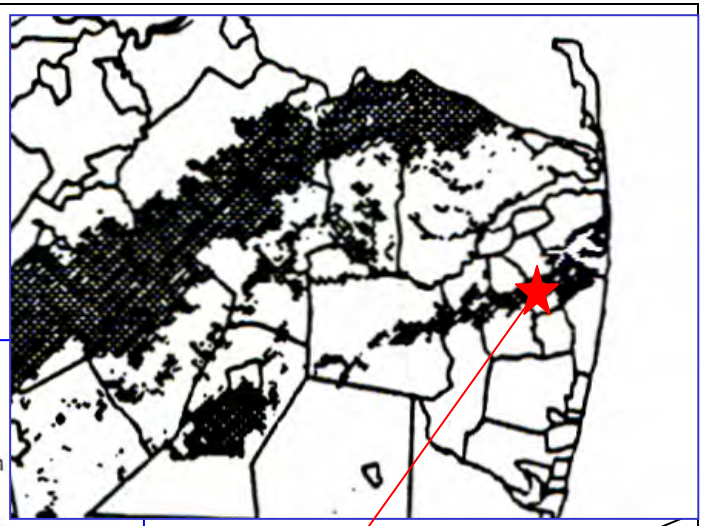


FIGURE 2-3
Geological Map of New Jersey
CW-3A Landfill Site
Fort Monmouth, New Jersey

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

Versar INC.





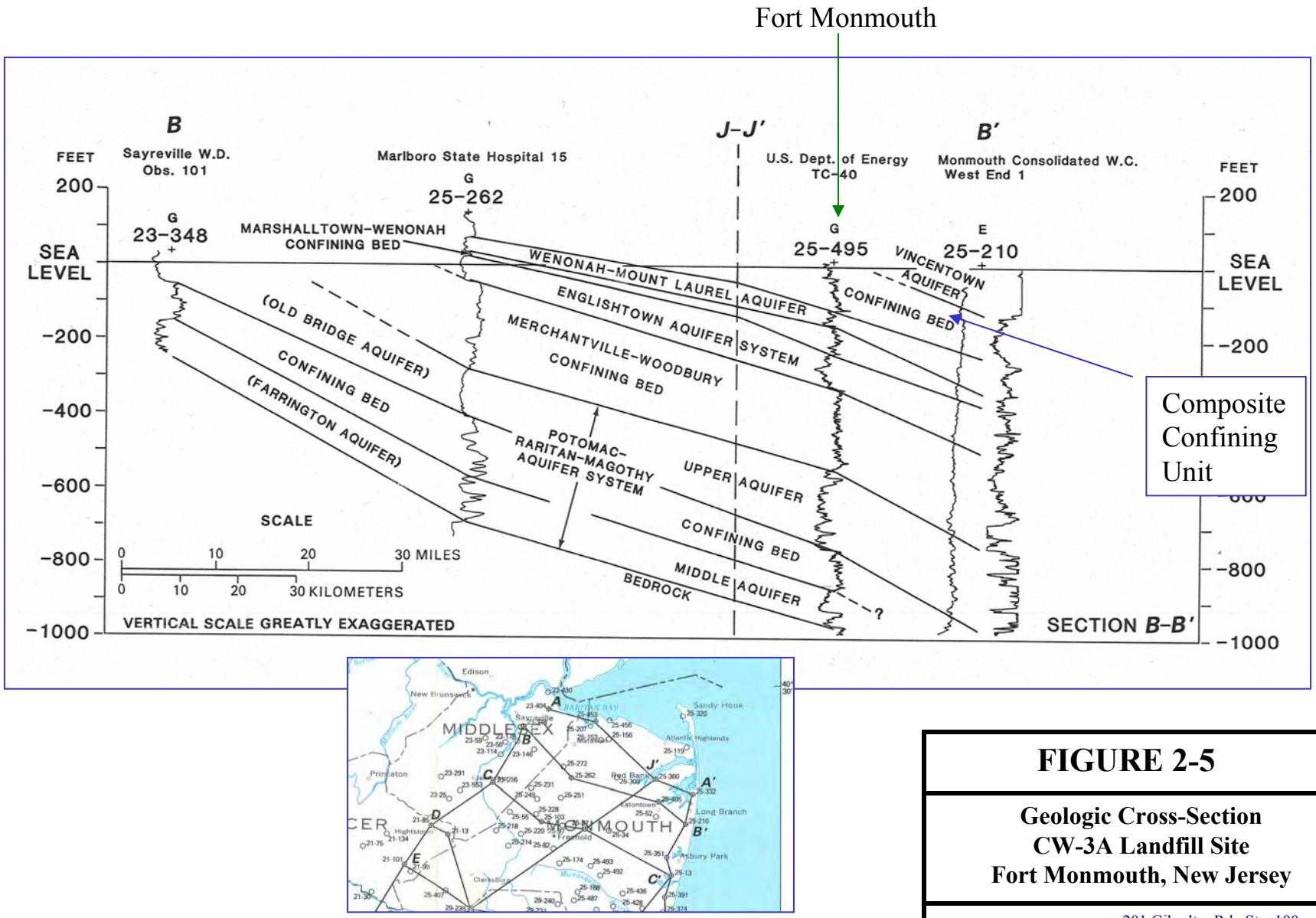
CW-3A Landfill Site

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

FIGURE 2-4

New Jersey Groundwater Classification
Class IIIA
CW-3A Landfill Site
Fort Monmouth, New Jersey

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

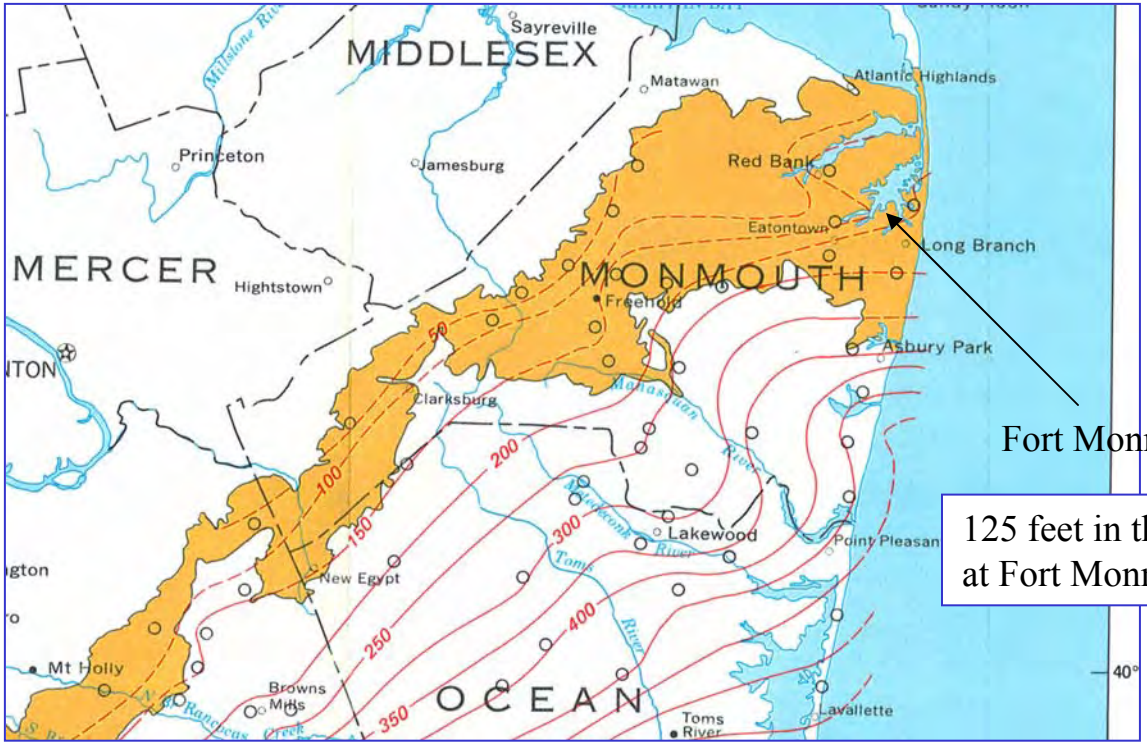


Source: Zapecza, O. 1989. *Hydrogeologic Framework of the New Jersey Coastal Plain.* USGS Professional Paper 1404-B. U.S. Government Printing Office, Washington, DC.

FIGURE 2-5

Geologic Cross-Section
CW-3A Landfill Site
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 2-6

Outcrop and Thickness of Composite Confining Unit CW-3A Landfill Site Fort Monmouth, New Jersey

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

US Department of Agriculture
Soil Conservation Service
Soil Survey of Monmouth County, NJ
April 1989

Figure 2-7
Soil Map of Monmouth County
CW-3A Landfill Site
Fort Monmouth, New Jersey

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

N

CW-3A LANDFILL

CW3A-MW3

CW3A-MW4

CW3A-MW2

CW3A-MW1

ATLANTIC HIGHLANDS

BRUSH

SIGN

SHRUBS

SH

CB

MH

2629

2713

2707

2712

2711

CONCRETE

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 AND SOIL SAMPLE LOCATION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 3-1
MONITORING WELL
AND SOIL SAMPLE LOCATION MAP
CW-3A LANDFILL SITE
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.: CW-3A FIG. 3-1
	FILE No.: CW-3A FIG. 3-1
	SCALE: 1" = 60'
	SHEET OF REV.: A

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

N

CW-3A LANDFILL

A'

CW3A-MW3

CW3A-MW4

CW3A-MW2

CW3A-MW1

A

TANEY AVENUE

ARBOR LANE

BRUSH

BRUSH

BRUSH

BRUSH

BRUSH

SIGN

SHRUBS

SH

SHRUBS

SH

SH

SH

SH

CB

SH

SH

CB

MH

2629

2713

2707

2712

2711

CONCRE

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

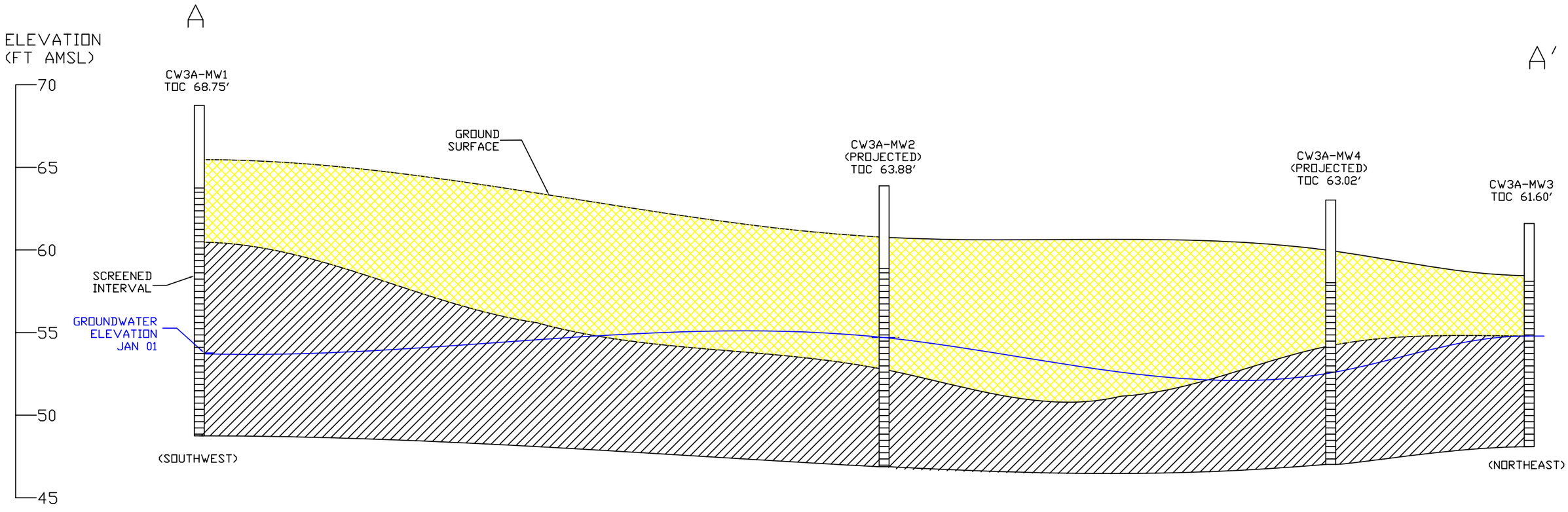
REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 4-1
GEOLOGIC CROSS SECTION LOCATION MAP
CW-3A LANDFILL SITE
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.: CW-3A FIG. 4-1
	FILE No.: CW-3A FIG. 4-1
	SCALE: 1" = 60'
	SHEET OF REV.: A

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



NOTES:

1) CROSS SECTION LINE (A TO A') IS SHOWN ON FIGURE 4-1.

2) VERTICAL SCALE: 1" = 6'.
HORIZONTAL SCALE: 1" = 20'.
VERTICAL EXAGGERATION = 3.33.

3) FT AMSL: FEET ABOVE MEAN SEA LEVEL

4) TOC = ELEVATION OF INNER WELL CASING SURVEY MARK (FT AMSL).

5) GROUNDWATER ELEVATION SHOWN IN FEET.

6) EACH OF THE WELLS HAS A DIAMETER OF 4 INCHES, WHICH IS ENLARGED ON THIS DRAWING FOR PRESENTATION.

7) BOUNDARIES ARE DASHED WHERE INFERRED.

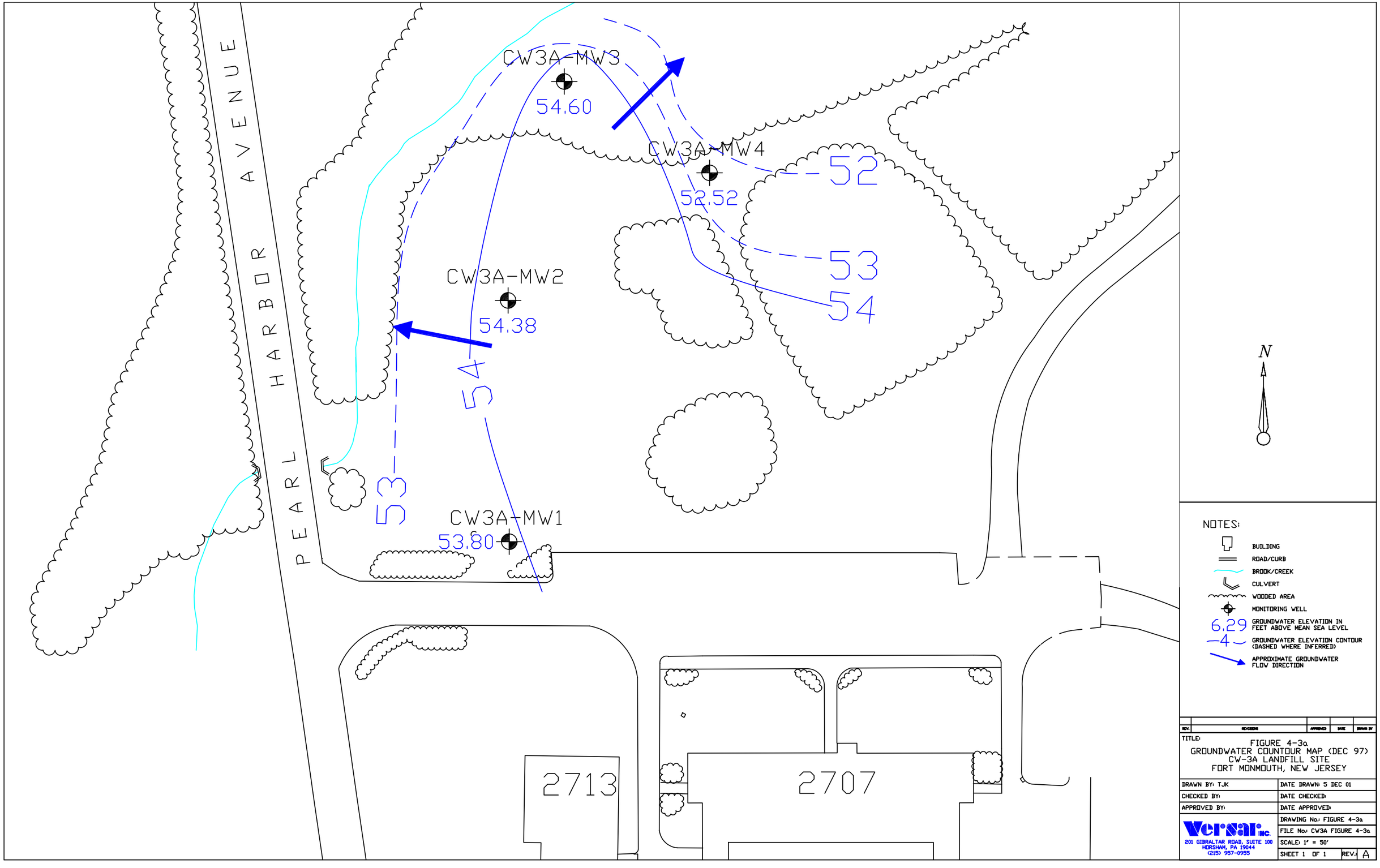
UNIT	SYMBOL	DESCRIPTION
(1)		BROWN MEDIUM TO COARSE SAND - FILL
(2)		GREENISH-GRAY TO BLACK SILTY CLAY

REV.	REVISIONS	APPROVED	DRAWN BY

TITLE:
FIGURE 4-2
GEOLOGIC CROSS SECTION A-A'
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK/TJW	DATE DRAWN: 16 OCT 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-2
	FILE No.: CW3A Figure 4-2
	SCALE: 1" = 20' (VERT 1"=6')
	SHEET 1 OF 1 REV.: A

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



NOTES:

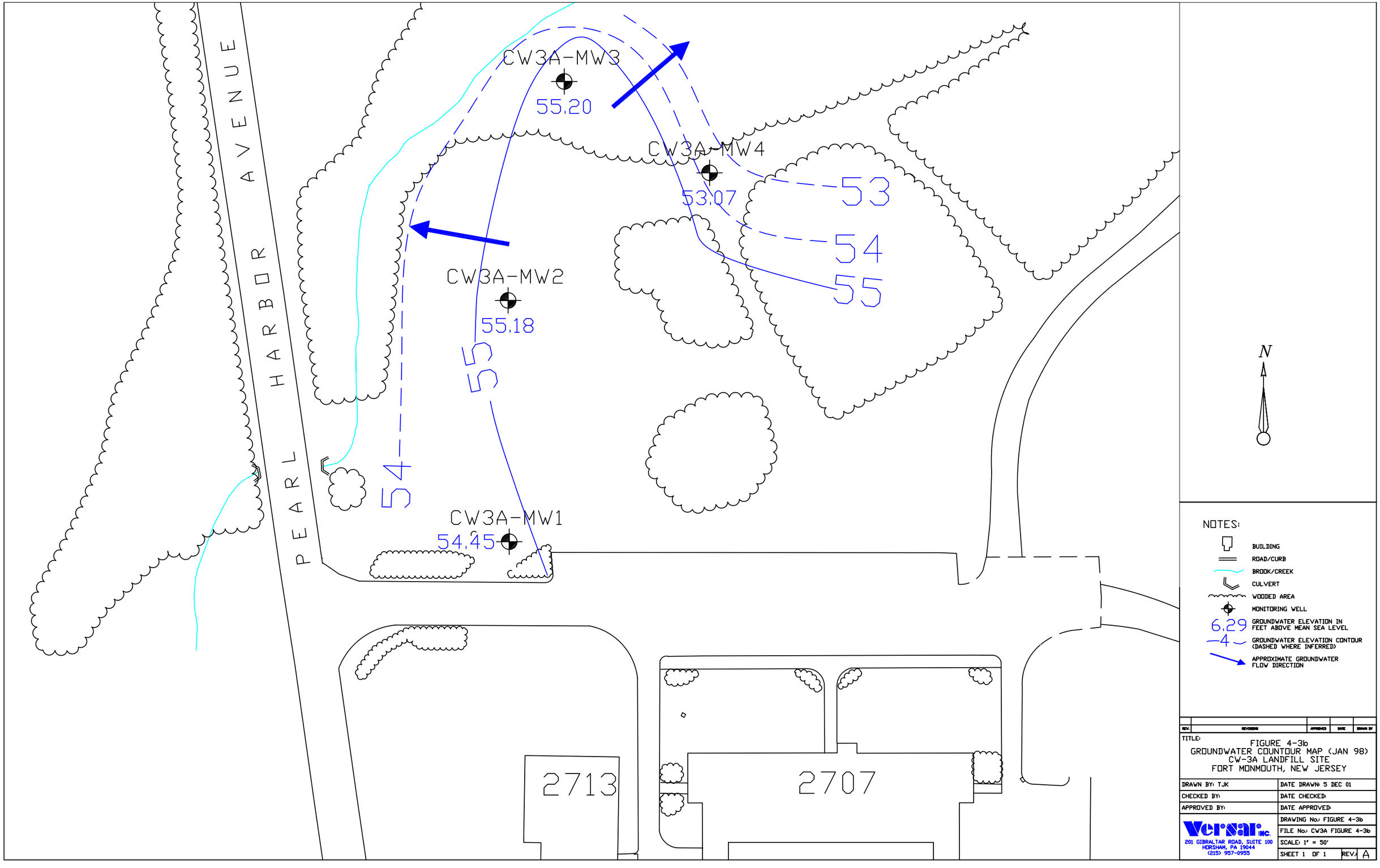
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3a
GROUNDWATER COUNTOUR MAP (DEC 97)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3a
	FILE No.: CW3A FIGURE 4-3a
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

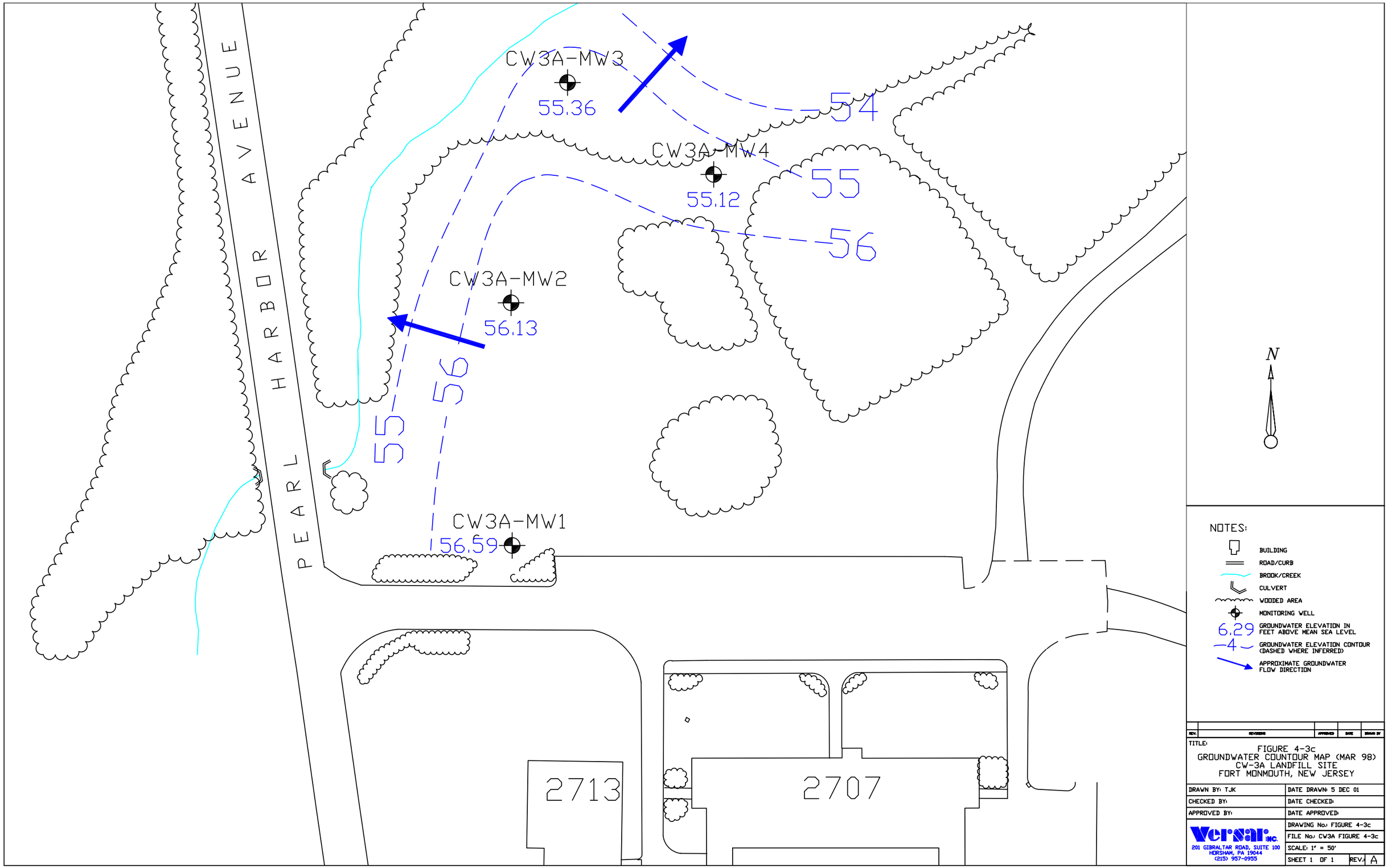
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3b
GROUNDWATER COUNTOUR MAP (JAN 98)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3b
	FILE No.: CW3A FIGURE 4-3b
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

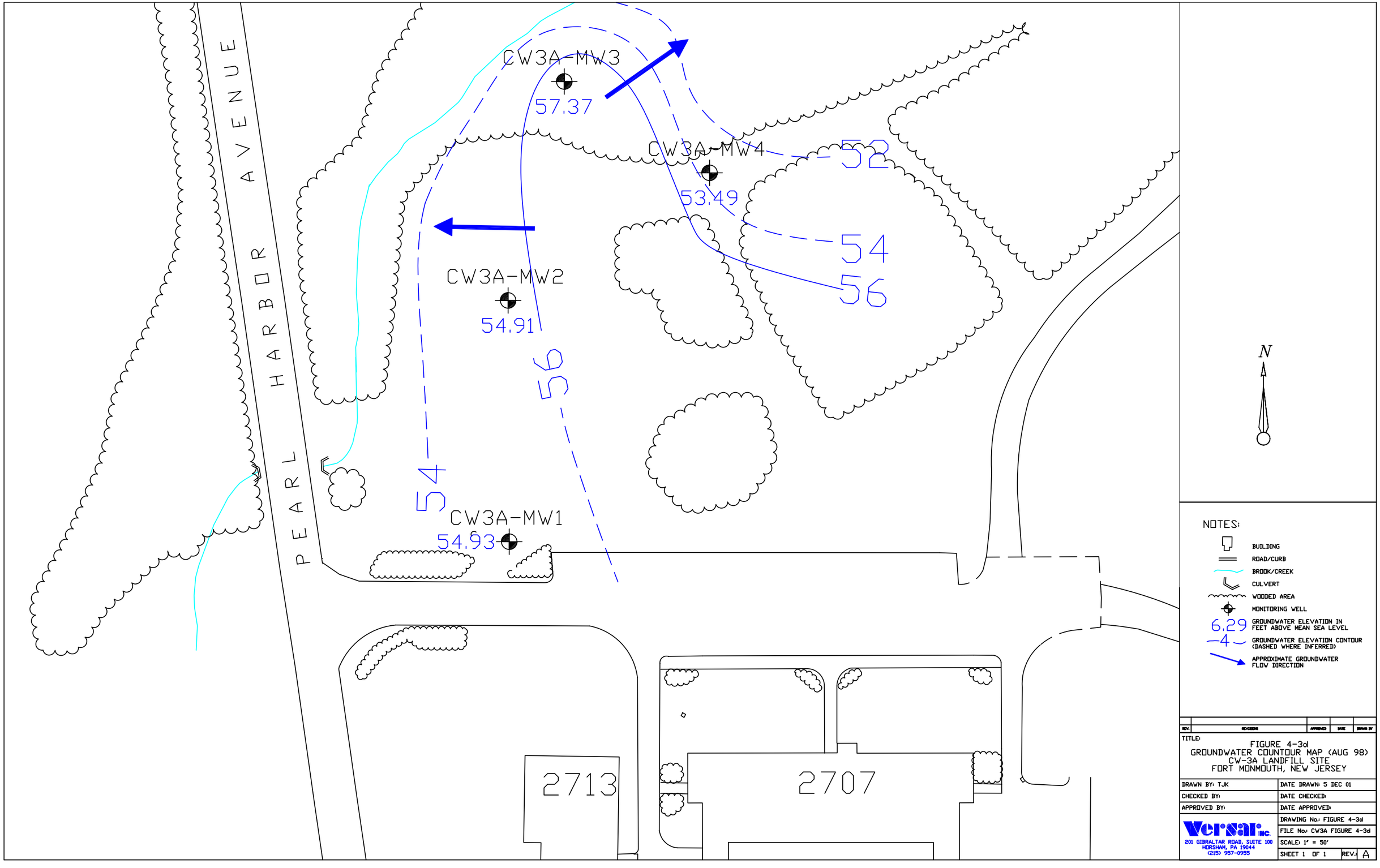
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3c
GROUNDWATER COUNTOUR MAP (MAR 98)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3c
	FILE No.: CW3A FIGURE 4-3c
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3d
GROUNDWATER COUNTOUR MAP (AUG 98)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3d
	FILE No.: CW3A FIGURE 4-3d
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.90

CW3A-MW4
51.75

CW3A-MW2
53.09

CW3A-MW1
52.98

51
52
53
54
52

2713

2707

N

NOTES:

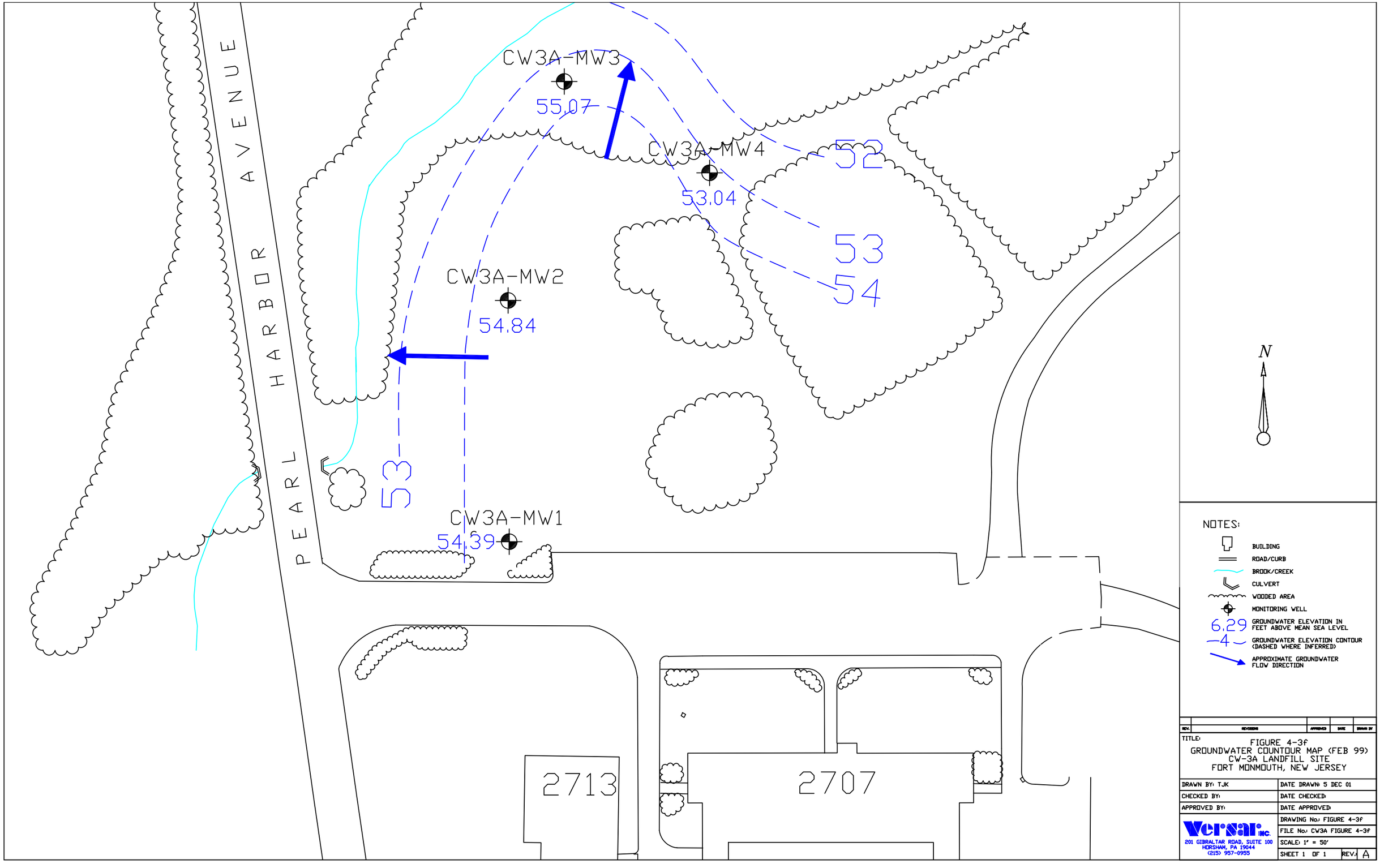
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3e
GROUNDWATER COUNTOUR MAP (DEC 98)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3e
	FILE No.: CW3A FIGURE 4-3e
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3f
GROUNDWATER COUNTOUR MAP (FEB 99)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3f
	FILE No.: CW3A FIGURE 4-3f
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.47

CW3A-MW4
53.09

CW3A-MW2
54.70

CW3A-MW1
54.38

52
53
54
54
53

2713

2707

N

NOTES:

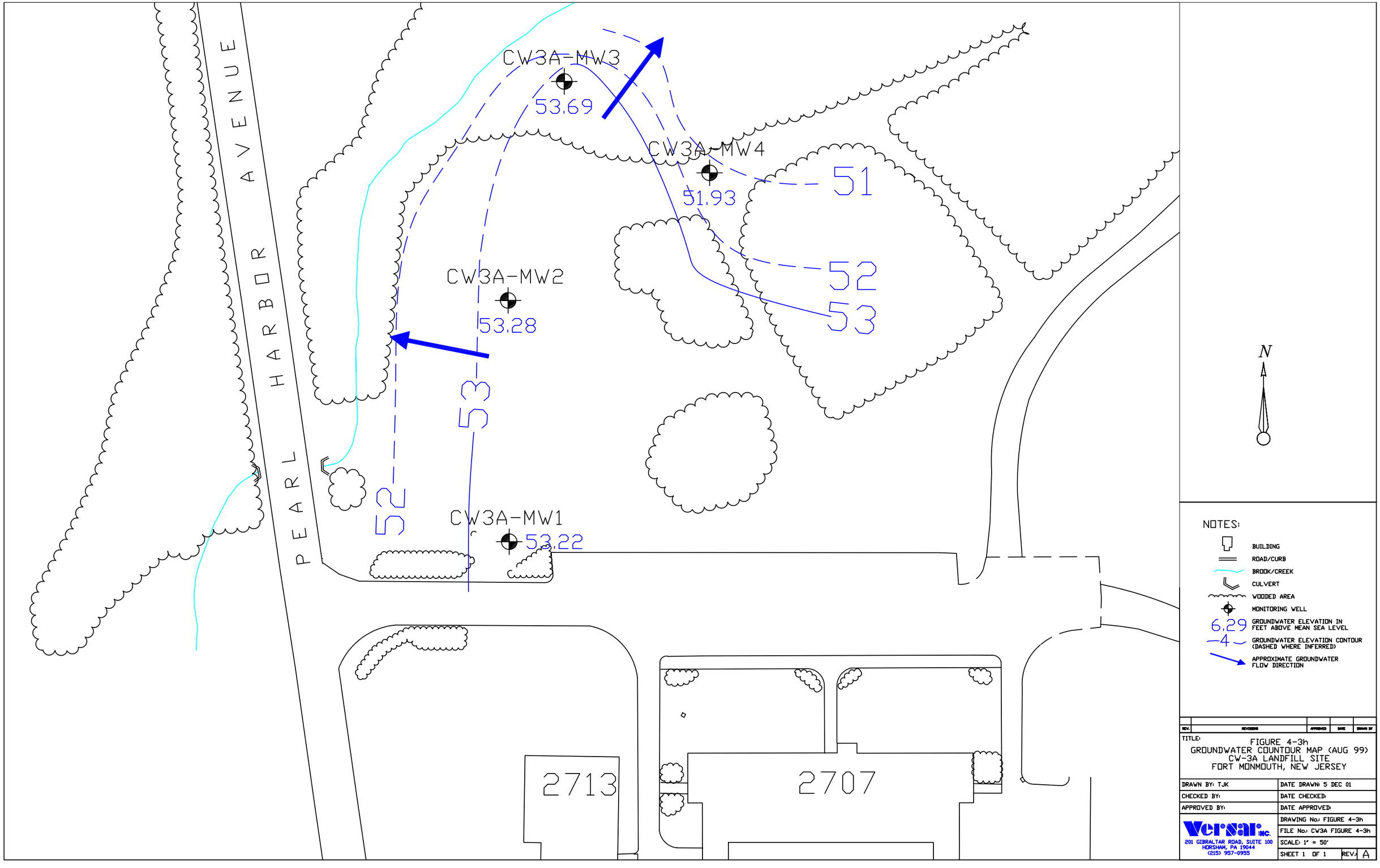
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

NO.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3g
GROUNDWATER COUNTOUR MAP (JUNE 99)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3g
	FILE No.: CW3A FIGURE 4-3g
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3h
GROUNDWATER COUNTOUR MAP (AUG 99)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3h
	FILE No.: CW3A FIGURE 4-3h
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.75

CW3A-MW4
52.21

CW3A-MW2
53.84

CW3A-MW1
53.50

52

53

54

54

2713

2707

N

NOTES:

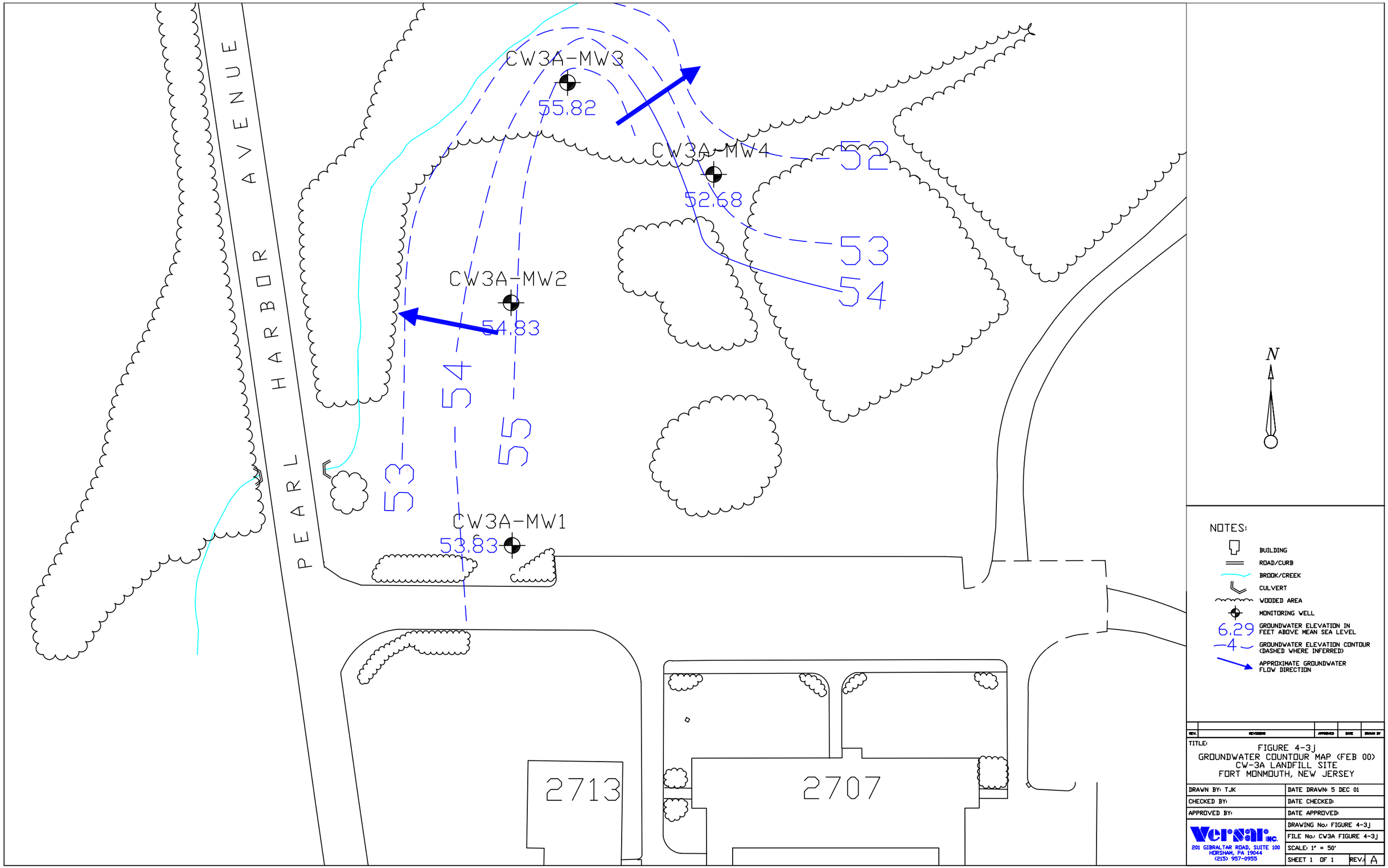
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3I
GROUNDWATER COUNTOUR MAP (NOV 99)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3I
	FILE No.: CW3A FIGURE 4-3I
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

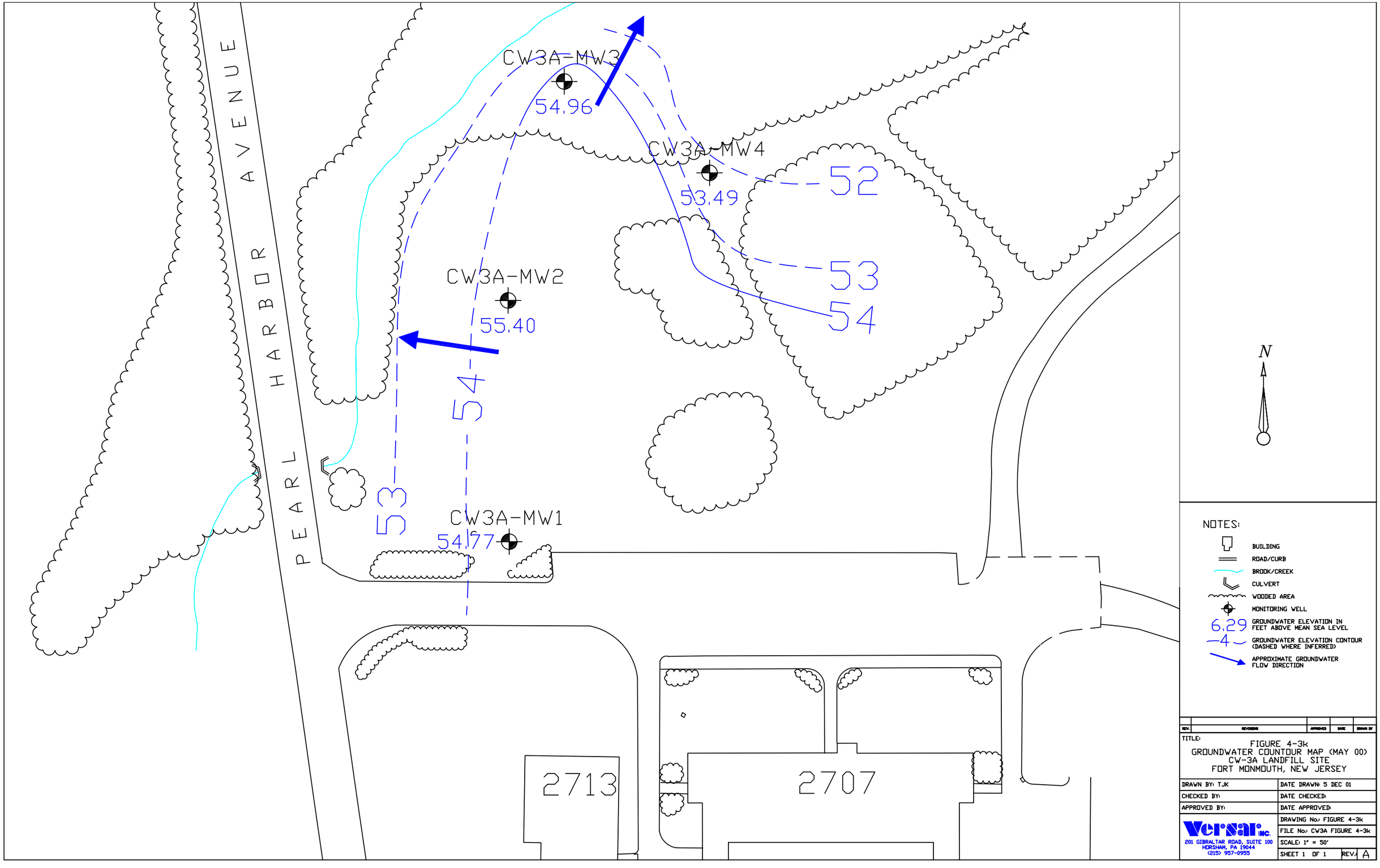
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3J
GROUNDWATER COUNTOUR MAP (FEB 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3J
	FILE No.: CW3A FIGURE 4-3J
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3k
GROUNDWATER COUNTOUR MAP (MAY 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3k
	FILE No.: CW3A FIGURE 4-3k
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.65

CW3A-MW4
52.71

CW3A-MW2
54.91

CW3A-MW1
54.10

52
53
54
54
53

2713

2707

N

NOTES:

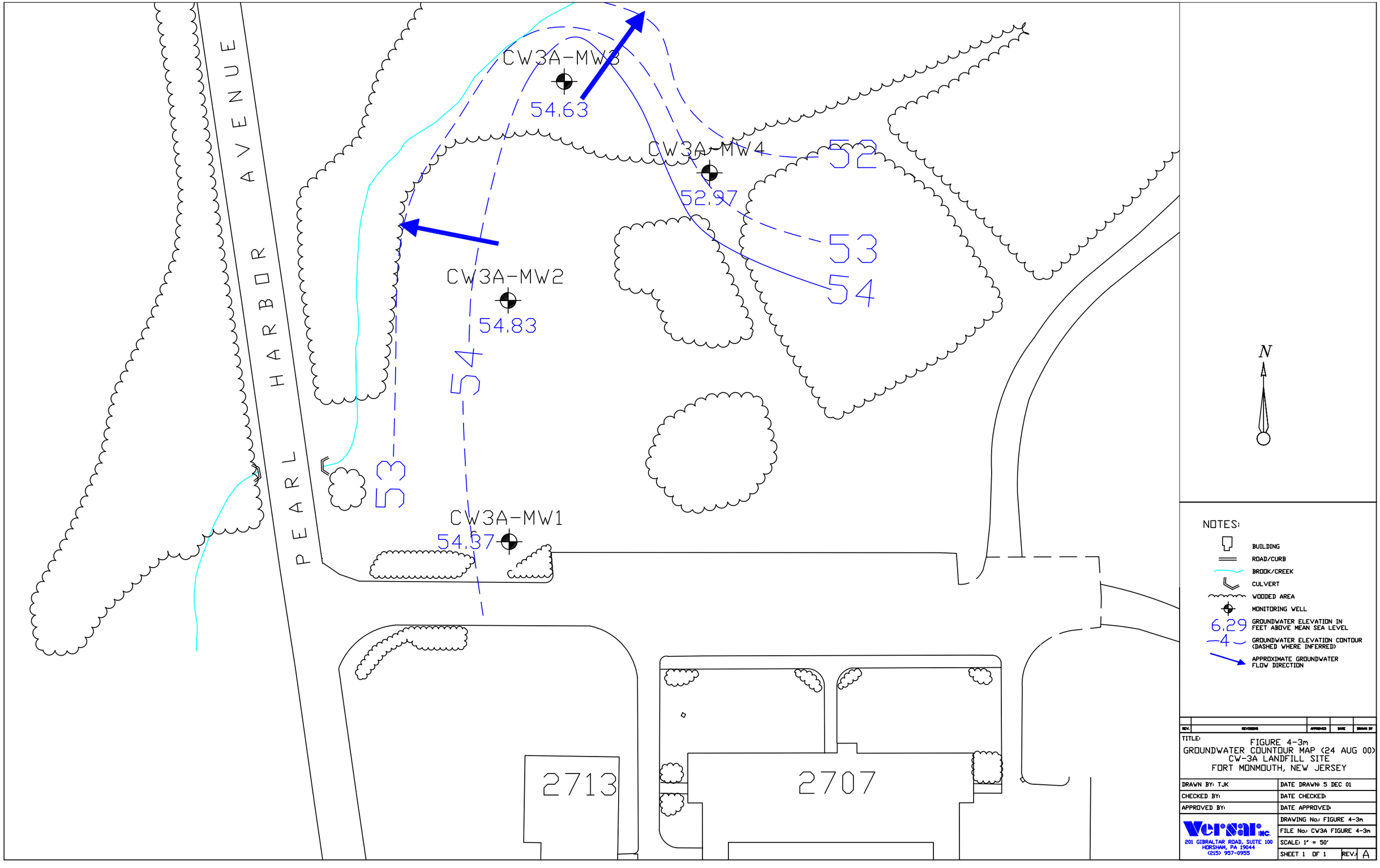
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3L
GROUNDWATER COUNTOUR MAP (3 AUG 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3L
	FILE No.: CW3A FIGURE 4-3L
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3m
GROUNDWATER COUNTOUR MAP (24 AUG 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3m
	FILE No.: CW3A FIGURE 4-3m
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.75

CW3A-MW4
52.87

CW3A-MW2
55.83

CW3A-MW1
54.27

52
53
54
55
54
53

2713

2707

N

NOTES:

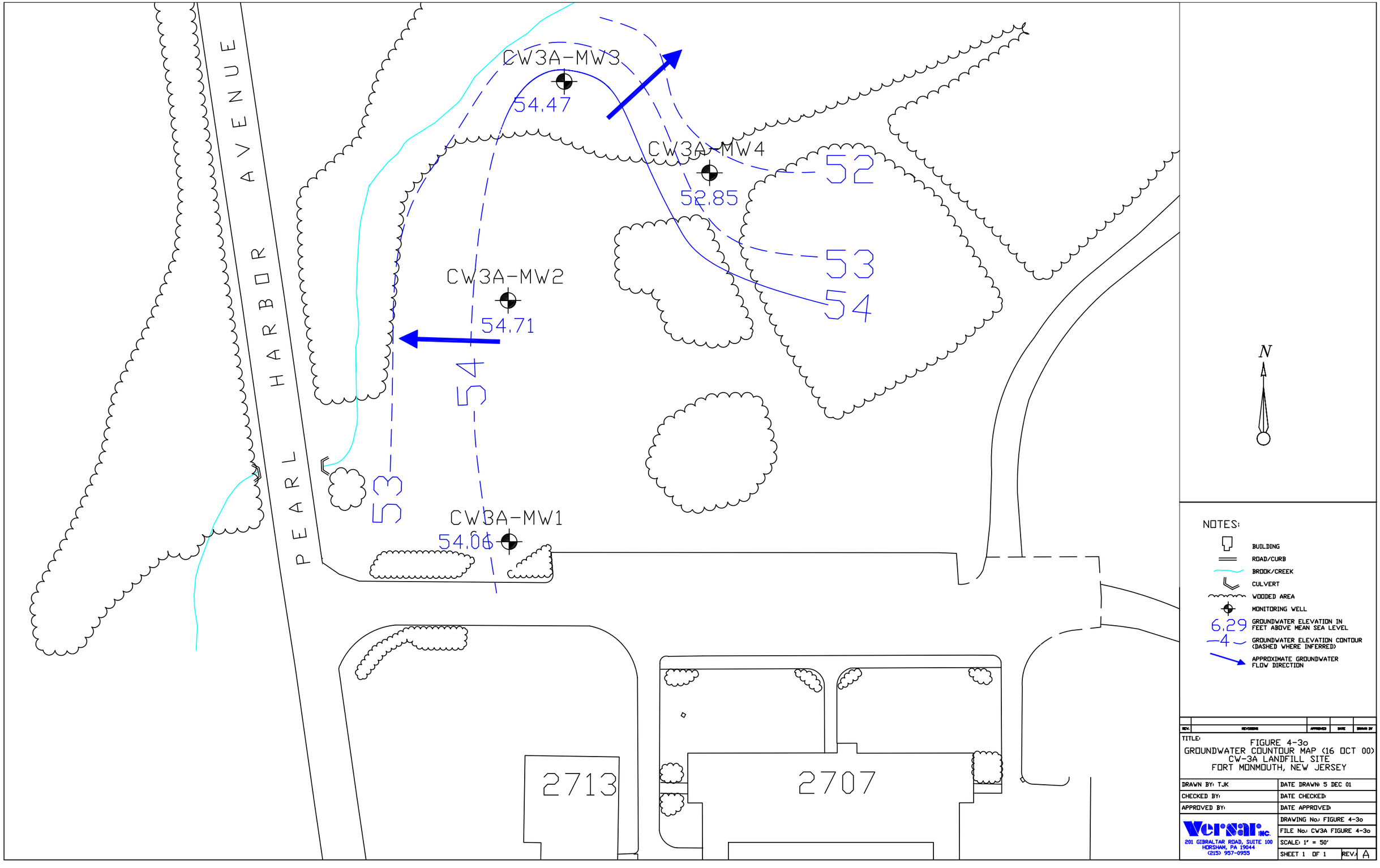
- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3n
GROUNDWATER COUNTOUR MAP (4 OCT 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3n
	FILE No.: CW3A FIGURE 4-3n
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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



NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 4 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3o
GROUNDWATER COUNTOUR MAP (16 OCT 00)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3o
	FILE No.: CW3A FIGURE 4-3o
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

PEARL HARBOR AVENUE

CW3A-MW3
54.79

CW3A-MW4
52.56

CW3A-MW2
54.70

CW3A-MW1
53.77

52
53
54
54
53

2713

2707

N

NOTES:

- BUILDING
- ROAD/CURB
- BROOK/CREEK
- CULVERT
- WOODED AREA
- MONITORING WELL
- 6.29 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- -4- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:
FIGURE 4-3p
GROUNDWATER COUNTOUR MAP (JAN 01)
CW-3A LANDFILL SITE
FORT MONMOUTH, NEW JERSEY

DRAWN BY: TJK	DATE DRAWN: 5 DEC 01
CHECKED BY:	DATE CHECKED:
APPROVED BY:	DATE APPROVED:
	DRAWING No.: FIGURE 4-3p
	FILE No.: CW3A FIGURE 4-3p
	SCALE: 1" = 50'
	SHEET 1 OF 1 REV.: A

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

N

AVENUE

HARBOR

PEARL

CW-3A LANDFILL BOUNDARY

Field Sample Location	RDCSCC	MW-3 (0.0'-2.0')	MW-3 (4.0'-6.0')
Sample Date	(mg/kg)	12/17/1997	12/17/1997
Benzo[a]anthracene	0.9	8.2	ND
Benzo[b]flouranthene	0.9	3.3 J	ND
Benzo[k]flouranthene	0.9	4.3 J	ND
Benzo[a]pyrene	0.66	6.2	ND
Indeno[1,2,3-cd]pyrene	0.9	2.8 J	ND
Barium	700	22.08	164.6
Cadmium	1	0.636	2.021
Lead	400	47.4	82.17
Zinc	1500	60.72	208.6

CW3A-MW03

Field Sample Location	RDCSCC	MW-4 (0.0-2.0")	MW-4 (4.0'-6.0')
Sample Date	(mg/kg)	12/17/1997	12/17/1997
Benzo[a]anthracene	0.9	ND	ND
Benzo[b]flouranthene	0.9	ND	ND
Benzo[k]flouranthene	0.9	ND	ND
Benzo[a]pyrene	0.66	ND	ND
Indeno[1,2,3-cd]pyrene	0.9	ND	ND
Barium	700	13.95	21.24
Cadmium	1	0.491	0.369
Lead	400	26.06	5.314
Zinc	1500	27.68	17.62

CW3A-MW04

Field Sample Location	RDCSCC	MW-2 (0.0-2.0')	MW-2 (6.0'-8.0')
Sample Date	(mg/kg)	12/17/1997	12/17/1997
Benzo[a]anthracene	0.9	ND	ND
Benzo[b]flouranthene	0.9	ND	ND
Benzo[k]flouranthene	0.9	ND	ND
Benzo[a]pyrene	0.66	ND	ND
Indeno[1,2,3-cd]pyrene	0.9	ND	ND
Barium	700	10.18	729.8
Cadmium	1	0.526	2.741
Lead	400	10.19	374.7
Zinc	1500	19.37	593.4

CW3A-MW02

Field Sample Location	RDCSCC	MW-1(0.0-2.0')	MW-1(11.5'-12.0')
Sample Date	(mg/kg)	12/17/1997	12/17/1997
Benzo[a]anthracene	0.9	ND	ND
Benzo[b]flouranthene	0.9	ND	ND
Benzo[k]flouranthene	0.9	ND	ND
Benzo[a]pyrene	0.66	ND	ND
Indeno[1,2,3-cd]pyrene	0.9	ND	ND
Barium	700	10.09	3.766
Cadmium	1	0.548	0.364
Lead	400	7.837	2.794
Zinc	1500	17.47	11.4

CW3A-MW01

COAL ASH SAMPLE		
Field Sample Location	RDCSCC	SAMPLE #1
Sample Date	(mg/kg)	12/17/1997
Benzo[a]anthracene	0.9	ND
Benzo[b]flouranthene	0.9	ND
Benzo[k]flouranthene	0.9	ND
Benzo[a]pyrene	0.66	ND
Indeno[1,2,3-cd]pyrene	0.9	ND
Barium	700	476.6
Cadmium	1	5.646
Lead	400	337.7
Zinc	1500	1842

2629

2712

2713

2707

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:

1) ALL CONCENTRATIONS IN MILLIGRAMS PER LITER (MG/KG) EQUIVALENT TO PARTS PER MILLION (PPM).
2) ND = ANALYTE NOT DETECTED IN SAMPLE
3) J = ESTIMATED VALUE
4) SAMPLE #1 = COAL/ASH SAMPLE
5) RDCSCC = NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJDEP); RESIDENTIAL DIRECT CONTACT SOIL CLEANUP CRITERIA (RDCSCC).

MONITORING WELL LOCATION

REV.	REVISIONS	APPROVED	DATE	DRAWN BY

TITLE:

FIGURE 5-1
SOIL SAMPLING CONTAMINANT MAP
CW-3A LANDFILL SITE
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.: CW-3A FIG. 5-1
	FILE No.: CW-3A FIG. 5-1
	SCALE: 1" = 60'
	SHEET OF REV.: A

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

APPENDICES

APPENDIX A

Roy F. Weston, Inc. Site Investigation Report, December 1995
Excerpts from Section 4.3 – Background Sampling and Debris Site CW-3A

4.3.5 Debris Site (CW-3A)

4.3.5.1 Site Location

Debris Site CW-3A is located west of the CW-3 area, north of Pulse Power, Building 2707 (Figure 4.3-6). The approximate area of site CW-3A is 116,000 ft^2 (2.6 acres).

4.3.5.2 Site History

According to long-term Fort Monmouth employees, the area north of Pulse Power was used as a disposal area. The 1957 aerial photograph shows the CW-3A area with bare ground. According to *Fort Monmouth History and Place Names, 1917-1959*, 90 buildings at Charles Wood were razed in late 1955 and during 1956. It is possible that the demolition debris from these buildings was placed in this area. In the 1974 aerial photo, a steel igloo is visible on this area. By 1986, the western part of this area had not revegetated. During the 1993 site visit, some small debris was observed in the woods.

4.3.5.3 Sampling Effort

Site CW-3A is also presented in Figure 4.3-6. Surface geophysics were conducted in this area because it was not known if subsurface disposal had occurred in this area and in accessible cleared areas to the southeast in the construction areas. Magnetic and electromagnetic (EM-31) measurements were collected on 10-ft centers. GPR was also used to assess the degree of subsurface soil disturbance.

4.3.5.4 Geophysical Results

The geophysical investigation at Charles Wood site CW-3A utilized EM, MAG, and GPR methods to characterize the site. Prior to the investigation, a site walk revealed numerous metallic objects on the surface in the form of pipes, sheet metal, metal cans, and concrete, as well as nonmetallic objects such as asphalt and construction debris. The debris was noted and considered during data interpretation.

The EM survey revealed prominent anomalous signatures not attributed to surface debris at grid coordinates 40N to 70N/40E to 70E and 140N to 160N/190E to 210E. These anomalies are shown on the EM quadrature and in-phase contour plots, Figures 4.3-7 and 4.3-8, respectively, as either violet or blue contour intervals (high and low conductivity, respectively). These two EM anomalies are confirmed by the magnetometer survey as being ferrous material. As shown on the total magnetic field and magnetic gradient contour plots, Figures 4.3-9 and 4.3-10, respectively, these anomalies are represented as a high and low pair or magnetic dipole with violet and blue contour intervals. Other subtle anomalies exist throughout the area, as depicted on the EM in-phase plot in Figure 4.3-8, which may indicate metallic debris. However, the size and magnitude of these EM signals are negligible. Also, the EM quadrature plot (Figure 4.3-7) shows high apparent conductivity, represented by the violet contour interval, along the north and western borders of the site. This higher conductivity may be due to a subsurface change in lithology.

The GPR survey at CW-3A revealed chaotic reflectors within grid coordinates 40N to 70N/40E to 70E, confirming the EM and MAG anomalies at a depth of approximately 2 to 3 ft bgs. These chaotic reflectors are indicative of buried metallic debris and are shown on the GPR profile along 60N in Figure 4.3-10A.

4.3.5.5 Recommendations

Geophysical surveys indicated two areas where subsurface metallic debris may be present.

Exploratory trenching will be performed to investigate areas where subsurface metallic debris may be present. Field screening will be conducted with a PID during the excavation. NJDEP will be requested to send a representative to observe the excavation. In the absence of elevated PID readings or evidence of subsurface debris, the excavation will be backfilled and no further action will be taken. If contamination is identified, then sampling will be conducted in accordance with the *Technical Requirements for Site Remediation* (NJDEP, 1993). Soil sample analytes will be collected and analyzed for the full range of contaminants.

APPENDIX B

Soil Boring Logs and Monitoring Well Construction Records

SERIAL # 004856

DWR-133M (10/96)

29 39021
29 39022
29 39023
29 39029

Mail to

NJDEP
Bureau Water Allocation
CN 426
Trenton, NJ 08625-0426

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
TRENTON, NJ

MONITORING WELL PERMIT

VALID ONLY AFTER APPROVAL BY THE D.E.P.

Permit No. 29 38029

COORD #: 29.03.554

Owner U.S. ARMY, FORT MONMOUTH
DIRECTOR OF PUBLIC WORKS
Address ~~BLDG. 173, attn; SELCM-7W-EV~~
FORT MONMOUTH NJ

Driller LUTZ ENVIRONMENTAL CO INC.
Address P.O. BOX 1247
LINDEN, NJ 07036

Name of Facility SITE CW- 3A
Address PEARL HARBOR AVENUE
TINTON FALLS (CHARLESWOOD POST) NJ

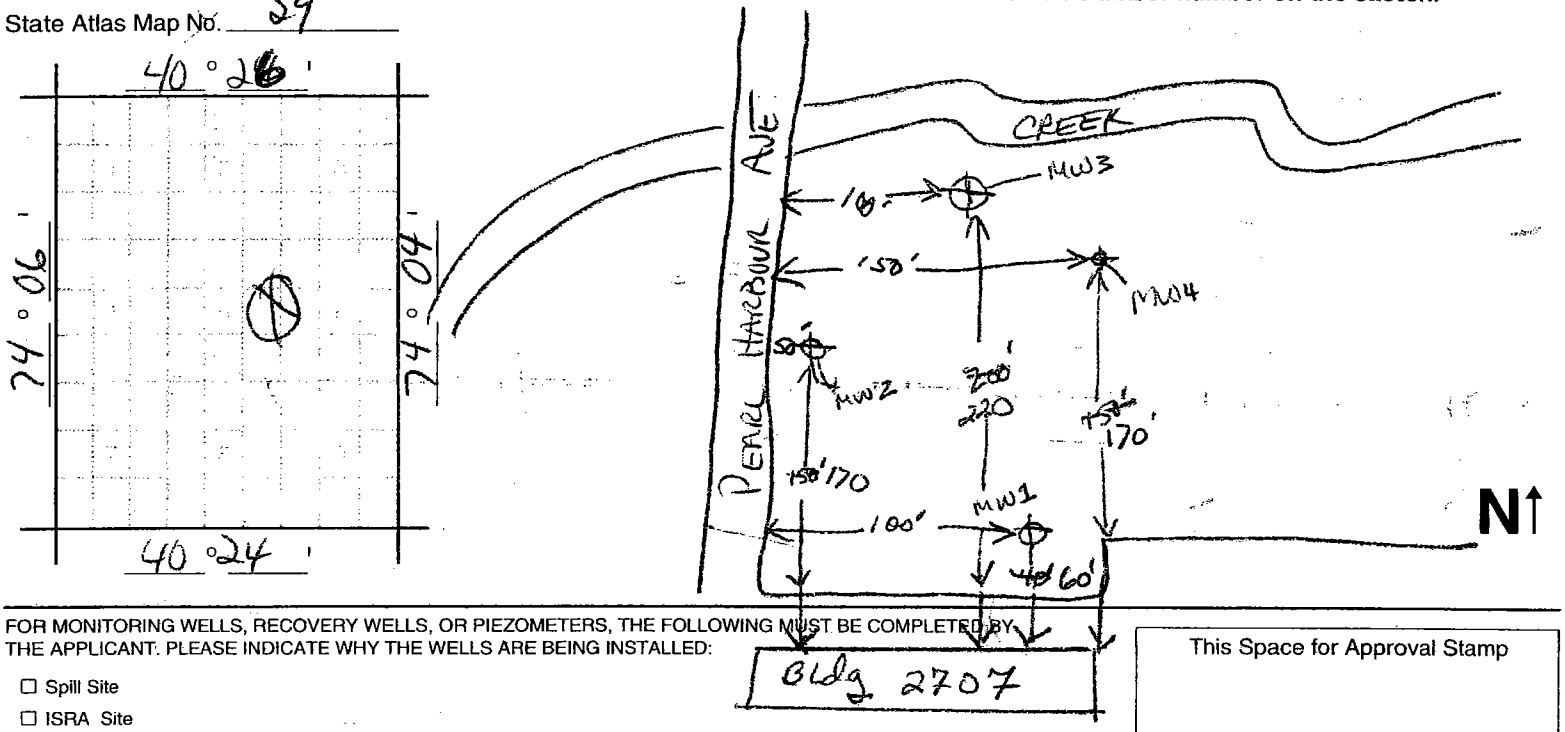
Diameter of Well(s) 4 inches		Proposed Depth of Well(s) 25 Feet	
# of Wells Applied for (max. 10) 4		Will pumping equipment be installed? YES ☐ NO ☒	
Type of Well (see reverse) MONITOR		If Yes, give pump capacity N/A cumulative GPM	

LOCATION OF WELL(S)

Lot #	Block #	Municipality	County
1, 1, 8, 01	1, 53, 54	~~TINTON FALLS~~	MONMOUTH

State Atlas Map No. 29

Draw sketch of well(s) nearest roads, buildings, etc. with marked distances in feet. Each well MUST be labeled with a name and/or number on the sketch.



FOR MONITORING WELLS, RECOVERY WELLS, OR PIEZOMETERS, THE FOLLOWING MUST BE COMPLETED BY THE APPLICANT. PLEASE INDICATE WHY THE WELLS ARE BEING INSTALLED:

- ☐ Spill Site
- ☐ ISRA Site
- ☐ CERCLA (Superfund) Site
- ☐ RCRA Site
- ☐ Underground Storage Tank Site
- ☐ Operational Ground Water Permit Site
- ☐ Pretreatment and Residuals Site
- ☐ Water and Hazardous Waste Enforcement Case
- ☐ Water Supply Aquifer Test Observation Well
- ☐ Other (explain) _____

CASE I.D. Number _____

This Space for Approval Stamp

WELL PERMIT APPROVED
N.J.D.E.P
DEC 16 1997
BUREAU OF WATER ALLOCATION

FOR D.E.P. USE

- ☐ Issuance of this permit is subject to the conditions attached. (see next page)
- ☒ For monitoring purposes only
- ☐ _____
- ☒ The well(s) may not be completed with more than 25 feet of total screen or uncased borehole.

SEE REVERSE SIDE FOR IMPORTANT PROVISIONS AND REGULATIONS PERTAINING TO THIS PERMIT.

In compliance with N.J.S.A. 58:4A-14, application is made for a permit to drill a well as described above.

Date 12-9-97 Signature of Driller _____ Registration No. 41444

Signature of Owner _____

COPIES: Water Allocation — White Health Dept. — Yellow Owner — Blue Driller — White

Groundwater & Environmental Services, Inc.
Monitoring Well Log

Project:	Fort Monmouth	Owner:	U.S. Army		
Location:	CW-3A at Fort Monmouth	Permit Number:	29-38021		
Well Number:	CW-3A-MW1	Total Depth:	20.0'	Diameter:	4"
Casing Elev.:	NA	Water Level Initial:	12.0'	Static:	12.0'
Screen Diam.:	4"	Length:	15.0'	Slot Size:	0.2
Casing Diam.:	4"	Length:	5.0'	Type:	PVC
Drilling Method:	Hollow Stem Auger	Sample Method:	Split Spoon		

Completion Details: Stickup protective casing with locking inner cap.

Driller Lutz Environmental, Inc. Log By: Jeff Campbell Date: 12/17/97

CW-3A-MW1

Depth	Sample ID	Well Construction	PID	Blow Count	Lithology
0			0	1, 1, 1, 1	0.0-2.0' Dark orange-brown silty SAND, little organics, moist.
1	1.5-2.0'				
2			0	2, 3, 2, 4	2.0-4.0' Dark orange-brown silty SAND, little organics, moist.
3					
4					
5	5.0-5.5'		0	1, 3, 6, 15	5.0-7.0' Light orange-brown fine SAND, trace fine subrounded Gravel, dry.
6					
7			0	13, 28, 26, 24	7.0-9.0' Light orange-brown fine SAND, trace fine subrounded Gravel, dry.
8					
9			0	10, 12, 12, 10	9.0-11.0' Light orange-brown fine SAND, trace fine subrounded Gravel, occasional 1" layers of fine silty Sand, some Silt, moist.
10					
11	11.5-12.0'		0	22, 20, 18, 21	11.0-13.0' Light orange-brown fine SAND, trace fine subrounded Gravel, occasional 1" layers of fine silty Sand, some Silt, saturated at 12.0'.
12					
13					
14					
15					
16					
17					
18					
19					
20					Monitoring well completed to 20.0'.
21					

S-4 CW-3A

THIS FORM MUST BE COMPLETED BY THE PERMITTEE OR HIS OR HER AGENT

GROUND WATER MONITORING WELL CERTIFICATION - FORM B - LOCATION CERTIFICATION

Name of Permittee: United States Army
Name of Facility: Camp Charles Wood
Location: Borough of Eatontown, New Jersey

NJPDES Permit No: NJ

LAND SURVEYOR'S CERTIFICATION

Well Permit Number (As assigned by NJDEPE's Water Allocation Section, 609-292-2957): This number must be permanently affixed to the well casing.		29-38021
Longitude (one tenth of a second):	West	74 ° 05 ' 19 . 7"
Latitude (one tenth of a second):	North	40 ° 17 ' 28 . 6"
Elevation of Top of Casing (cap off)		68.75
Distance from Top of Casing (cap off) to ground		3.28'
Owner's Well Number (As shown in the application or Plans):		MW-1

Benchmark: NJGCS Monument No. 9235
Elevation = 56.69

AUTHENTICATION:

I declare under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment.

Frederick W. Kocen

Professional Land Surveyor's Signature

Frederick W. Kocen Jr.

Professional Land Surveyor's Name SEAL

N.J. Lic. #34008

Professional Land Surveyor's License #

The Department reserves the right in cases of violation of permit specified ground water limits or Ground Water Quality Standards (NJAC 7:9-6.1 et seq.) to require that wells be resurveyed to an accuracy of one-hundredth of a second latitude and longitude. This shall not be considered to require a major modification of the NJPDES permit.

Groundwater & Environmental Services, Inc.
Monitoring Well Log

Project:	Fort Monmouth	Owner:	U.S. Army		
Location:	CW-3A at Fort Monmouth	Permit Number:	29-38022		
Well Number:	CW-3A-MW2	Total Depth:	17.0'	Diameter:	4"
Casing Elev.:	NA	Water Level Initial:	6.5'	Static:	6.5'
Screen Diam.:	4"	Length:	12.0'	Slot Size:	0.2
Casing Diam.:	4"	Length:	5.0'	Type:	PVC
Drilling Method:	Hollow Stem Auger	Sample Method:	Split Spoon		

Completion Details: Stickup protective casing with locking inner cap.

Driller Lutz Environmental, Inc. Log By: Jeff Campbell Date: 12/17/97

CW-3A-MW2

Depth	Sample I D	Well Construction	PID	Blow Count	Lithology
0			0	1, 1, 2, 2	0.0-2.0' Brown to dark brown silty coarse to fine SAND, little Silt, trace subangular Gravel (up to 3/4"), little organics, moist.
1					
	1.5-2.0'				
2			0	4, 8, 15, 12	2.0-3.0' Brown silty fine SAND, trace Silt, trace fine Gravel.
3					3.0-5.5' Black-stained silty gravelly COARSE to fine SAND, little Silt, little medium to fine subangular Gravel, moist.
4			0	10, 15, 22, 30	
5					5.5-6.0' Black coarse angular GRAVEL, little coarse Sand.
6	6.0-6.5'		0	2, 2, 1, 1	6.0-8.0' Black coarse angular GRAVEL, little coarse Sand, saturated at 6.5'.
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					Monitoring well completed to 17.0'.

Sht CU-3A

THIS FORM MUST BE COMPLETED BY THE PERMITTEE OR HIS OR HER AGENT

GROUND WATER MONITORING WELL CERTIFICATION - FORM B - LOCATION CERTIFICATION

Name of Permittee: United States Army
Name of Facility: Camp Charles Wood
Location: Borough of Eatontown, New Jersey

NJPDES Permit No: NJ

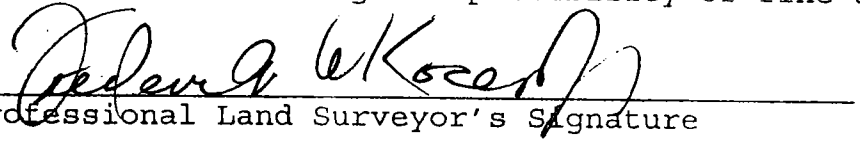
LAND SURVEYOR'S CERTIFICATION

Well Permit Number (As assigned by NJDEPE's Water Allocation Section, 609-292-2957): This number must be permanently affixed to the well casing.		29-38022
Longitude (one tenth of a second):	West	74° 05 ' 20 . 2"
Latitude (one tenth of a second):	North	40° 17 ' 29 . 9"
Elevation of Top of Casing (cap off)		63.88
Distance from Top of Casing (cap off) to ground		3.11'
Owner's Well Number (As shown in the application or Plans):		MW-2

Benchmark: NJGCS Monument No. 9235
Elevation = 56.69

AUTHENTICATION:

I declare under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment.



Professional Land Surveyor's Signature

Frederick W. Kocen Jr.
Professional Land Surveyor's Name

SEAL

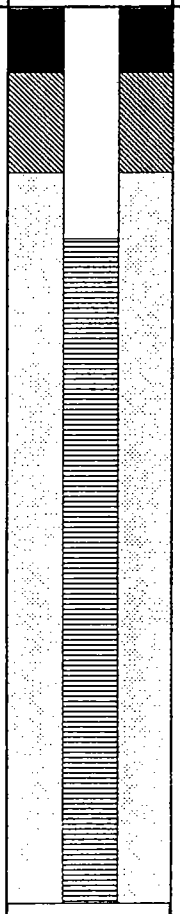
N.J. Lic #34008
Professional Land Surveyor's License #

The Department reserves the right in cases of violation of permit specified ground water limits or Ground Water Quality Standards (NJAC 7:9-6.1 et seq.) to require that wells be resurveyed to an accuracy of one-hundredth of a second latitude and longitude. This shall not be considered to require a major modification of the NJPDES permit.

Groundwater & Environmental Services, Inc.
Monitoring Well Log

Project:	Fort Monmouth	Owner:	U.S. Army		
Location:	CW-3A at Fort Monmouth	Permit Number:	29-38023		
Well Number:	CW-3A-MW3	Total Depth:	13.5'	Diameter:	4"
Casing Elev.:	NA	Water Level Initial:	NA	Static:	NA
Screen Diam.:	4"	Length:	10.0'	Slot Size:	0.2
Casing Diam.:	4"	Length:	3.5'	Type:	PVC
Drilling Method:	Hollow Stem Auger	Sample Method:	Split Spoon		
Completion Details:	Flush with grade manhole and locking inner cap.				
Driller	Lutz Environmental, Inc.	Log By:	Jeff Campbell	Date:	12/17/97

CW-3A-MW3

Depth	Sample I D	Well Construction	PID	Blow Count	Lithology
0			0	2, 3, 2, 1	0.0-2.0' Brown silty SAND, little Silt, dry.
1					
	1.5-2.0'				
2			0	16, 12, 5, 3	2.0-4.0' Brown silty SAND, little Silt, lumber fragments, dry.
3					
4			0	3, 2, 2, 3	4.0-5.0' Green-brown silty SAND, trace Silt, saturated at 5.0'.
5	5.0-5.5'				5.0-6.0' Very dark brown sandy SILT, some organics, wet.
6					
7					
8					
9					
10					
11					
12					
13					
					Monitoring well completed to 13.5'.

Site CW-3A

THIS FORM MUST BE COMPLETED BY THE PERMITTEE OR HIS OR HER AGENT

GROUND WATER MONITORING WELL CERTIFICATION - FORM B - LOCATION CERTIFICATION

Name of Permittee: United States Army
Name of Facility: Camp Charles Wood
Location: Borough of Eatontown, New Jersey

NJPDES Permit No: NJ

LAND SURVEYOR'S CERTIFICATION

Well Permit Number (As assigned by NJDEPE's Water Allocation Section, 609-292-2957): This number must be permanently affixed to the well casing.		29-38023
Longitude (one tenth of a second):	West	74 ° 05 ' 19.2"
Latitude (one tenth of a second):	North	40 ° 17 ' 31.2 "
Elevation of Top of Casing (cap off)		61.60
Distance from Top of Casing (cap off) to ground		3.15'
Owner's Well Number (As shown in the application or Plans):		MW-3

Benchmark: NJGCS Monument No. 9235
Elevation = 56.69

AUTHENTICATION:

I declare under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment.

Frederick W Kocen Jr

Professional Land Surveyor's Signature

Frederick W. Kocen Jr.

Professional Land Surveyor's Name

SEAL

N.J. Lic. #34008

Professional Land Surveyor's License #

The Department reserves the right in cases of violation of permit specified ground water limits or Ground Water Quality Standards (NJAC 7:9-6.1 et seq.) to require that wells be resurveyed to an accuracy of one-hundredth of a second latitude and longitude. This shall not be considered to require a major modification of the NJPDES permit.

Groundwater & Environmental Services, Inc.
Monitoring Well Log

Project:	Fort Monmouth	Owner:	U.S. Army		
Location:	CW-3A at Fort Monmouth	Permit Number:	29-38024		
Well Number:	CW-3A-MW4	Total Depth:	16.0'	Diameter:	4"
Casing Elev.:	NA	Water Level Initial:	6.0'	Static:	6.0'
Screen Diam.:	4"	Length:	12.0'	Slot Size:	0.2
Casing Diam.:	4"	Length:	4.0'	Type:	PVC
Drilling Method:	Hollow Stem Auger	Sample Method:	Split Spoon		

Completion Details: Flush with grade manhole and locking inner cap.

Driller Lutz Environmental, Inc. Log By: Jeff Campbell Date: 12/17/97

CW-3A-MW4

Depth	Sample I D	Well Construction	PID	Blow Count	Lithology
0			0	3, 3, 2, 12	0.0-1.5' Light brown gravelly MEDIUM to fine SAND, little medium to fine subrounded Gravel, moist.
1					
	1.5-2.0'				1.5-2.0' Dark brown silty medium to fine SAND, little
2			0	12, 10, 8, 8	Silt, moist.
					2.0-4.0' Light brown coarse to fine SAND, moist, minor
3					black staining.
4			0	10, 8, 18, 15	4.0-6.0' Brown to black silty coarse to fine SAND, saturated at 6.0'.
5					
	5.5-6.0'				
6			0	2, 3, 4, 4	6.0-6.75' Brown to black silty coarse to fine SAND, saturated.
7					6.75-7.75' Very dark green-black silty SAND, wet.
					7.75-8.0' Light green medium to fine SAND, wet.
8					
9					
10					
11					
12					
13					
14					
15					
16					Monitoring well completed to 16.0'.

Site CW-3A

THIS FORM MUST BE COMPLETED BY THE PERMITTEE OR HIS OR HER AGENT

GROUND WATER MONITORING WELL CERTIFICATION - FORM B - LOCATION CERTIFICATION

Name of Permittee: United States Army
Name of Facility: Camp Charles Wood
Location: Borough of Eatontown, New Jersey

NJPDES Permit No: NJ

LAND SURVEYOR'S CERTIFICATION

Well Permit Number (As assigned by NJDEPE's Water Allocation Section, 609-292-2957): 29-38024
This number must be permanently affixed to the well casing.
Longitude (one tenth of a second): West 74° 05 ' 18.1 "
Latitude (one tenth of a second): North 40° 17 ' 30.7 "
Elevation of Top of Casing (cap off) 63.02
Distance from Top of Casing (cap off) to ground 3.06'
Owner's Well Number (As shown in the application or Plans): MW-4
Benchmark: NJGCS Monument No. 9235
Elevation = 56.69

AUTHENTICATION:

I declare under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment.

Professional Land Surveyor's Signature

Frederick W. Kocen Jr.
Professional Land Surveyor's Name

SEAL

N.J. Lic. #34008
Professional Land Surveyor's License #

The Department reserves the right in cases of violation of permit specified ground water limits or Ground Water Quality Standards (NJAC 7:9-6.1 et seq.) to require that wells be resurveyed to an accuracy of one-hundredth of a second latitude and longitude. This shall not be considered to require a major modification of the NJPDES permit.

APPENDIX C

Current Conditions Site Photograph

APPENDIX C
Current Conditions Site Photographs
CW-3A Landfill Site
Fort Monmouth, New Jersey

Northeastern View of CW3A-MW1

APPENDIX D

Soil Laboratory Data Sheets

APPENDIX E

Groundwater Laboratory Data Sheets