Remedial Action Workplan Addendum

Building 699
Main Post Area
Fort Monmouth, New Jersey

NJDEP UST Registration No. 0081533-112
NJDEP Incident # 89-10-19-1329

June 10, 1999

Prepared For
United States Army
Directorate of Public Works
Fort Monmouth, New Jersey
Building 173
Fort Monmouth, New Jersey 07703

Prepared By
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CERTIFICATION

For: Remedial Action Workplan Addendum Building 699 site, NJDEP Incident # 89-10-19-1329, Fort Monmouth, New Jersey

"I certify under penalty of law that the information provided in this document is true, accurate, and complete to the best of my knowledge. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

Charles Appleby
Environmental Protection Specialist
NJDEP Subsurface Evaluator Cert# 2056
Fort Monmouth, New Jersey 07703
Name, Title

Signature

6/23/99
Date

"I certify that under penalty of law that I have personally examined and am familiar with the information submitted herein and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete to the best of my knowledge. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

Mark H. Johnson
LTC, MI
Garrison Commander
Name, Title

Signature

6/23/99
Date

This Remedial Action Workplan Addendum has been reviewed and approved.

Ian Curtis
Case Manager
NJDEP, Bureau of Federal Management
Name, Title

Signature

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ENCLOSURE #1
BUREAU OF UNDERGROUND STORAGE TANKS
ADMINISTRATIVE CHECKLIST FOR REMEDIAL ACTION WORKPLANS

Facility Name: United States Army, Fort Monmouth

Case #: 89-10-19-1329

UST #: 0081533-112

General	Check one: yes	no	n/a
1. Table of Contents	X		
Environmental Setting			
1. USGS topographic map	X		
2. Scaled site map w/ all site features	X		
3. Background conditions summary, including discussion on all potential receptors, source mitigation, etc.	X		
4. Effectiveness Analysis and Certification (as per P.L. 1993, c. 139, Section 35)	X		
5. Soil remediation plan			
a. Summary of sampling results to date, including all sample locations and concentration on a scaled site map and in tabular form (i.e. Remedial Investigation Report)	X		
b. Detailed description of remedial action and remedial technology for each area of concern	X		
c. Post-remedial sampling plan		X	
d. Cleanup goals (compound specific)	X		
e. Soil disposal/soil re-use plan			X
f. Permit requirements/applications	X		
g. Scaled site maps per N.J.A.C. 7:26E-4.9 and 6.2(a)6i-v	X		
h. Soil erosion and sediment control plan			X
6. Ground water remediation plan	X		
a. Summary of sampling results to date, including contaminant isopleth maps and tabular	X		

presentation (i.e. RIR)

Check one:	yes	no	n/a
b. Plume delineated	X		
c. Wells properly constructed	X		
d. Flow direction defined, including ground water contour maps	X		
e. Detailed description of remedial action and remedial technology	X		
f. Cleanup goals (compound specific)	X		
g. System specifications	X		
h. Remedial monitoring plan/effectiveness evaluation plan	X		
i. Hydraulic control information/maintenance	X		
j. Treated water discharge location	X		
k. Permit requirements/applications	X		
7. Data presentation format	X		
8. Site restoration plan and remedial system dismantling plan		X	
9. Schedule of implementation	X		
10. Cost estimate	X		
11. Site specific Health and Safety Plan		X	

Note: all "no" and "n/a" responses must be accompanied by supporting rational.

5c. A post remedial soil sampling plan will be submitted at a later date.

5e. Soil vapor extraction is proposed as a remedial alternative for soil.

5h. Soil erosion to surface waters is not expected to occur at this site.

8. A remedial system dismantling plan will be submitted at a later date.

11. A site specific health and safety plan is located in GES files and will be available for review upon request. As per OSHA, any and all contractors will complete a Health and Safety Plan as contracts are awarded.

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EXECUTIVE SUMMARY

Groundwater & Environmental Services, Inc. (GES) was contracted by Fort Monmouth, (through TECOM-Vinell Services, Inc. PO #98-0017 and #99-838) to prepare a Remedial Action Workplan Addendum (RAWA) for Building 699 (site), Main Post area of United States (U.S.) Army Fort Monmouth, Fort Monmouth, Monmouth County, New Jersey. On October 19, 1989, the Main Post gasoline station at Fort Monmouth contacted the New Jersey Department of Environmental Protection (NJDEP), to report an apparent release of gasoline from the piping system. Incident # 89-10-19-1329 was assigned to the site for the gasoline release. A separate-phase product (SPP) recovery pump was installed in a monitoring well immediately downgradient of the source in an attempt to recover remaining SPP. The Fort Monmouth Directorate of Public Works (DPW) submitted a Remedial Action Workplan (RAW) on October 12, 1993. In response to the 1989 gasoline discharge, seventeen (17) monitoring wells, and three (3) recovery wells have been installed at the site. The horizontal extent of the groundwater plume has been delineated.

On June 9, 1998, a 2,000 gallon No. 2 fuel oil fiberglass underground storage tank (UST) was removed in accordance with the New Jersey Department of Environmental Protection (NJDEP) underground storage tank procedures at the Main Post area of the U.S. Army Fort Monmouth, Fort Monmouth, New Jersey. The UST, NJDEP Registration No. 0081533-112 (Fort Monmouth ID No. 699), was located southwest of Building 699. A No Further Action was proposed for the 2,000-gallon fuel oil UST.

The Krydon Group, Inc. (Krydon) was contracted to determine the extent of gasoline contamination at the site. Krydon conducted a soil boring program on July 23 – 24, 1993, and collected a total of 27 soil samples. Benzene soil concentrations were found to be ranging between non-detect and 60 milligrams per kilogram (mg/Kg).

The existing groundwater recovery and treatment system extracts groundwater from one (1) recovery well (RW-11). GES has been contracted to operate and maintain the existing groundwater system since January 1998. The treatment system consists of one (1) sediment filter, and three (3) one hundred and eighty (180) pound (lb) liquid-phase granular activated carbon (GAC) units installed in series. The GAC units provide the necessary treatment for the removal of volatile organic compounds (VOCs). The treated groundwater is discharged via the sanitary sewer in accordance with the existing Treatment Works Approval (TWA) permit the Northeast Monmouth County Regional Sewerage Authority

Historically, groundwater samples have been collected at the site since 1989, and quarterly since 1995. Currently, depth to groundwater measurements were collected from all monitoring and recovery wells at the Main Post site by GES, on a bi-weekly basis from April 1998 through

February 1999, with the exception of May and December 1998. The Fort Monmouth DPW personnel collected groundwater samples on January 15, 1998, June 8, 1998, July 29, 1998, and December 30, 1998 from various monitoring wells located at the site.

A remedial action pilot test was performed on April 17, 1998 utilizing GES' data acquisition and processing laboratory (DAPL) vehicle. Pilot testing was performed at this site to evaluate remedial options to address impacted soil. Based on an evaluation of the pilot test data, a low-vacuum soil vapor extraction (SVE) system with groundwater extraction and optional air sparge system has been determined to be a technically feasible, and the most cost effective remedial technology to address this site.

The proposed remedial system will utilize SVE and groundwater pumping to extract soil vapor and groundwater from existing monitoring wells and proposed vapor extraction laterals and wells. Soil vapor extraction will apply vacuum to the subsurface soils to volatilize and extract VOCs. In addition, in-situ air stripping (air sparging) may be utilized in the future to remediate groundwater in the saturated zone. The extracted soil vapor and groundwater will be treated and discharged in accordance with the applicable discharge permits. The Classification Exception Area (CEA) will encompass the capture zone of the proposed remedial system.

The proposed remedial system complies with the NJDEP regulations and guidelines. GES estimates that the proposed system will be required to operate for a period of approximately 5 years. This estimate is based on GES' extensive experience in the operation and maintenance of similar remedial systems. The actual time as well as efficiency of the system will be determined by site-specific conditions. Modeling has been done to the best of GES' ability and satisfies the regulatory intent.

1.0 INTRODUCTION

Groundwater & Environmental Services, Inc. (GES) was contracted by Fort Monmouth, (through TECOM-Vinelli Services) to prepare a Remedial Action Workplan Addendum (RAWA) for Building 699 (site), Main Post area of U.S. Army Fort Monmouth, Fort Monmouth, Monmouth County, New Jersey. The site is situated on Saltzman Avenue, a thoroughfare through Fort Monmouth. Figure 1 is an annotated U.S. Geological Survey (USGS) 7.5-minute series quadrangle map depicting the site location, topography, and drainage patterns.

On October 19, 1989, the Main Post gasoline station at Fort Monmouth contacted the New Jersey Department of Environmental Protection (NJDEP), to report an apparent release of gasoline from the piping system. Incident # 89-10-19-1329 was assigned to the site for the gasoline release. Approximately 11,000-gallons of gasoline was discharged into the soil surrounding the underground storage tanks (USTs) and piping (Krydon 1993). After the gasoline release, the Main Post gasoline station has replaced the piping system connecting the USTs and the fuel pumps with equipment compliant with the NJDEP Bureau of Underground Storage Tanks (BUST). A separate-phase product (SPP) recovery pump was installed in a monitoring well immediately downgradient of the source in an attempt to recover remaining SPP. In response to the NJDEP letter, the United States Army submitted *A Discharge Investigation and Corrective Action Report* (DICAR), dated July 3, 1990 prepared by GES.

In a letter dated June 18, 1993, the NJDEP requested the submission of a Remedial Action Workplan (RAW). The United States Army submitted a RAW on October 12, 1993 (Krydon 1993). This RAWA presents a brief history of the site and area of concern, a performance summary of the current groundwater remedial system, a summary of groundwater monitoring and sampling data and the design and specifications of the proposed remedial system upgrade.

1.1 Site History

The loss of product was discovered as a result of an inventory discrepancy found during routine inventory control. Pressure testing of the gasoline system indicated that the leak was located in the product line between the tanks and the pumps. A Phase Two Vapory Recovery system was subsequently installed. In response to the 1989 gasoline discharge, seventeen (17) monitoring wells, and three (3) recovery wells have been installed at the site. Two monitoring wells (MW-10, MW-A) were abandoned at a later date. Copies of selected well logs and Forms A are included in Appendix I

On June 10, 1998 one 2,000-gallon fiberglass diesel UST, (Registration No. 0081533-112) was closed at Building 699, by the United States Army Directorate of Public Works (DPW). Based on tank inspection, field screening of subsurface soils and review of analytical results of

collected soil samples, it was concluded that no significant historical discharges were associated with the UST or associated piping. Results of tank closure activities are presented in the *Tank Closure Report*, dated June 1998. This UST Closure and Site Investigation Report was prepared by SMC Environmental Services Group, to assist the DPW in complying with the NJDEP-BUST regulations.

1.2 Health and Safety Procedures

A site specific Health and Safety Plan (HASP) was prepared by GES for all site activities. The HASP outlines the required field monitoring equipment, protective clothing, action levels, anticipated compounds, and emergency response procedures. The HASP is retained in GES' files and is available upon request. Based on the field air monitoring data and an evaluation of the potential hazards, site activities were conducted in level "D" protection. Air monitoring was conducted throughout sampling and drilling activities utilizing a photo-ionization detector (PID). All GES field personnel are trained and certified in accordance with Occupational Safety and Health Administration (OSHA) requirements. Per OSHA, any contractor working on the site is required to complete a site specific HASP prior to commencement of work.

2.0 PHYSICAL SETTING

2.1 Site Description

The site is approximately one acre, and serves as the only on-base Main Post location for non-military vehicles to obtain fuel. The station has six 10,000-gallon, fiberglass USTs which store various grades of gasoline products. These products are distributed from two remote pumping islands, with a total of four dispensers. The remainder of the pump islands do not have any dispensers. A former fuel oil UST, and waste oil UST were located east of the building in the immediate vicinity of MW-12. The building was historically utilized as an automobile service garage. However, automobile servicing has been discontinued since 1997. There are four bays located at the eastern side of the building. The site is approximately ninety percent covered by impervious surfaces including pavement, concrete islands and a service station. Large paved parking areas exist to the east and west of the site. A large grassey area is found to the north across Saltzman Avenue. Building 699A is located approximately 750 feet northwest of Husky Brook, which empties into Oceanport Creek. The nearest water body is Parkers Creek, located approximately 1,000 feet north of the site. Topography at the site is relatively flat, sloping gradually to the southeast.

2.2 Geology/Hydrogeology

The following description of regional and local geology was taken in part from Smith, 1998.

Regional Geology

Monmouth County lies within the New Jersey Section of the Atlantic Coastal Plain Physiographic province. The site is located in what may be referred to as the Outer Coastal Plain subprovince, or the Outer Lowlands.

In general, New Jersey Coastal Plain formations consist of a seaward-dipping wedge of unconsolidated deposits of clay, silt, and gravel. These formations typically strike northeast-southwest with a dip ranging from 10 to 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 New Jersey Coastal Plain formations record several major transgressive/regressive cycles and contain units which are generally thicker to the southeast and reflect a deeper water environment. Over 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 thicknesses for these units vary greatly (i.e., from several feet to several hundred feet). The Coastal Plain deposits thicken to the southeast from the Fall Line to greater than 6,500 feet in Cape May County (Brown and Zapecza, 1990).

Local Geology

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 to 80 percent of the sand fraction in the

upper part of the unit (Minard, 1969). The upper part of the Tinton is often highly oxidized and iron oxide encrusted (Minard).

The upper soils at the site consist of Udorthents as described in the U.S. Department of Agriculture Soil Survey of Monmouth County New Jersey. Udorthents consists of well drained to somewhat poorly drained soils that have no horizonation. These soils were formed in stratified or graded, sandy or loamy fill material that has as much as 35 percent gravel by volume. Slopes range from 0 to 3 percent. These soils have been altered in some way. In some areas the altering resulted from filling over or excavating excessively drained to very poorly drained areas. These soils differ greatly from place to place. In filled areas the soils may be more than 20 inches deep to undisturbed material. They are strongly acidic to extremely acidic.

The hydrogeologic characteristics of the area are typical of the Atlantic Coastal Plain. The interbedded sequences of sand and clay transmit water under both confined and unconfined conditions. The intermittent clay strata serve as semi-confining beds where present. The Atlantic Coastal Plain receives recharge from precipitation and vertical leakage between aquifers through semi-confining beds.

The general flow of groundwater in the Atlantic Coastal Plain is southeasterly, following the dip of the strata. Local flow variations have been reported in the vicinity of pumping wells and surface bodies. The Hornerstown Sand, being mostly clay, serves as an aquiclude either independently or in conjunction with adjacent formations. It serves as an aquiclude independently where Red Bank Sand is present, separating this aquifer from the overlying Vincentown Formation. Down dip, where the aquifer in the Red Bank Sand has been removed, the Hornerstown Sand serves as a composite aquiclude with the Navesink Formation and the lower member of the Red Bank Sand, separating the Mount Laurel Sand from the Vincentown or Kirkwood aquifers. Although considered an aquiclude, the Hornerstown Sand may yield enough water in some parts of the formation to satisfy domestic needs.

Due to the limited horizontal extent and variable thickness of the Tinton bed, it is not considered a significant groundwater source and probably serves as a composite aquiclude with the overlying Hornerstown Sand.

Hydrogeology

The water table aquifer at the site is identified as part of the "composite 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.

Due to the proximity Fort Monmouth to the Atlantic Ocean, shallow groundwater may be tidally influenced and may flow toward creeks and brooks as the tide goes out, and away from creeks and brooks as the tide comes in. However, an abundance of clay lenses and sand deposits were noted in borings installed throughout Fort Monmouth. Therefore, the direction of shallow groundwater should be determined locally on a case-by-case basis.

Shallow groundwater may be locally influenced at the site 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, and
- local groundwater recharge areas (i.e., streams, lakes).

Due to the fluvial nature of the overburden deposits (i.e., sand and clay lenses), shallow groundwater flow direction is best determined on a case-by-case basis. This is consistent with lithologies observed in borings installed within the Main Post area, which primarily consisted of fine-to-medium grained sands, with occasional lenses or laminations of gravel silt and/or clay.

Aquifer Characteristics

Henderson, Breen & Hess developed and performed pump tests to study aquifer characteristics at the site. The aquifer characteristics studied included hydraulic conductivity, transmissivity and storage coefficient. These characteristics were calculated using data obtained from groundwater elevations observed on the 4-inch diameter monitoring wells between July 7 and August 13, 1992 while under the influence of the pumping 10" recovery well. Henderson, Breen & Hess calculated that the average coefficient of transmissivity was 418 gallons per day per foot (gpd/ft), the coefficient of storage for the study period was 0.06, and the hydraulic conductivity was 32.15 gpd/ft^2. Copies of the pumping test data tables compiled by Henderson, Breen, & Hess are included in Appendix II.

2.3 Local Water Supply/Well Search

Based on records of wells drilled in the Main Post area, water is typically encountered at depths of 2 to 9 feet below ground surface (bgs). According to Jablonski, wells drilled in the Red Bank and Tinton Sands may produce 2 to 25 gallons per minute (gpm). Some well owners have reported acidic water that requires treatment to remove iron.

According to the New Jersey Pollution Discharge Elimination System (NJPDES 1992 - 1993), 2.9 percent (%) of the population of Eatontown receives its water from domestic wells. In 1993,

a manual well search was conducted by Roy F. Weston Inc., a contractor of the US Army. A copy of the well search results is included in Appendix III.

3.0 PRODUCT RECOVERY

GES was contracted in October 1989 by the US Army at Fort Monmouth to remove SPP present at the site. Two 4-inch wells were installed from which a total of 4,506 gallons of SPP were removed (Krydon 1993). In December 1989, a dual pump recovery system was installed to maintain hydraulic control and to increase SPP recovery. A second dual phase recovery system was installed in March 1990 to expedite the product recovery process. A total of 6,733 gallons of SPP were recovered by summer 1990 (Krydon 1993). Currently, product recovery is not being conducted at the site.

4.0 GROUNDWATER MONITORING AND SAMPLING

4.1 Groundwater Elevations

Depth to groundwater measurements were collected from all monitoring and recovery wells at the Main Post site by GES, on a bi-weekly basis from April 1998 through February 1999, with the exception of May and December 1998. Groundwater monitoring events were conducted on April 2, 1989, April 9, 1998, May 27, 1998, June 11, 1998, June 26, 1998, July 2, 1998, July 8, 1998, July 29, 1998, August 8, 1998, August 18, 1998, September 4, 1998, September 17, 1998, October 2, 1998, October 16, 1998, November 12, 1998, November 25, 1998, December 4, 1998, January 22, 1999, January 29, 1999, February 12, 1999, and February 19, 1999. Measurements for depth to water, SPP thickness (when SPP was detected), and adjusted groundwater elevations are included in Table 1. Groundwater contours were generated from groundwater elevation data and the maps were submitted to Fort Monmouth DPW. Selected Contour Maps are included in this RAWA: July 2, 1998 (Figure 2), November 12, 1998 (Figure 3), January 22, 1999 (Figure 4), and February 19, 1999 (Figure 5).

4.2 Groundwater Sampling

Groundwater sampling has been conducted previously at the site at various intervals. Historical groundwater data from 1995 are presented in Appendix IV, in the form of hydrographs. The hydrographs include time versus groundwater concentration. Fort Monmouth DPW conducted groundwater sampling on January 15, 1998, June 8, 1998, and July 29, 1998, from monitoring wells MW-1 through MW-9, RW-11, MW-12, MW-15, MW-16, and MW616-1. Groundwater samples were also collected on December 30, 1998 from monitoring wells MW-2, MW-5, MW-

8, MW-9, MW-12, MW-15, MW-16, and MW616-1. All samples were submitted to US Army Fort Monmouth Environmental Laboratory (New Jersey Certification # 13461), and analyzed for Volatile Organic Compounds (VOCs) by Method 624, and lead by Method 3120B. The Site Information Plan for June 8, 1998 is included as Figure 6. A Benzene Isopleth Map for July 29, 1998, is included as Figure 7.

5.0 SOIL BORING PROGRAM

The Krydon Group, Inc. (Krydon) was contracted by Serv-Air, Inc. (Serv-Air), a designated contractor for the US Army at Fort Monmouth, to determine the extent of gasoline contamination and to provide an appropriate remediation recommendation at the site for Building 699. Krydon conducted a soil boring program on July 23 – 24, 1993, at the site. A total of 27 soil samples were collected by Krydon at a depth of 5.5 feet below grade (the soil-groundwater interface) and submitted to 21st Century Environmental and Fort Monmouth Environmental Laboratory for analysis. All soil samples collected on July 23 - 24, 1993 were analyzed for total petroleum hydrocarbons (TPH), VOCs with a forward library search of ten compounds (VOCs+10), and lead. The method numbers for analyses were not provided in the October 11, 1993 RAW by Krydon. The July 23 – 24, 1993, soil sampling locations are shown on a Figure provided by the US Army, a copy of which is included in Appendix V. The soil sampling results are included in Table 3, also provided by the US Army, a copy of which is included in Appendix V.

Soil Analytical Results

A review of the analytical results of the July 23 – 24, 1993, soil sampling indicates that the soil in the vicinity of the tankfield and pump islands has not been delineated. However, the biodegradation of gasoline components is widely documented. It is likely that the concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) has degraded by advection, diffusion, dispersion, and bioremediation mechanisms. In addition, the areas in the vicinity of the tankfield and the pump island as identified during the soil boring program have been included in the Vapor Enhanced Groundwater Extraction (VEGE) treatment system being proposed for this site (See Section 8.0 for details).

6.0 SUMMARY OF REMEDIAL SYSTEM PERFORMANCE

The existing groundwater recovery and treatment system is installed within the existing fiberglass groundwater treatment system enclosure. Utilizing an electric submersible pump, groundwater extraction is ongoing from one (1) recovery well (RW-11). The treatment system consists of one sediment filter, which is utilized for solids removal, and three (3) one hundred

and eighty (180) pound (lb) liquid-phase Granular Activated Carbon (GAC) units installed in series. The GAC units provide the necessary treatment for the removal of VOCs. The existing groundwater system operates intermittently at a flowrate of approximately one (1) gpm. The treated groundwater is discharged to the Northeast Monmouth County Sewerage Authority via the sanitary sewer.

A Remedial System Performance Summary from January 2, 1998 through April 9, 1999, is included in Appendix VI. A total of 454,981 gallons have been discharged during this period.

7.0 PILOT TESTING

A remedial action pilot test was performed on April 17, 1998 utilizing GES' data acquisition and processing laboratory (DAPL) vehicle. The DAPL vehicles' computer-controlled telemetry permits the collection and instant analysis of real-time pilot test data. If required by site-specific conditions, the DAPL vehicle can be utilized to perform low-vacuum soil vapor extraction (SVE), high-vacuum SVE, SVE enhanced with groundwater recovery, dual phase vapor/groundwater extraction, and air sparge pilot tests.

Pilot testing was performed at this site to evaluate remedial options. Vapor point VP-1 and recovery well RW-2 were utilized as extraction wells for pilot testing activities. Five monitoring points, MP1, MP2, MP3, MP4, and MP5 were installed in the vicinity of RW-2 and VP-1. The monitoring points were utilized to measure both pneumatic and hydraulic influence during pilot testing.

The first pilot test utilizing low-vacuum SVE with groundwater extraction was performed utilizing VP-1 as the target well. Due to a problem with the construction of VP-1, pilot testing activities were terminated after a period of ten minutes. No useful data was acquired during this portion of the pilot test. The pilot test data is included in Appendix VII.

The second pilot test utilized low-vacuum SVE with groundwater extraction with RW-2 as the target well. At an applied vacuum of approximately 68 inches-H_2O and an air flowrate of approximately 9 standard cubic foot per minute (scfm), an effective radius of influence of 20 feet was generated. An effective radius of vacuum influence is empirically assumed to be the distance in feet from the extraction well under a minimum vacuum of 0.1 inches of water column.

Influent VOC concentrations were measured at greater than 100 percent of the lower explosive limit (% LEL) during this phase of the pilot test. This equates to greater than 13,000 parts per

million (ppm) based on a conversion factor of 130 ppm/% LEL. Off-gas treatment utilized two (2) one hundred and eighty (180) pound (lb) vapor phase GAC units.

During the pilot test on RW-2, groundwater was recovered at a rate of five (5) gpm. Recovered groundwater was conveyed to the existing groundwater treatment system for treatment and discharge.

Air injection into a temporary sparge point installed in the vicinity of VP-1 was attempted. However, the sparge point was located nineteen (19) feet from the operating target well RW-2. Due to the distance between the sparge point and RW-2, it was not possible to effectively capture the air injected into the sparge point. The sparge test indicated that with properly located sparge points and vapor extraction points, air injection would be a feasible method to target impacted soil below the water table.

Based on an evaluation of the pilot test data, a low-vacuum SVE system with groundwater extraction and optional air sparge system has been determined to be a technically feasible remedial technology to address this site.

8.0 REMEDIAL ACTION WORKPLAN ADDENDUM

The proposed remedial system is based on the site-specific hydrogeologic conditions discussed above, the physical extent and chemical characteristics of the impacted soil, as well as technical feasibility and cost effectiveness. In addition, the DPW provided historical background information that was utilized in the design of the remedial system. The proposed remedial system will utilize SVE and groundwater pumping to extract soil vapor and groundwater from existing monitoring wells and proposed vapor extraction laterals and wells. Soil vapor extraction will apply vacuum to the subsurface soils to volatilize and extract VOCs. In addition, in-situ air stripping (air sparging) may be utilized in the future to remediate groundwater in the saturated zone. The extracted soil vapor and groundwater will be treated and discharged in accordance with the applicable discharge permits. Previous experience with numerous soil vapor extraction/groundwater pump and treat systems has demonstrated the effectiveness of this technology.

The SVE/Air Sparge system may induce and/or enhance biological degradation of the organic compounds in the impacted soil by the introduction of atmospheric oxygen in the subsurface. The combined approach described above can accomplish the overall site remediation goals by providing both source removal and residual reduction strategies.

The process and instrumentation diagram for the proposed remedial system is depicted in Figure 8. As indicated in this Figure, groundwater extraction is proposed from one (1) existing monitoring well (RW-11) and two (2) proposed recovery wells (RW-3 and RW-4). Soil vapor extraction is proposed from one (1) existing recovery well (RW-11), two (2) proposed recovery wells (RW-3 and RW-4), and nine (9) proposed horizontal SVE laterals. The below-grade piping will be installed for eight (8) proposed air sparge points. The sparge points may be installed at a later date to introduce air in the saturated zone in order to volatize dissolved phase volatile organic compounds in the groundwater. The locations of the existing and proposed recovery wells, sparge points, and laterals are shown on the Proposed Remedial System Layout, Figure 9. A general description of the proposed remedial system is presented below.

8.1 Soil Vapor Extraction System

The design of the proposed SVE system is based on the data collected during the April 17, 1998 pilot test. The SVE lateral/extraction well radius of influence was calculated utilizing Johnson's equation and pilot test data. The SVE laterals have been designed to operate between 60 to 70 inches of water column vacuum yielding a radius of influence of approximately 20 feet. Design calculations and pilot test data are presented in Appendix VIII.

A sufficiently sized regenerative blower will be used to generate the moderate vacuum required for the extraction of soil vapor from the three (3) recovery wells and nine (9) SVE laterals. The recovery wells will be constructed with approximately 3 feet of casing as indicated in Figure 10. The SVE laterals will be constructed with approximately 5 feet of screen as indicated in Figure 11. SVE laterals are located in proximity to a series of eight (8) **proposed** sparge points in order to enhance the removal of contaminated soil vapor volatilizing from the impacted groundwater. The sparge points will also enhance remediation of the groundwater in the saturated zone beyond the reach of the groundwater pumps. A Sparge Well Head Detail is shown on Figure 12. The remedial system will be installed as indicated in Figure 9.

Individual polyvinyl chloride (PVC) extraction pipes will be installed within utility trenches to connect the extraction/treatment system to each of the SVE wells and laterals through an influent manifold located within the extraction/treatment system compound. The vacuum blower will pull the soil vapor from each SVE well/lateral through an influent manifold, then through a moisture separator before the blower. In the moisture separator, condensate will be removed. The blower discharges to the vapor phase treatment system. The condensate will be automatically pumped from the moisture separator to the groundwater treatment system as required. As indicated in Figure 13, the SVE and sparge systems will be installed in a fenced compound. Inside the fenced compound, several weatherized enclosures will be constructed to house the equipment and piping as indicated. Construction of the fenced compound, which will house the SVE, vapor phase treatment, and sparge systems, will be in accordance with all

applicable US Army, and National Fire Protection Association, Inc. (NFPA) codes, standards, and regulations.

8.2 Vapor Phase Treatment System

Vapor phase treatment will be implemented in stages as required to treat declining concentrations of VOCs. Specifically, as VOC concentrations decrease, the British Thermal Unit (BTU) equivalent fuel value associated with the extracted soil vapor decreases, requiring different technologies to optimize treatment. It is anticipated that the initial mode of vapor phase treatment will be catalytic oxidation. Due to economic and operational considerations, it is expected that catalytic oxidation and granular activated carbon will be the only two modes of vapor phase treatment utilized on this project.

8.2.1 Catalytic Oxidation

The use of a platinum group metal catalyst reduces the temperature required for the oxidation of organic compounds to 600 degrees Fahrenheit (°F). This results in a destruction efficiency equivalent to a thermal oxidizer operating at 1400 °F while significantly reducing the costs associated with a supplemental fuel. Furthermore, the reduced energy requirements allow electricity to be utilized as the supplemental fuel in addition to either propane or natural gas. Typically, the catalytic oxidation treatment process is implemented when influent vapor concentrations range from 6 to 25 % LEL. During catalytic oxidation, influent and effluent temperature of the process gas will be continuously monitored at the catalyst to regulate the supplemental fuel source. Dilution air will be added as necessary to maintain influent vapor concentrations below 25 % LEL. The catalytic oxidation unit may be equipped with a heat exchanger in order to recover a portion of the exhaust stack heat. At concentrations below 6 % LEL, the catalytic oxidizer operates inefficiently and vapor phase treatment is better accomplished using GAC for adsorption of volatile organic compounds.

8.2.2 Adsorption With Granulated Activated Carbon

Treatment with GAC is achieved by passing the extracted soil vapor flow through a number of carbon vessels arranged in series. Both the size and total number of carbon vessels will be dependent upon the anticipated design flowrate and VOC concentration of the soil vapor, as well as the desired carbon changeout frequency. Typically, a maximum influent concentration of 6 % LEL is assumed for design purposes since this corresponds to the approximate maximum concentration at which GAC treatment is considered cost effective. The minimum quantity of GAC contained in the initial vessel(s) should correspond to a breakthrough time of approximately seven (7) days under the assumed design conditions. This will reduce the required number of operation and maintenance visits to one visit per week. A minimum of one

additional GAC vessel should be located between the initial vessel(s) and the discharge stack. This will ensure compliance with the discharge limitations in the event that breakthrough of the initial vessel(s) occurs.

A hydrocarbon gas detection system will be used to continually monitor the performance of the carbon treatment system. A gas sensor will be used to monitor the % LEL of the combined influent to the initial vessel(s). If influent concentrations exceed 6 % LEL, or some other selected limit, the remedial system will be automatically shutdown. A second gas sensor will monitor the % LEL at the inlet to the second carbon vessel. This sensor will be used to shutdown the remedial system when any breakthrough of the initial vessel(s) is detected.

The temperature of the combined influent to the initial vessel(s) will be continuously monitored. The maximum influent temperature should remain below approximately 120 °F to efficiently utilize the adsorption capacity of the carbon. As a result, the remedial system will be automatically shutdown if the influent temperature alarm set point is exceeded.

Over time, influent VOC concentrations from the individual SVE wells will typically fluctuate. A flow control valve on each extraction line connected to the manifold system allows the influent flowrates to be independently controlled. This feature allows remedial efforts to be concentrated in the areas of highest impact while balancing the combined influent flowrates and concentrations to maintain conditions suitable for the applicable treatment technologies. As influent concentrations decrease with time, the influent manifold system will provide the ability to "pulse vent." Specifically, the valves allow individual wells to be closed off while vapor extraction continues at the remaining wells. This allows areas with low soil vapor concentrations to be closed off so that VOC concentrations can recover to levels amenable to the available treatment process prior to resuming the extraction process. In addition, the vapor flow paths between the extraction wells can be varied to influence stagnant or "dead" zones and optimize performance.

The SVE system will follow the required NJDEP monitoring frequency after start-up. The monitoring frequency for the SVE system utilizing catalytic oxidation as an off-gas treatment will be as follows:
Week 1: once per day for days 1 and 2, and one additional day in week 1.
Week 2: twice at least 3 days apart.
Weeks 3 - 10: weekly
Weeks 11+: monthly

8.3 Groundwater Pump and Treat

Currently, a groundwater pump and treat system is operational at this site. It utilizes an electric submersible pump, sediment filter, and three (3) GAC units to pump and treat groundwater from RW-11. The existing groundwater system discharges to the sanitary sewer via a subsurface discharge line. This system is not sufficient to treat the projected groundwater flow rate of the proposed system. The proposed groundwater pump and treat system will incorporate a low-profile air stripper, large GAC units, and additional sediment filtration.

The design of the proposed groundwater system is based on the data collected during the April 17, 1998 pilot test, periodic monitoring well testing results, and operational data collected during the operation of the current groundwater system. The groundwater system is designed to handle a flowrate of fifteen (15) gpm. The design flowrate is based on a flowrate of five (5) gpm per well as observed during the above referenced pilot test. It should be noted that the design flow rate is significantly greater than the current one to two (1-2) gpm of the existing groundwater system. The increase in flow rate is attributable to the effect of VEGE. By applying a vacuum to the recovery well, both subsurface vapors and groundwater are mobilized through the subsurface to the recovery well. VEGE will result in higher groundwater recovery rates for the proposed system.

Influent VOC concentrations for the proposed groundwater system are based on monitoring well testing results for MW-1 and RW-11 and analytical results for the existing groundwater system. Design calculations for the groundwater pump and treat system are presented in Appendix VIII.

Sufficiently sized submersible, electric pumps such as Grundfos 5E5 pumps will be used to pump groundwater from one (1) retrofitted monitoring well (RW-11) and two (2) proposed recovery wells (RW-3 and RW-4) in order to maintain hydraulic control of the site. Because of the relatively low permeability of the soil at this site, low groundwater flowrates are anticipated under normal pumping conditions. However, it is also anticipated that the SVE system will provide vacuum enhancement of groundwater extraction. The groundwater will flow from each extraction well through an influent manifold into a transfer tank and then to the groundwater treatment system.

The groundwater will be pumped through a pair of sediment filters to an appropriately sized, low-profile type air stripper for the removal of suspended solids and dissolved phase VOCs, respectively. Following the air stripping process, the treated groundwater will gravity drain into the air stripper sump.

A transfer pump, which will be controlled by liquid level sensors in the air stripper sump, will be used to pump the groundwater through to the next phase of the treatment, which consists of an

iron removal filter/clarifier unit and a transfer tank. A transfer pump, which will be controlled by liquid level sensors in the transfer tank, will be used to pump groundwater through to the final phase of the treatment to the local storm sewer system. The final phase of treatment includes a pair of sediment filters followed by three (3) GAC units in series. Flow through the liquid phase treatment system will be continuously monitored by flowmeter/totalizers located at the air stripper inlet and the effluent discharge. The proposed treatment system has been designed to comply with all applicable discharge limitations.

It should be noted that the Northeast Monmouth County Sewerage Authority has a moratorium on new discharges to its system. Therefore, the proposed remedial design incorporates a New Jersey Pollutant Discharge Elimination System - Discharge to Surface Water (NJPDES-DSW) rather than continue discharging to sanitary sewer.

Individual PVC extraction pipes will be installed within utility trenches to connect the extraction/treatment system to each of the extraction wells through an influent manifold located within the extraction/treatment system enclosure. In addition to the existing groundwater system enclosure, a second groundwater system enclosure will be constructed to house additional equipment. Both enclosures will be weather-tight, heated, and ventilated to protect against freezing conditions in the winter and overheating in the summer. Enclosure Compound Elevations are shown on Figure 14, and Trenching Cross-sections are shown on Figure 15. A small-insulated pipe chase will be installed to connect the two enclosures together. Construction of the enclosure, which will house the liquid phase treatment system, will be in accordance with all applicable, NFPA and Army codes, standards, and regulations. An Electrical One-Line Diagram is shown on Figure 16.

Effluent samples from the proposed groundwater pump-and-treat system will be collected for analysis in accordance with the requirements of the NJPDES-DSW permit requirements. The frequency of sampling and the analytical parameters will be specified in the NJPDES-DSW permit. The proposed groundwater pump-and-treat system will be monitored on a weekly basis.

8.4 Proposed Groundwater Cleanup Levels

Groundwater

The US Army proposes to remediate groundwater within the area of concern (i.e. service station) using the proposed ground water pump and treat system in combination with the soil vapor extraction system. Hydraulic control will be maintained via operation of the groundwater pump and treat system by utilizing three pumping wells RW-11 (existing), RW-3, and RW-4).

When influent concentrations of petroleum hydrocarbons (i.e. BTEX) and methyl *tertiary* butyl ether (MTBE) reach asymptotic levels for at least two consecutive quarters, the US Army proposes to place the treatment system off-line. The remaining *de minimus* concentrations in soil and groundwater will be remediated by natural attenuation/biodegradation (passive remediation) as part of the Natural Remediation Compliance Program. The US Army will request for passive remediation when the influent concentrations reach asymptotic levels, or if requirements of the Mann-Whitney U test are met. The US Army will request No Further Action or investigation when all targeted VOCs concentrations are at or below the applicable Ground Water Quality Standards (GWQS) for Class II-A aquifers. For this site, the applicable GWQS are as follows:

Compound of Concern	GWQS, µg/L
Benzene[1]	1
Toluene[1]	1,000
Ethylbenzene[1]	700
Xylenes[2]	1,000
MTBE[2]	70
TBA[2]	100

1. The most recent GWQS pursuant to N.J.A.C. 7:9-6.

2 Interim Specific Groundwater Criteria listed in an NJDEP correspondence from Mr. Rick Gimello, Assistant Commissioner, dated February 5, 1997.

Following system shut-down, the US Army will continue to monitor groundwater quality in accordance with the schedule as outlined in Section 6.4. Groundwater sampling will be suspended when concentrations of individual BTEX and MTBE concentrations are at or below the applicable NJDEP's GWQS for at least two consecutive groundwater sampling events.

Soil

The US Army proposes to remediate soil to the NJDEP proposed Unrestricted Site Use Soil Cleanup Criteria in the source area. Soil will be considered remediated when SVE vapor concentrations of BTEX attenuate to an asymptotic level. Post-remedial soil sampling will be conducted pursuant to N.J.A.C. 7:26E-6.4. Post-remedial soil samples will be analyzed for VOCs via USEPA test methods 8240+10 utilizing the recently adopted methanol preservation pursuant to N.J.A.C. 7:26E-2.1(a)4. In addition, soil is considered remediated when the total volatile organic contaminants and Total Organic Carbon (TOC) are less than 1,000 and 10,000 parts per million (ppm), respectively. All future soil quality data submissions will be evaluated using the applicable NJDEP soil cleanup criteria.

If the laboratory analytical results do not indicate the presence of any organic compound concentrations above the applicable NJDEP soil cleanup criteria, the US Army will propose to the NJDEP that no further soil remediation be required, and that the facility be granted a No Further Action declaration for soil.

8.5 Proposed Groundwater Monitoring and Sampling Program

Fort Monmouth DPW is currently conducting a quarterly groundwater gauging and sampling program utilizing on-site and off-site monitoring wells. Utilizing historical groundwater quality data, the DPW proposes to continue monitoring groundwater quality on-site, in accordance with the sampling schedule outlined below.

SAMPLING MONTH	MONITORING WELLS SAMPLED
January, June, August, December	MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-8, MW-9, RW-11, MW-12, MW-15, MW-16, MW616-1

A *Remedial Action Progress Report* (RAPR) will be submitted as requested by the NJDEP. Information including groundwater contour maps, groundwater quality, tabulated laboratory analytical results and laboratory deliverables will be included in each RAPR. Moreover, each RAPR will contain a summary of the operation performance of both the groundwater and SVE remedial treatment systems. Data will be summarized in appropriate tables (e.g., historical groundwater quality, influent and effluent concentrations) and figures (e.g., cumulative mass of BTEX removed versus time, mass of BTEX removed to date).

9.0 CAPTURE ZONE ANALYSIS

GES modeled the overall capture zone of RW-11 using a computer model entitled "A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas (WHPA)" (Blandford and Huyakorn, 1991). This modeling was simulated under an assumed, two-dimensional, homogeneous, steady-state flow condition. Input parameters for the simulation were based on site-specific conditions, field data acquired during site investigative activities and published values for conditions that approximate those reported for this site. The objective of this simulation is to conservatively estimate the overall capture zone of the existing groundwater extraction (pump and treat) system.

The WHPA computer model consists of four independent computation modules that may be used to delineate capture zones. Three of the four modules contain semi-analytical capture zone solutions. Multiple pumping and injection wells may also be simulated. Barrier stream

boundary conditions which exist over the entire aquifer depth also may be simulated. The fourth module is general particle tracking that may be used as a post-processor for two-dimensional numerical models of groundwater flow. One of the semi-analytical models, RESSQC, was used to simulate the capture zone of the existing groundwater recovery system.

RESSQC was selected due to the model's widespread acceptance and the ability to simulate time-related capture zones around one or more pumping wells in homogeneous aquifers of infinite aerial extent with steady and uniform ambient groundwater flow.

9.1 Capture Zone Modeling

Based on the VEGE pilot test conducted on April 17, 1998, using RW-11 and the groundwater treatment system, and the transmissivity value of 64.5 ft^2/day calculated by Henderson, Breen & Hess, an assumed aquifer thickness of 15 feet, and the hydraulic conductivity of the water-bearing zone onsite of 4.3 ft/day. The hydraulic gradient used in the computer simulation was 0.03 feet. The effective porosity was set at 0.25 based on site geological conditions.

Based on the calculated hydraulic conductivity of 4.3 ft/day, the predicted groundwater capture zones at steady-state generated from the output RESSQC are presented on Figure 17. Based on the calculated capture zones as presented on Figure 17, it is concluded that groundwater on-site will be captured using the three pumping wells (RW-11, RW-2, and RW-3). Because no compound of concern within the capture zone will migrate offsite, Fort Monmouth DPW requests the predicted capture zone also serve as a Classification Exception Area (CEA) for the onsite groundwater plume.

10.0 QUALITY ASSURANCE PROJECT PLAN

A field sampling activities will be conducted in accordance with NJDEP Field Sampling Manual. All analyses will be conducted in accordance with the NJ Laboratory Certification Program. A separate Quality Assurance Project Plan will not be submitted by the US Army for this site.

11.0 REQUIRED PERMITS

The following permits will be required:

- NJDEP New Jersey Pollutant Discharge Elimination System – Discharge to Surface Water (NJPDES-DSW) Permit
- NJDEP Permit to construct/install/alter Air Quality Apparatus/Equipment

- NJDEP Certification to operate Air Quality Apparatus/Equipment
- NJDEP Treatment Works Approval
- NJDEP Well Permits

In addition to meeting the NJDEP permitting requirements, the US Army permitting requirements will also be met.

12.0 EFFECTIVENESS ANALYSIS AND CERTIFICATION

In conducting this investigation, different remedial approaches were examined and evaluated. The selection of pump and treat/soil vapor extraction/air-spraging system to remediate soil and groundwater is based upon technical and site-specific criteria presented in this RAWA and historical data contained therein. It is our judgment that the development, selection and implementation of this remedial action will be effective and will be protective of the public health, safety and the environment as outlined in Section 35(g) of P.L. 1993, c.139 (S-1070) of the Industrial Site Recovery Act.

13.0 EROSION, DUST, AND ODOR CONTROL

If required, a Sediment and Erosion Control Plan will be prepared in accordance with the US Army requirements.

14.0 IMPLEMENTATION SCHEDULE

Within 90 days upon written NJDEP approval of this RAW, the Fort Monmouth DPW will solicit and award a contract for completion of work described herein. Any requests or recommendations to modify or alter the groundwater monitoring and sampling program will be completed in writing to the assigned NJDEP case manager.

15.0 SITE RESTORATION PLAN

Upon receipt of a No Further Action declaration from the NJDEP regarding the remediated soils, the US Army will contract to dismantle and remove the aboveground portions of the SVE system. The below ground sections of the SVE systems will be sealed and abandoned in-place following generally accepted procedures.

Once the groundwater quality has attenuated to concentrations below the applicable NJDEP GWQS and a No Further Action statement is provided by the NJDEP, the US Army will implement proper well abandonment procedures as part of the site restoration plan. All monitoring wells and vacuum monitoring points on-site and off-site will be properly abandoned by a New Jersey-licensed well driller. The wells will be sealed via a tremie pipe with a grout/cement mixture. The concrete flushmount pads will be removed and the former well locations will be restored to near pre-construction conditions.

16.0 ESTIMATED COST

The estimated cost comparison for the proposed remedial system upgrade is presented in Appendix VIII. The cost comparison indicates that the total costs to operate the remedial system with a catalytic oxidizer are lesser compared to the costs to operate with GAC as an off-gas treatment. Initially, the catalytic oxidizer is being proposed to be utilized as an off-gas treatment for the SVE (and optional sparge). However, in the event that the soil vapor and/or soil concentrations reach asymptotic levels, a decision may be made to switch to GAC as an off-gas treatment. A cost comparison between catalytic oxidation versus GAC as an off-gas treatment is included in Appendix IX.

17.0 REFERENCES

Blandford, T.N. and P.S. Huyakorn. 1991. "A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas. Version 2.0," Office of Ground-Water Protection, USEPA, Washington, DC.

Krydon 1993. *Remedial Action Workplan*, Fort Monmouth Military Installation Service Station, Fort Monmouth, New Jersey. October 1993.

NJDEP. 1990. New Jersey Pollutant Discharge Elimination System 1992-93 Annual Fee Report and Assessment of Fees, Trenton, NJ.

Smith 1998. *Underground Storage Tank Closure and Site Investigation Report.* SMC Environmental Services Group. June 1998.

FIGURES

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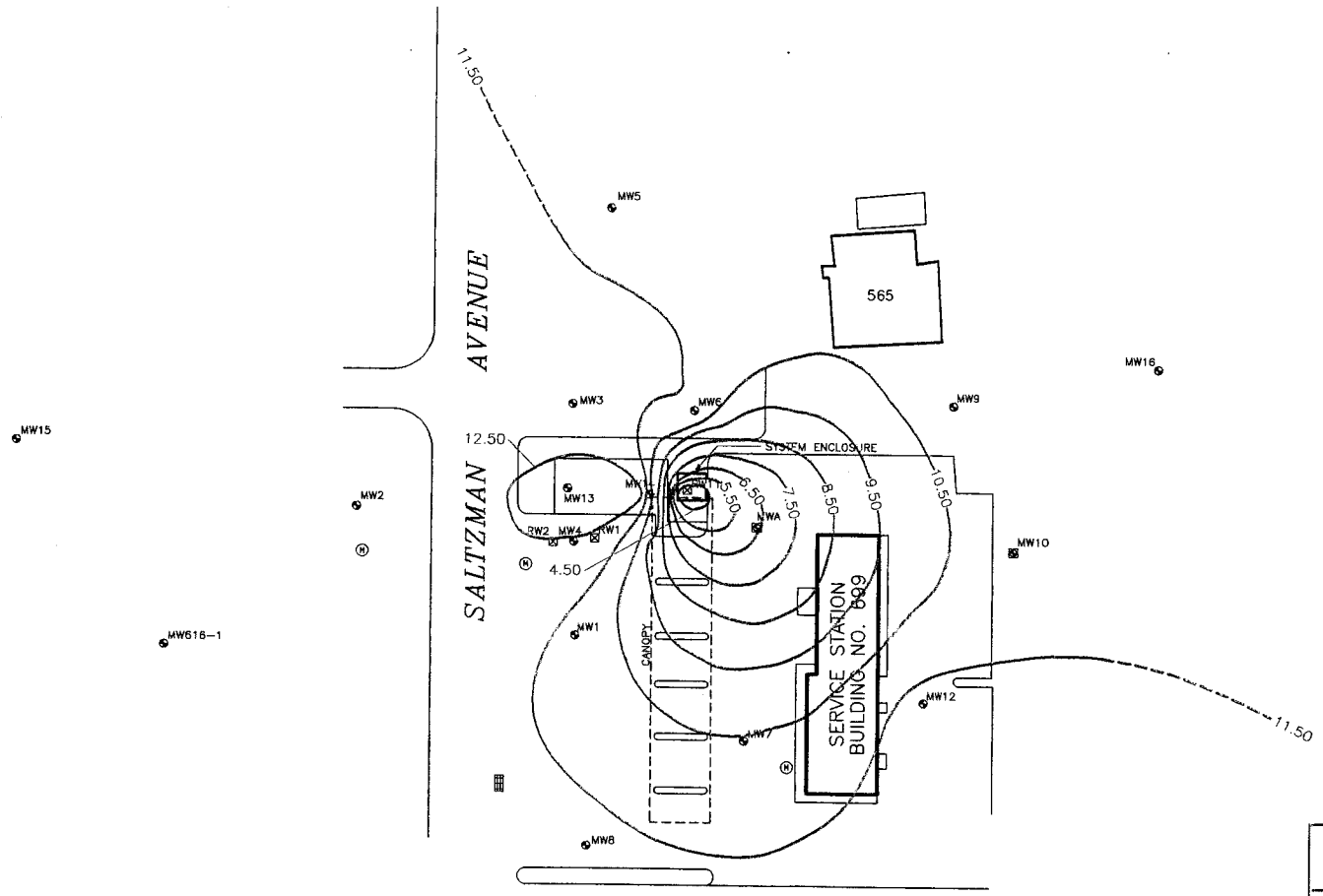


LEGEND

- STORM SEWER INLET
- UTILITY MANHOLE
- PUMP ISLAND
- FENCE
- RECOVERY WELL
- MONITORING WELL
- ABANDONED MONITORING WELL

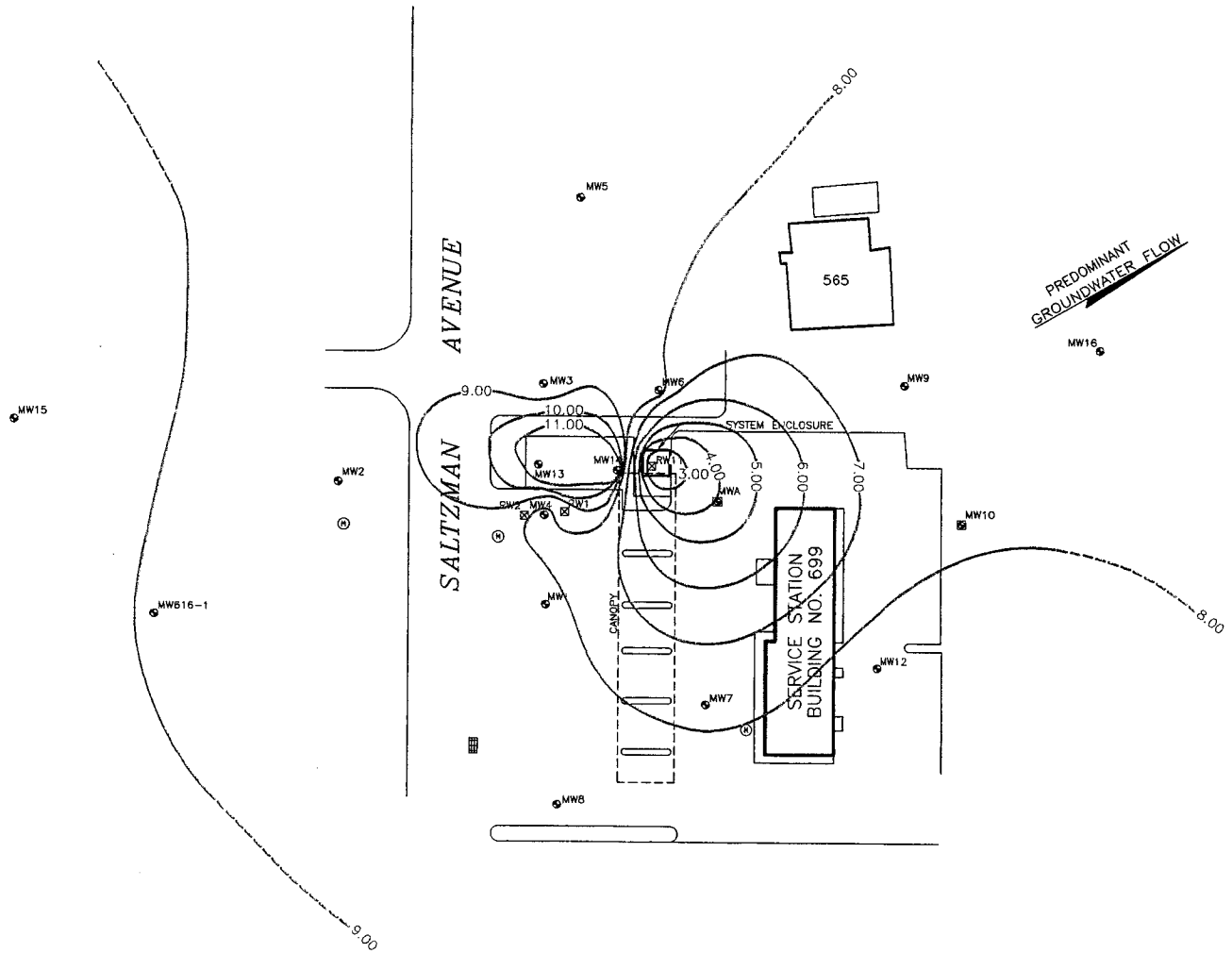
NOTE:
GROUNDWATER ELEVATION CONTOURS IN FEET.

GROUNDWATER CONTOUR MAP
2 JULY 1998

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-14-99	NJ
		DWG # FORT MON	FIGURE 2

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

- STORM SEWER INLET
- UTILITY MANHOLE
- PUMP ISLAND
- FENCE
- RECOVERY WELL
- MONITORING WELL
- ABANDONED MONITORING WELL
- CAS EL — CASING ELEVATION (feet)
- DTW — DEPTH TO WATER (feet)
- GW EL — GROUNDWATER ELEVATION (feet)

WELL	CAS EL	DTW	ADJUSTED GW EL
RW2	16.09	7.58	8.58
MW1	15.81	8.50	8.22
MW2	16.64	8.17	8.47
MW3	15.80	7.63	8.17
MW4	15.92	8.57	7.85
MW5	15.48	7.10	8.38
MW6	15.78	7.74	8.04
MW8	16.20	7.51	8.69
MW9	15.96	7.84	8.12
MW11	17.14	15.72	1.43
MW12	16.66	8.09	8.57
MW13	16.21	3.51	12.70
MW14	15.98	3.35	12.63
MW15	17.04	7.50	9.54
MW16	15.27	8.07	7.20
616-1	18.92	10.01	8.91

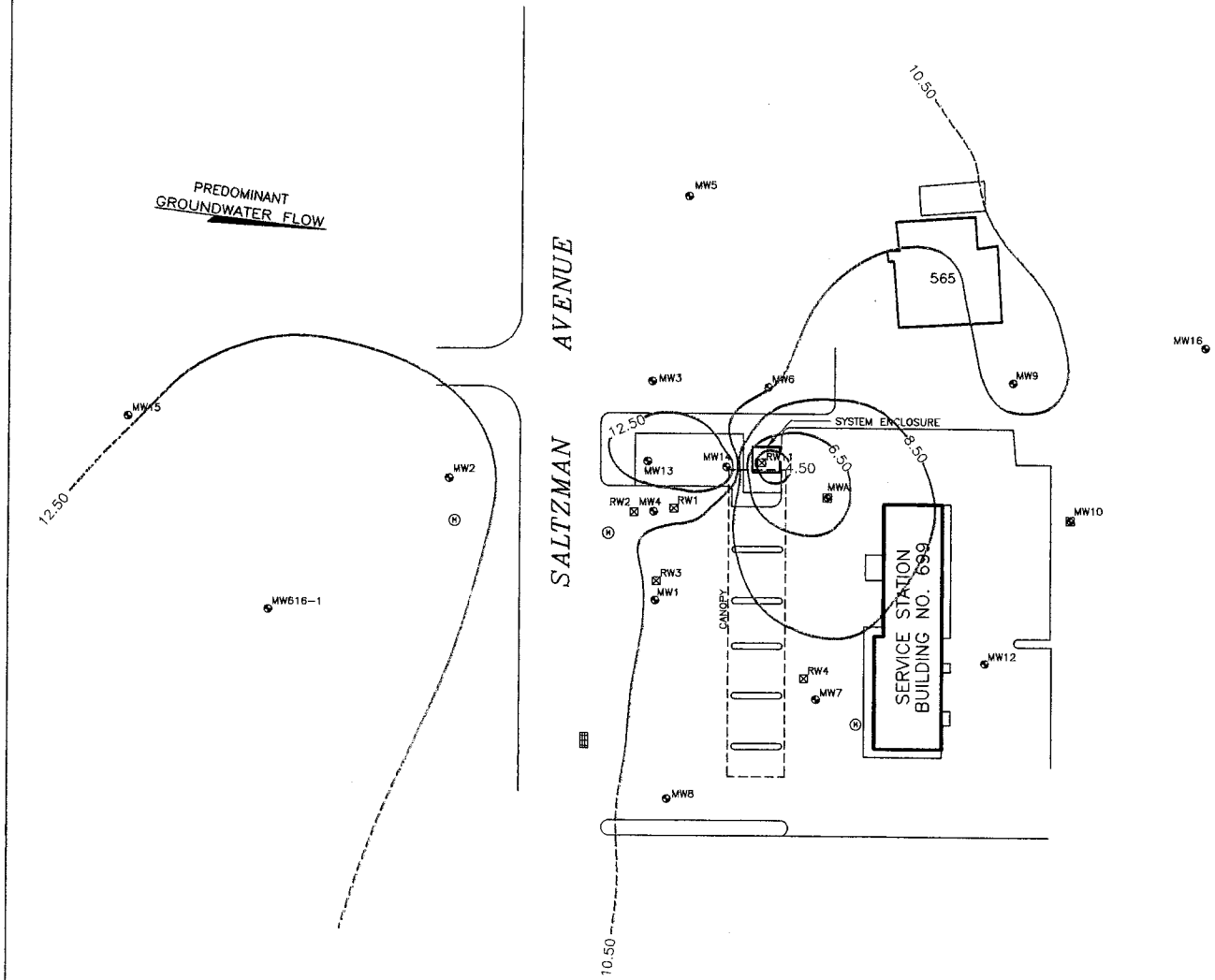
NOTE:
GROUNDWATER ELEVATION CONTOURS IN FEET.
MW9 NOT USED WHEN DETERMINING CONTOUR ELEVATIONS.

GROUNDWATER CONTOUR MAP
12 NOVEMBER 1998

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-14-99	NJ
		DWG # FORT MON	FIGURE 3

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

▦	STORM SEWER INLET
Ⓗ	UTILITY MANHOLE
⬭	PUMP ISLAND
— · —	FENCE
⊠	RECOVERY WELL
⊕	MONITORING WELL
⊠	ABANDONED MONITORING WELL
CAS EL	CASING ELEVATION (feet)
DTW	DEPTH TO WATER (feet)
GW EL	GROUNDWATER ELEVATION (feet)

WELL	CAS EL	DTW	ADJUSTED GW EL
RW2	16.09	5.22	10.87
MW1	15.81	5.62	10.28
MW2	16.64	3.87	12.77
MW3	15.80	4.89	10.91
MW4	15.92	5.14	10.78
MW5	15.48	4.89	10.59
MW6	15.78	4.85	10.93
MW8	16.20	6.10	10.10
MW9	15.96	5.09	10.87
MW11	17.14	14.20	2.94
MW12	16.66	6.61	10.05
MW13	16.21	2.25	13.96
MW14	15.98	2.12	13.86
MW15	17.04	4.58	12.46
MW16	15.27	5.64	9.63
616-1	18.92	4.90	14.02

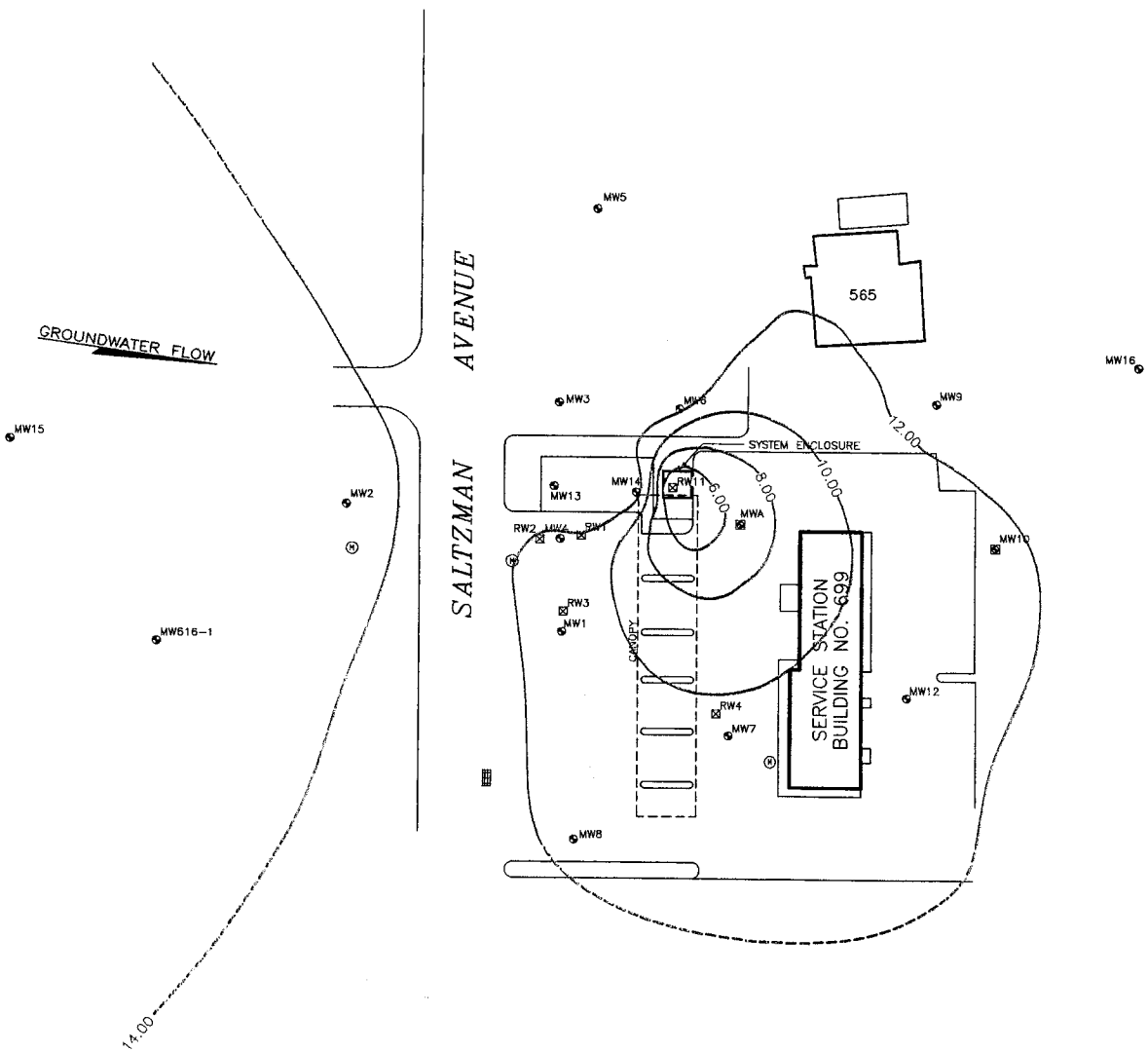
NOTE:
GROUNDWATER ELEVATION CONTOURS IN FEET.

GROUNDWATER CONTOUR MAP
22 JANUARY 1999

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-14-99	NJ
		DWG # FORT MON	FIGURE 4

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

	STORM SEWER INLET
	UTILITY MANHOLE
	PUMP ISLAND
	FENCE
	RECOVERY WELL
	MONITORING WELL
	ABANDONED MONITORING WELL
CAS EL	CASING ELEVATION (feet)
DTW	DEPTH TO WATER (feet)
GW EL	GROUNDWATER ELEVATION (feet)

WELL	CAS EL	DTW	ADJUSTED GW EL
RW2	16.09	4.36	11.73
MW1	15.81	4.20	11.61
MW2	16.64	1.79	14.85
MW3	15.80	3.98	11.82
MW4	15.92	4.18	11.74
MW5	15.48	3.41	12.07
MW6	15.78	3.65	12.13
MW8	16.20	4.47	11.73
MW9	15.96	3.44	12.52
MW11	17.14	14.37	2.77
MW12	16.66	5.00	11.66
MW13	16.21	2.11	14.10
MW14	15.98	1.98	14.00
MW15	17.04	1.99	15.05
MW16	15.27	2.85	12.42
616-1	18.92	3.51	15.41

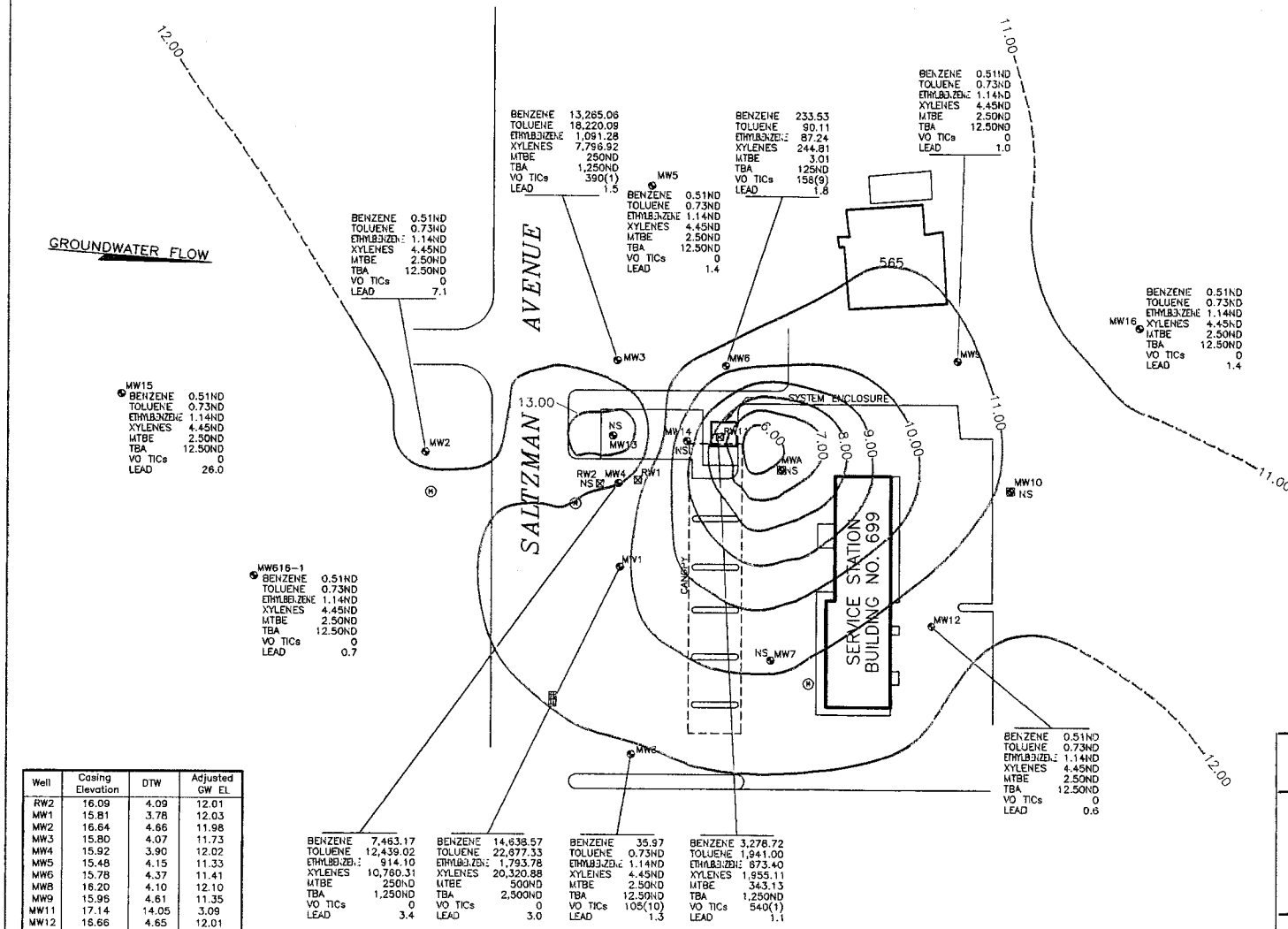
NOTE:
GROUNDWATER ELEVATION CONTOURS IN FEET.

GROUNDWATER CONTOUR MAP
19 FEBRUARY 1999

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-14-99	NJ
		DWG # FORT MON	FIGURE 5

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



Well	Casing Elevation	DTW	Adjusted GW EL
RW2	16.09	4.09	12.01
MW1	15.81	3.78	12.03
MW2	16.64	4.66	11.98
MW3	15.80	4.07	11.73
MW4	15.92	3.90	12.02
MW5	15.48	4.15	11.33
MW6	15.78	4.37	11.41
MW8	16.20	4.10	12.10
MW9	15.96	4.61	11.35
MW11	17.14	14.05	3.09
MW12	16.66	4.65	12.01
MW13	16.21	2.98	13.23
MW14	15.98	2.85	13.13
MW15	17.04	4.66	12.38
MW16	15.27	4.70	10.57
616-1	18.92	6.62	12.30

LEGEND

- STORM SEWER INLET
- UTILITY MANHOLE
- PUMP ISLAND
- FENCE
- RECOVERY WELL
- MONITORING WELL
- ABANDONED MONITORING WELL
- MTBE — METHYL *tert*-BUTYL ETHER
- TBA — *tert*-BUTYL ALCOHOL
- DTW — DEPTH TO WATER (feet)
- GW EL — GROUNDWATER ELEVATION (feet)
- NS — NOT SAMPLED
- ND — NOT DETECTED, METHOD DETECTION LIMIT PROVIDED
- VO TICs — VOLATILE ORGANICS TENTATIVELY TENTATIVELY IDENTIFIED COMPOUNDS
- (#) — INDICATES NUMBER OF COMPOUNDS FOUND IN LIBRARY SEARCH

NOTES:

ALL GROUNDWATER ELEVATION DATA IN FEET.

ALL ANAYLTICAL RESULTS IN PARTS PER BILLION.

GROUNDWATER SAMPLES WERE COLLECTED ON 8 JUNE 1998.

LIQUID LEVEL MEASUREMENTS WERE OBTAINED ON 11 JUNE 1998.

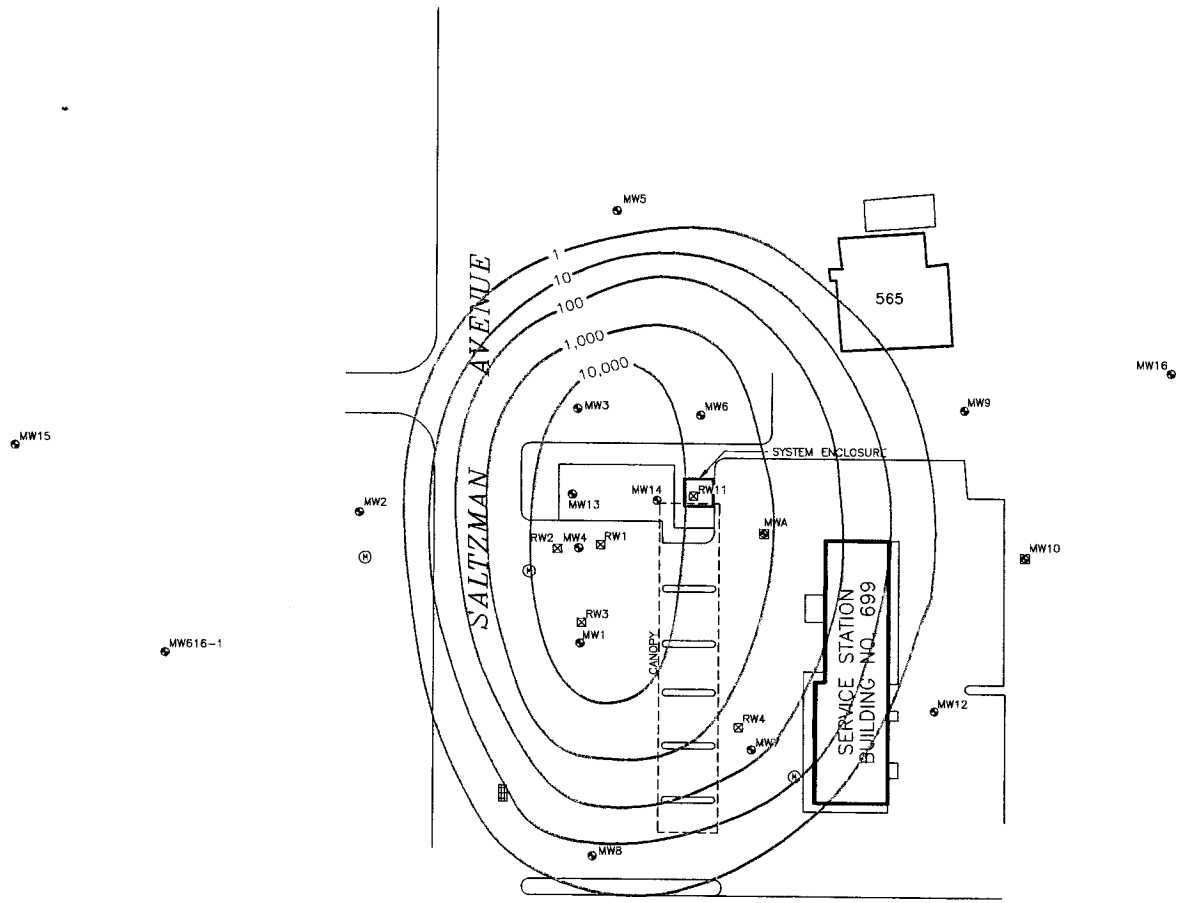
MW11, MW13 AND MW14 NOT USED TO DRAW CONTOUR LINES.

SITE INFORMATION PLAN
8 JUNE 1998

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-14-99	NJ
		DWG # FORT MON	FIGURE 6

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

	STORM SEWER INLET
	UTILITY MANHOLE
	PUMP ISLAND
	FENCE
	RECOVERY WELL
	MONITORING WELL
	ABANDONED MONITORING WELL
ppb	PARTS PER BILLION
D	SECONDARY DILUTION
ND	NOT DETECTED
NS	NOT SAMPLED

MW	BENZENE CONCENTRATION (ppb)
1	22,227.82 D
2	ND
3	23,686.26 D
4	13,224.65 D
5	ND
7	NS
8	2.03
9	ND
10	NS
11	4,110.10
12	ND
15	ND
16	ND
616-1	ND

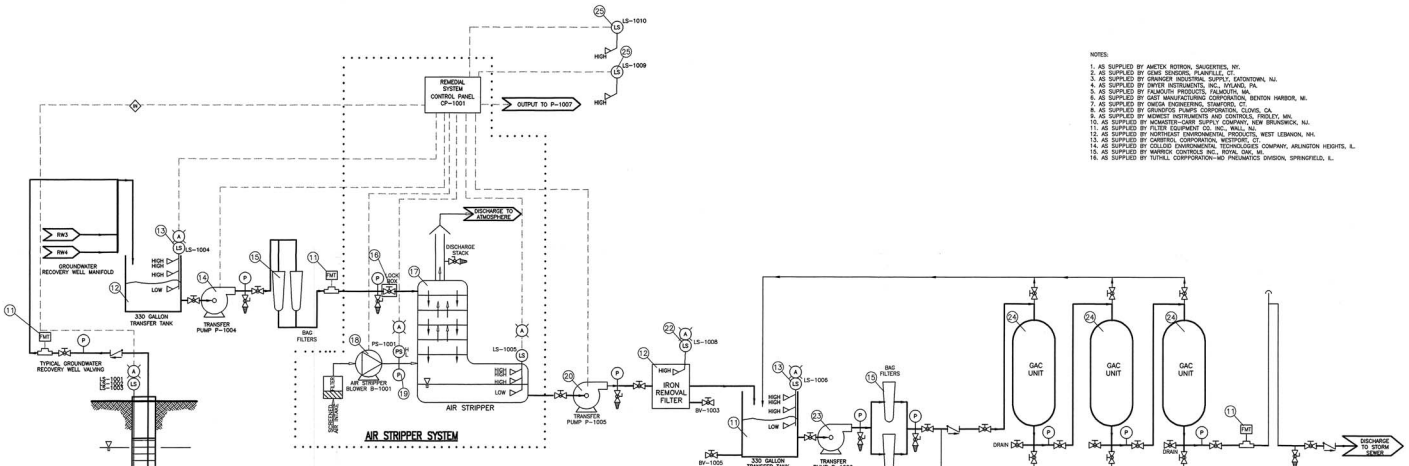
NOTE:
ANALYTICAL RESULTS IN PARTS PER BILLION.

BENZENE ISOPLETH SITE MAP (ppb)
29 JULY 1998

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-17-99	NJ
		DWG # FORT MON	FIGURE 7

GES GROUNDWATER & ENVIRONMENTAL SERVICES, INC.



AIR STRIPPER SYSTEM

NOTES:

1. AS SUPPLIED BY AMETEK ROTRON, SAUGERTIES, NY.
2. AS SUPPLIED BY GORE SENSORS, PLAINFIELD, CT.
3. AS SUPPLIED BY GRAINGER INDUSTRIAL SUPPLY, EATONTOWN, NJ.
4. AS SUPPLIED BY DWYER INSTRUMENTS, INC., MYLAND, PA.
5. AS SUPPLIED BY FALMOUTH PRODUCTS, FALMOUTH, MA.
6. AS SUPPLIED BY GAST MANUFACTURING CORPORATION, BENTON HARBOR, MI.
7. AS SUPPLIED BY OMEGA ENGINEERING, STAMFORD, CT.
8. AS SUPPLIED BY GRUNDFOS PUMPS CORPORATION, CLOVIS, CA.
9. AS SUPPLIED BY MIDWEST INSTRUMENTS AND CONTROLS, FRIDLEY, MN.
10. AS SUPPLIED BY MCMASTER-CARR SUPPLY COMPANY, NEW BRUNSWICK, NJ.
11. AS SUPPLIED BY FILTER EQUIPMENT COMPANY, INC., WALL, NJ.
12. AS SUPPLIED BY CHEMICAL LIME COMPANY OF AMERICA, INC., WEST LEBANON, NH.
13. AS SUPPLIED BY CARBITROL CORPORATION, WESTPORT, CT.
14. AS SUPPLIED BY COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY, ARLINGTON HEIGHTS, IL.
15. AS SUPPLIED BY WARRICK CONTROLS INC., ROYAL OAK, MI.
16. AS SUPPLIED BY TUTHILL CORPPORATION-MD PNEUMATICS DIVISION, SPRINGFIELD, IL.

LEGEND

- BALL VALVE W/ SECURITY LOCK BOX
- BALL VALVE
- CHECK VALVE
- SAMPLE PORT
- CONTROL/ELECTRICAL INTERLOCK
- FLOW METER-TOTALIZER
- LEVEL SENSOR
- VACUUM RELIEF VALVE
- PRESSURE RELIEF VALVE
- MANUAL PRESSURE RELIEF VALVE
- PRESSURE GAUGE
- VACUUM BREAK
- Y-STYLE STRAINER
- VACUUM GAUGE
- ALARM
- LEVEL SWITCH
- VACUUM SWITCH
- THERMAL COUPLE
- TEMPERATURE RECORDER
- TEMPERATURE SENSOR
- PROCESS FLOW LINE
- ELECTRIC/CONTROL LINE
- PNEUMATIC AIR LINE
- AIR/FILTER COALESCER
- AIR FILTER/REGULATOR
- SOLENOID VALVE
- ROTAMETER FLOWMETER
- MOTOR ACTIVATED VALVE

SYSTEM DESCRIPTION

1. EXTRACTION LINES ARE RUN TO EACH RECOVERY WELL.
2. GROUNDWATER RECOVERY RATES ARE CONTROLLED BY INDIVIDUAL VALVES.
3. GROUNDWATER FLOW RATES ARE MEASURED FOR EACH INDIVIDUAL RECOVERY WELL, COMBINED INFLUENT TO THE AIR STRIPPER, AND THE EFFLUENT AFTER THE CARBON UNITS.
4. BAG FILTERS AND IRON REMOVAL FILTER ARE UTILIZED TO REMOVE SUSPENDED SOLIDS FROM GROUNDWATER.
5. PRIMARY REMOVAL OF VOC'S SHALL BE ACCOMPLISHED UTILIZING A LOW PROFILE AIR STRIPPER.
6. GRANULAR ACTIVATED CARBON (GAC) SHALL BE UTILIZED TO PROVIDE SECONDARY TREATMENT AND POLISHING OF THE EFFLUENT.
7. TREATED GROUNDWATER SHALL BE DISCHARGED TO SURFACE WATER IN ACCORDANCE WITH APPLICABLE NJPDES DISCHARGE PERMITS. LOCATION OF DISCHARGE TO BE DETERMINED.
8. AIR STRIPPER OFF GAS SHALL BE DISCHARGED TO ATMOSPHERE WITHOUT TREATMENT IN ACCORDANCE WITH THE APPLICABLE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL (NJDEP) AIR DISCHARGE PERMIT.
9. CONTROL PANEL CP-1001 SHALL INCLUDE ALL NECESSARY MOTOR STARTERS, RELAYS, AND CONTROLLERS TO OPERATE GROUNDWATER SYSTEM.
10. CONTROL PANEL CP-1001 SHALL BE INCLUDED AS A COMPONENT OF THE ENTIRE AIR STRIPPER PACKAGE.
11. PRESSURE GAUGES ON GROUNDWATER SYSTEM SHALL BE OF LIQUID-FILLED COPPER-ALLOY BOURDON TUBE CONSTRUCTION.
12. ALL GROUNDWATER SYSTEM PIPING INSTALLED SHALL BE 2" SCH. 40 PVC PIPE.

CONTROL PANEL CP-1002 CONTROL SUMMARY

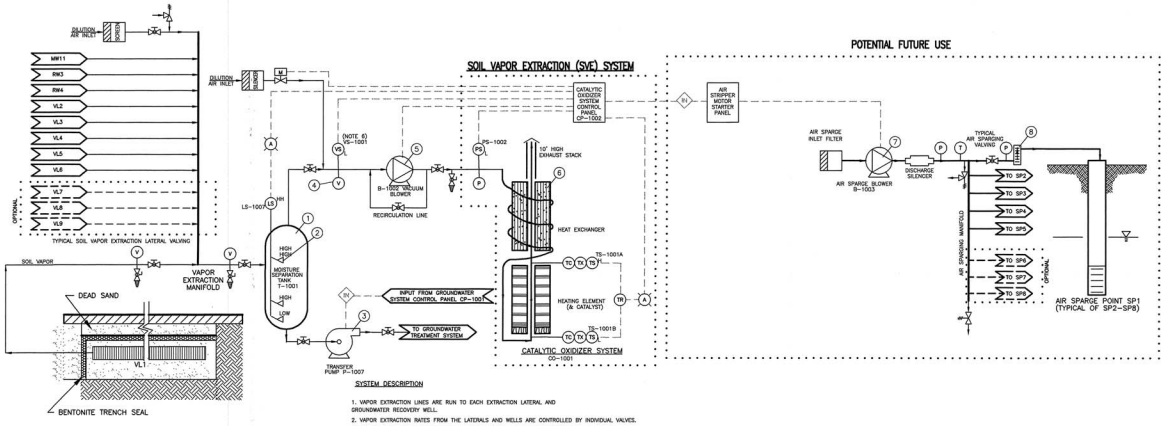
Input	Input No.	B-1002	P-1007	CO-1001	B-1003
		OUTPUT			
LSHH-1007 (1)	1	OFF	OFF	OFF	OFF
LSH-1007	1	–	ON	–	–
LSL-1007	1	–	OFF	–	–
VSL-1007 (1)	2	OFF	–	OFF	OFF
PSL-1002 (1)	3	OFF	–	OFF	OFF
TSH-1001A (1)	4	OFF	–	OFF	OFF
TSL-1001B (1)	5	OFF	–	OFF	OFF

(1) Output shown in alarm mode

CONTROL PANEL CP-1001 CONTROL SUMMARY

INPUT	INPUT #	OUTPUTS							
		B1001	P1001	P1002	P1003	P1004	P1005	P1006	P1007
LSHH-1001	1	–	ON	–	–	–	–	–	–
LSH-1001	1	–	ON	–	–	–	–	–	–
LSL-1001	1	–	OFF	–	–	–	–	–	–
LSHH-1002	2	–	–	ON	–	–	–	–	–
LSH-1002	2	–	–	ON	–	–	–	–	–
LSL-1002	2	–	–	OFF	–	–	–	–	–
LSHH-1003	3	–	–	–	ON	–	–	–	–
LSH-1003	3	–	–	–	ON	–	–	–	–
LSL-1003	3	–	–	–	OFF	–	–	–	–
LSHH-1004 (1)	4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSH-1004	4	–	–	–	–	ON	–	–	–
LSL-1004	4	–	–	–	–	OFF	–	–	–
LSHH-1005 (1)	5	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSH-1005	5	–	–	–	–	–	ON	–	–
LSL-1005	5	–	–	–	–	–	OFF	–	–
PSH-1001 (1)	6	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
PSL-1001	6	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSHH-1006 (1)	7	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSH-1006	7	–	–	–	–	–	–	ON	–
LSL-1006	7	–	–	–	–	–	–	OFF	–
LSH-1008 (1)	8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSH-1009 (1)	9	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LSH-1010 (1)	10	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

(1) OUTPUTS IN ALARM MODE.



SYSTEM DESCRIPTION

1. VAPOR EXTRACTION LINES ARE RUN TO EACH EXTRACTION LATERAL AND GROUNDWATER RECOVERY WELL.
2. VAPOR EXTRACTION RATES FROM THE LATERALS AND WELLS ARE CONTROLLED BY INDIVIDUAL VALVES.
3. CONDENSATION IS REMOVED FROM THE VAPOR PHASE IN THE SEPARATION TANK.
4. CONDENSATE FROM MOISTURE SEPARATOR TO BE AUTOMATICALLY PUMPED TO GROUNDWATER TREATMENT SYSTEM.
5. A 2-CHANNEL RECORDER SHALL BE INSTALLED BY THE MANUFACTURER OF THE CATALYTIC OXIDIZER TO THE OXIDIZER INFLUENT AND EFFLUENT TEMPERATURES.
6. VACUUM SENSOR/SWITCH TO BE INSTALLED IF REQUIRED BY NJDEP AIR DISCHARGE PERMIT.
7. CONTROL PANEL CP-1002 WILL BE PROVIDED BY MANUFACTURER OF CATALYTIC OXIDIZER.
8. PRESSURE VACUUM GAUGES FOR SOIL VAPOR EXTRACTION/SPARGE SYSTEM SHALL BE OF COPPER-ALLOY BOURDON TUBE CONSTRUCTION.
9. ALL SOIL VAPOR EXTRACTION PIPING INSTALLED SHALL BE 2" PVC SCH. 40 PIPE WITH THE EXCEPTION OF 3.5" OH SUCTION DISCHARGED ENDS AND RECIRCULATION LOOP OF SOIL VAPOR EXTRACTION BLOWER, WHICH WILL BE 3" SCH. 40 GALVANIZED STEEL.
10. ALL SPARGE SYSTEM PIPING WILL BE 1-1/2" SCH. 40 PVC PIPE.

ITEM	QTY	PART #	DESCRIPTION	NOTES
25	2	146181	HIGH LEVEL ULTRASONIC LEVEL SWITCH	2
24	3	TW18	LIQUID PHASE GRANULAR ACTIVATED CARBON ADSORBER UNIT (500 LBS EACH)	14
23	1	2PC30	HIGH-VOLUME PRESSURE BOOSTER PUMP 2 HP 230/60/1	3
22	2	38651	HIGH LEVEL FLOAT SWITCH	2
21	1	–	IRON REMOVAL FILTER 40 GPM MAX.	13
20	1	1MS24	CENTRIFUGAL TRANSFER PUMP 1/3 HP 230/60/1	3
19	1	–	LOW AIR PRESSURE PRESSURE SWITCH	12
18	1	AF15	CENTRIFUDAL PRESSURE BLOWER 5hp 230/60/3	12
17	2	2341-P	POLYETHYLENE LOW-PROFILE AIR STRIPPER W/ SUMP LEVEL FLOAT SWITCHES	12
16	1	ST821	BALL VALVE WITH LOCKOUT BOX	3
15	4	NC-122	CARBON STEEL BAGFILTER	11
14	1	2PC22	HIGH-VOLUME PRESSURE BOOSTER PUMP 1-1/2 HP 230/60/1	3
13	2	SERIES 3E	TRANSFER PUMP LEVEL CONTROLLERS	15
12	2	3R62K17	330 GALLON TRANSFER TANK	10
11	5	–	INLINE FLOWMETER TOTALIZER 3/4" BODY	9
10	3	SERIES 3W	DOWNWELL LEVEL CONTROLLERS	15
9	3	SE5	ELECTRIC SUBMERSIBLE GROUNDWATER PUMP	8
8	8	FL7411	ROTAMETER	7
7	1	6066-P223A-T909	SPARGE COMPRESSOR 7-1/2 HP 230/60/3	6
6	1	FALCO 300	CATALYTIC OXIDIZER 20.3 KW 230/60/3	5
5	1	COMPETITORS 4005	ROOTS BLOWER	16
4	1	3000-63100	VACUUM SWITCH	4
3	1	INS44	CENTRIFUGAL TRANSFER PUMP 1/3 HP 230/60/1	3
2	1	30288	LIQUID LEVEL FLOAT SWITCHES	2
1	1	MS35086	MOISTURE SEPARATOR W/INTEGRAL HIGH LEVEL SWITCH	1

NO.	REVISIONS	DATE

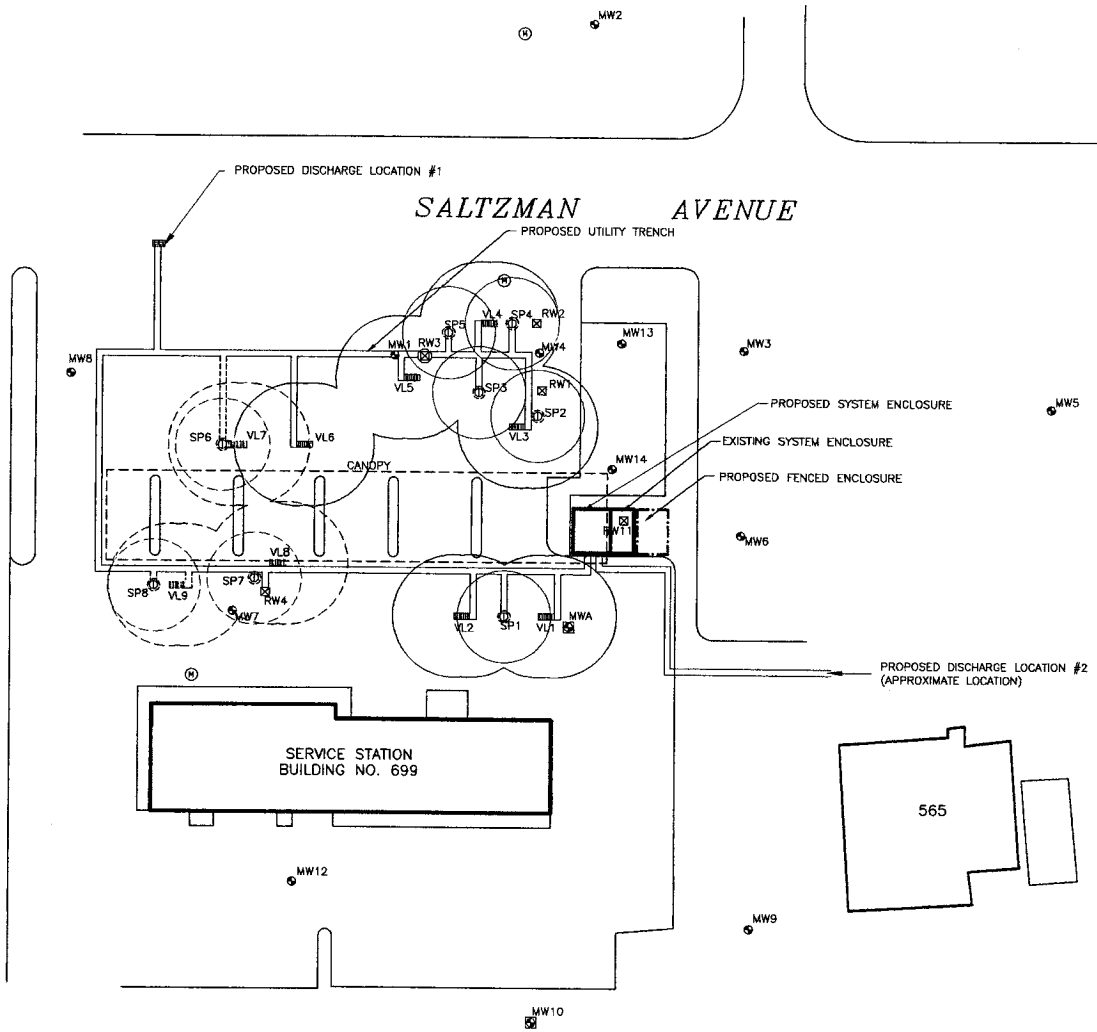
REMEDIAL SYSTEM PROCESS & INSTRUMENTATION DIAGRAM

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

GROUNDWATER & ENVIRONMENTAL SERVICES, Inc.
1340 CAMPUS PARKWAY WALL, N.J. 07719
PHONE (732) 919-0100 FAX (732) 919-0916

DRAWING NO. FORT MONMOUTH
SCALE NOT TO SCALE
DRAWN BY: D. O'CONNOR
CHECKED BY:
DESIGNED BY: P. CLARK
CHECKED BY:
DATE: 21 APRIL 1999
FIGURE 8

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

- STORM SEWER INLET
- UTILITY MANHOLE
- ABANDONED MONITORING WELL
- RECOVERY WELL
- MONITORING WELL
- PUMP ISLAND
- FENCE
- PROPOSED RECOVERY WELL
- PROPOSED SOIL VAPOR EXTRACTION 5' LATERAL
- PROPOSED UTILITY TRENCH
- PROPOSED OPTIONAL UTILITY TRENCH
- PROPOSED OPTIONAL SOIL VAPOR EXTRACTION 5' LATERAL
- PROPOSED OPTIONAL AIR SPARGE POINT
- PROPOSED 15' AIR SPARGE RADIUS OF INFLUENCE
- PROPOSED 20' SOIL VAPOR EXTRACTION RADIUS OF INFLUENCE

NOTES:

1) INDIVIDUAL PNEUMATIC SUPPLY LINE AND CORRESPONDING PRODUCT RECOVERY LINE SHALL BE RUN TO EACH OF THE RECOVERY WELLS (MW11, RW3 AND RW4). THE LINES SHALL BE CAPPED AND TERMINATED IN THE RECOVERY WELL MANHOLES FOR POTENTIAL FUTURE USE.

2) 2" SCH. 40 PVC PIPE SVE LINES WILL BE INSTALLED TO MW11, RW3, RW4 RECOVERY WELL MANHOLES.

3) AREAL EXTENT OF VACUUM INFLUENCE WITH OPTIONAL LATERALS (VL7, VL8, & VL9) = 11,553 sq. ft.

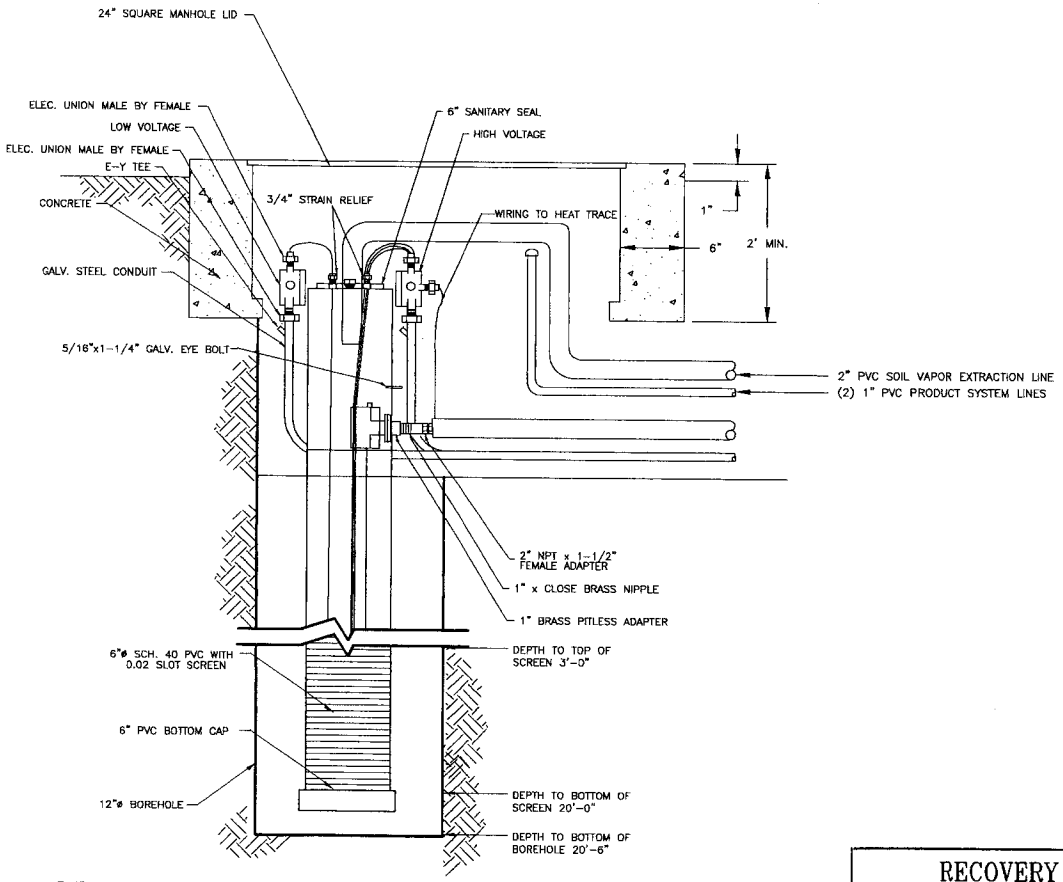
4) AREAL EXTENT OF VACUUM INFLUENCE WITHOUT OPTIONAL LATERALS (VL7, VL8, & VL9) = 7,928 sq. ft.

PROPOSED REMEDIAL SYSTEM LAYOUT

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 20 40	5-11-99	NJ
		DWG # FORT MON	FIGURE 9

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.

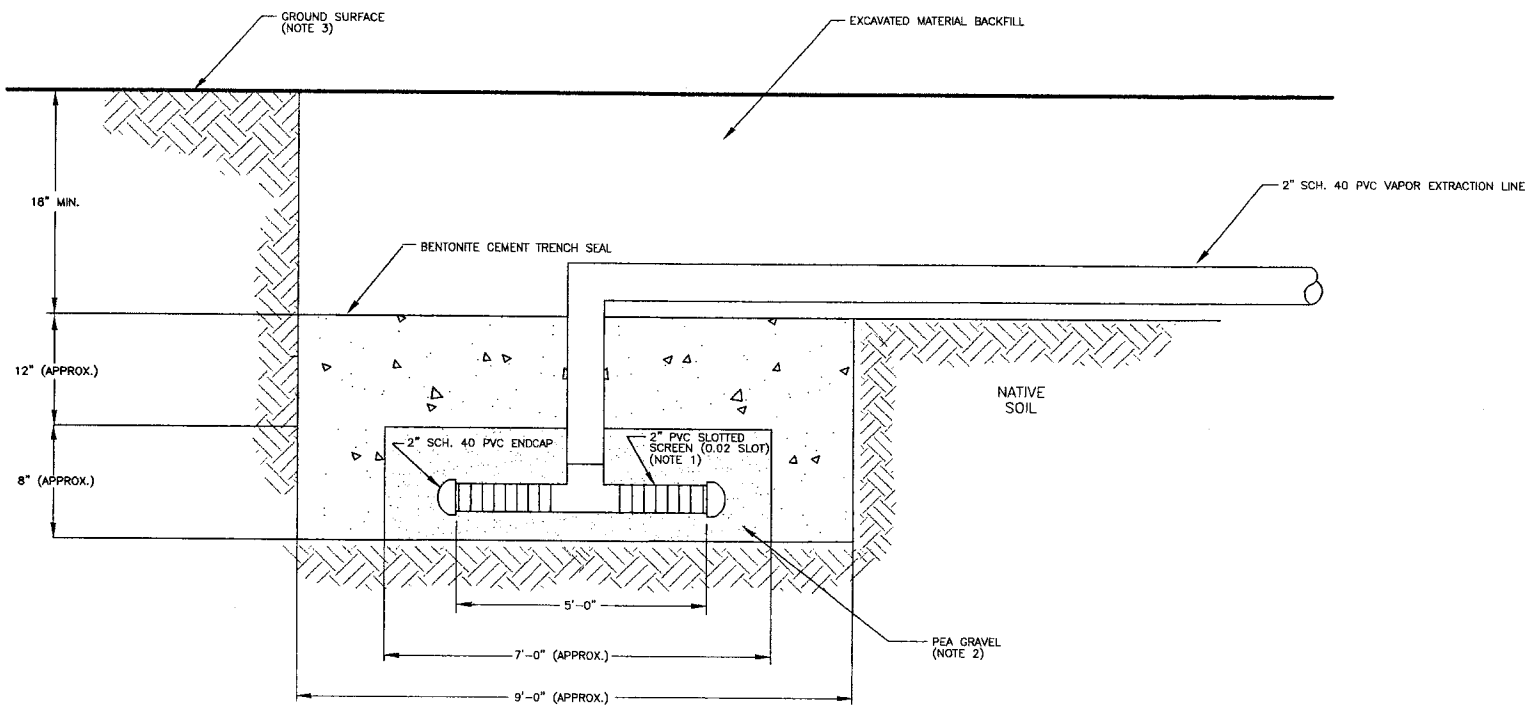


GROUNDWATER RECOVERY WELL DETAIL

(NOT TO SCALE)

RECOVERY WELL DETAIL			
US ARMY BUILDING 699 FORT MONMOUTH EATONTOWN, NEW JERSEY			
	NOT TO SCALE	DATE 4-29-99	SOURCE NJ
		DWG # FORT MO	FIGURE 10

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



NOTES:

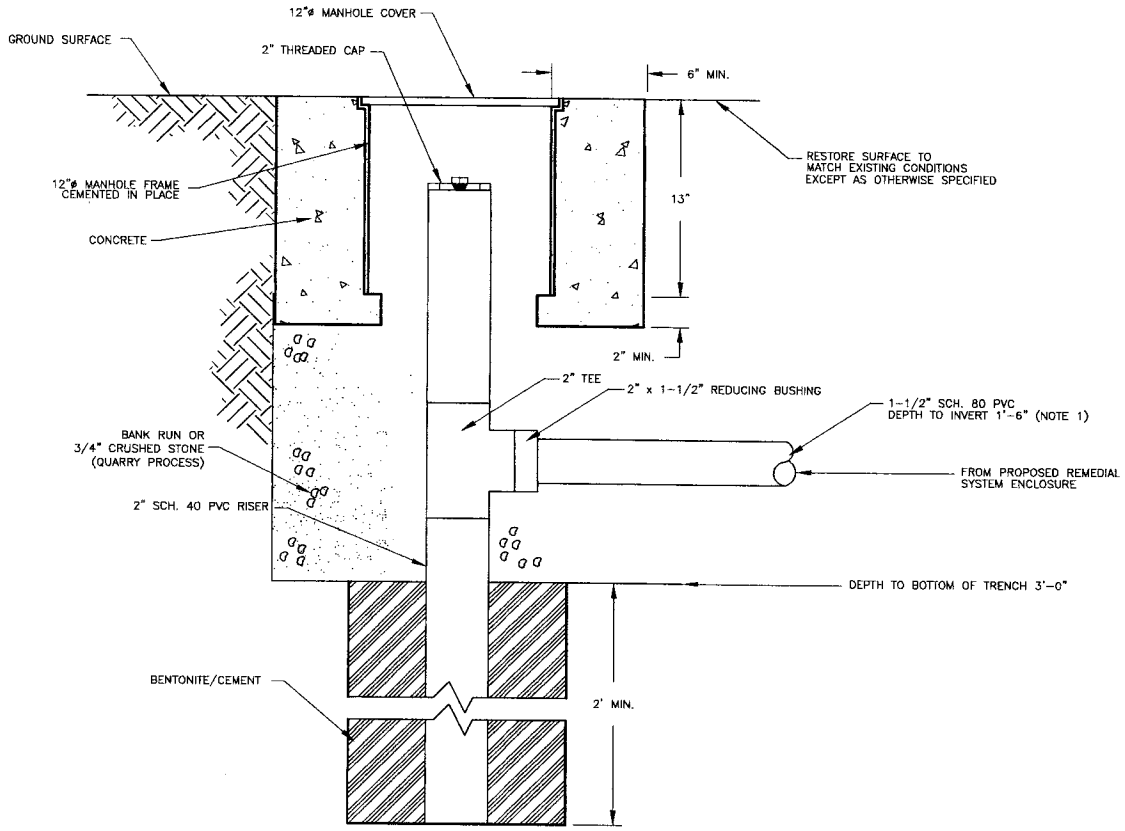
1. SVE LATERAL CONSISTS OF APPROX. 5' OF 2" PVC SLOTTED SCREEN BISECTED BY A FITTING CONNECTING THE LATERAL TO ITS VAPOR EXTRACTION LINE.

2. PEA GRAVEL SURROUNDING THE SCREENED LATERAL EXTENDS APPROXIMATELY 1 FOOT LATERALLY AND 4 INCHES ABOVE ANG BELOW THE SCREENED LATERAL.

3. GROUND SURFACE WILL BE RESTORED TO PRE-EXCAVATION CONDITION, INCLUDING ASPHALTIC PAVING OR CONCRETE PAVING IF APPLICABLE.

SOIL VAPOR EXTRACTION LATERAL DETAIL			
U.S. ARMY BUILDING 699 FORT MONMOUTH EATONTOWN, NEW JERSEY			
	NOT TO SCALE	DATE 4-19-99	SOURCE NJ
		DWG # FORT MO	FIGURE 1

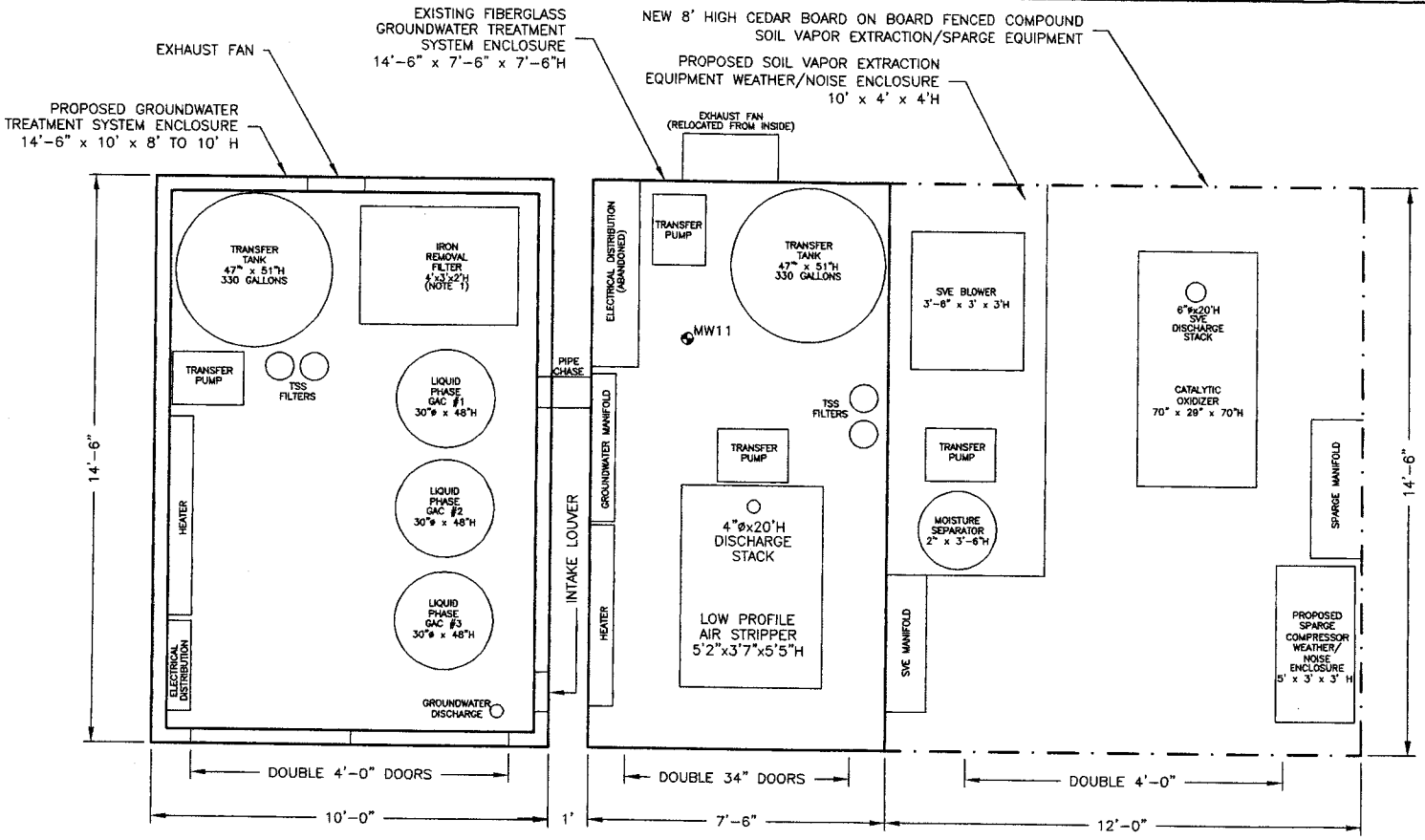
GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



WELL HEAD DETAIL
AIR SPARGE WELL
(TYPICAL OF SP1 – SP9)
(NOT TO SCALE)

AIR SPARGE WELL HEAD DETAIL			
U.S. ARMY BUILDING 699 FORT MONMOUTH EATONTOWN, NEW JERSEY			
	NOT TO SCALE	DATE 4-19-99	SOURCE NJ
		DWG # FORT M	FIGURE 12

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



NOTES:

1. IRON REMOVAL FILTER IS INSTALLED ON A 4' HIGH ELEVATED PLATFORM TO ALLOW FILTER TO GRAVITY DRAIN TO TRANSFER TANK.

2. ELECTRICAL DISTRIBUTION RELOCATED FOR EASIER ACCESS.

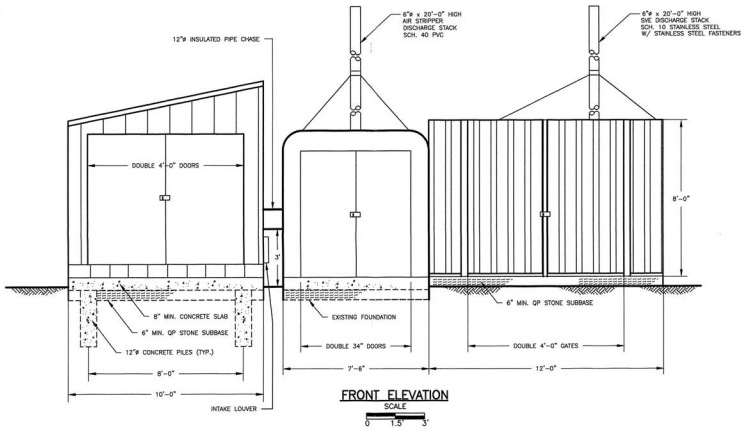
3. PIPE CHASE IS INSULATED 12" SCH. 40 PVC INSTALLED BETWEEN BUILDINGS.

EQUIPMENT FOOTPRINT
REMEDIAL SYSTEM ENCLOSURE

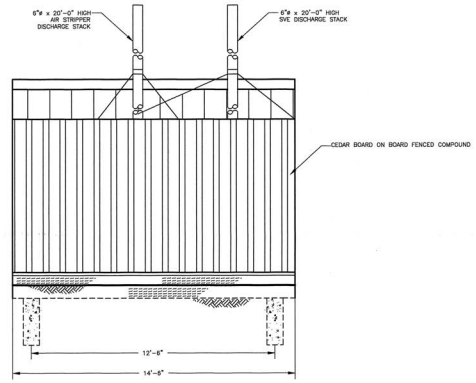
US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

SCALE	DATE	SOURCE
0 1.5' 3'	4-23-99	NJ
	DWG # FORT MON	FIGURE 13

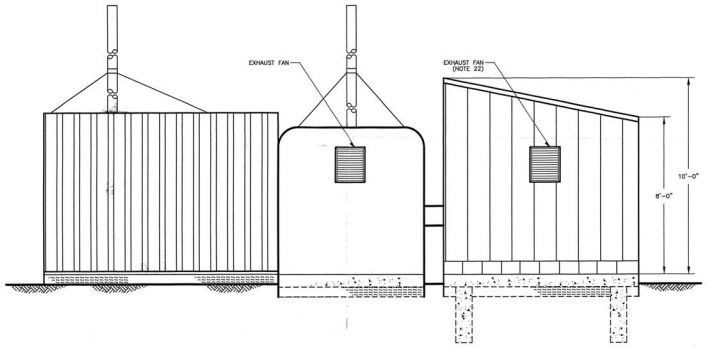
GES GROUNDWATER & ENVIRONMENTAL SERVICES, INC.



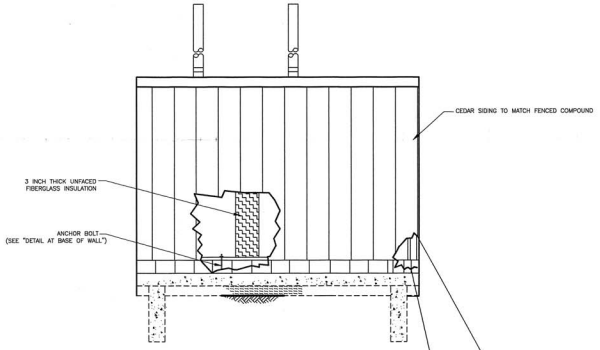
FRONT ELEVATION
SCALE
0 1.5' 3'



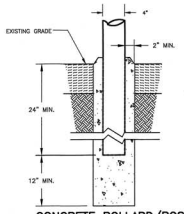
RIGHT ELEVATION
SCALE
0 1.5' 3'



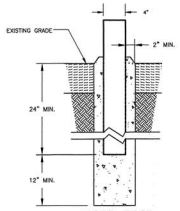
REAR ELEVATION
SCALE
0 1.5' 3'



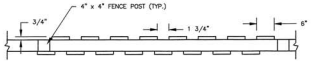
LEFT ELEVATION
SCALE
0 1.5' 3'



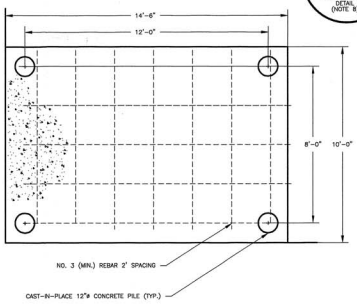
CONCRETE BOLLARD/POST
(TYPICAL)
(NOT TO SCALE)



WOOD POST
(TYPICAL)
(NOT TO SCALE)



BOARD-ON-BOARD FENCE DETAIL (PLAN VIEW)
(NOT TO SCALE)



PLAN – FOUNDATION
SCALE
0 1.5' 3'

NOTES:

1. CONSTRUCTION DETAILS FOR ALL-WEATHER GROUNDWATER TREATMENT ENCLOSURE.
2. CONCRETE SLAB W/ NO. 3 (MIN.) LONGITUDAL & LATERAL STEEL REINFORCING BARS 24 INCHES ON CENTER TO BE CAST-IN-PLACE ON CRUSHED STONE BASE. ACTUAL DEPTH OF CONCRETE SLAB WILL VARY WITH EXISTING GRADE. MINIMUM DEPTH OF SLAB SHALL NOT BE LESS THAN 8". THE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,500 PSI IN ACCORDANCE WITH BUILDING OFFICIALS AND CODE ADMINISTRATORS INTERNATIONAL, INC., COUNTRY CLUB HILLS, IL. (BOCA) TABLE 1907.1.2 (1).
3. 2"x4" WOOD STUDS MAY BE PLACED 24" ON CENTER (O.C.) IF WOOD STRUCTURAL PANEL SHEATHING HAS A MINIMUM SPAN RATING OF 24".
4. 12"ø CONCRETE PILES TO BE CAST-IN-PLACE USING SONOTUBE CASING IN ACCORDANCE WITH BOCA 1806.1. CONCRETE PILES SHALL EXTEND TO A DEPTH EQUIVALENT TO THE FROST LINE OF THE LOCALITY (3.0' BELOW GROUND SURFACE IN CENTRAL NEW JERSEY). EACH PILE WILL BE TIED INTO PROPOSED CONCRETE SLAB WITH TWO NO. 4 STEEL REINFORCING BARS.
5. 19/32" SHALLOW GROOVE T1-11 PANELS, AS SUPPLIED BY ROSEBURG LUMBER CO., ROSEBURG, OR., OR EQUIVALENT.
6. ANCHOR BOLTS SHALL BE A MINIMUM DIAMETER OF 1/2" AND SHALL BE PLACED 12" FROM EACH CORNER WITH INTERMEDIATE BOLTS SPACED A MAXIMUM OF 6' O.C. ANCHOR BOLTS SHALL BE EMBEDDED IN CONCRETE SLAB TO A DEPTH OF 8" (MIN.) IN ACCORDANCE WITH BOCA 2305.16.
7. CONCRETE BLOCK CONTAINMENT DIKE SHALL BE CONSTRUCTED OF 8" HOLLOW CONCRETE BLOCK FILLED WITH CONCRETE IN ACCORDANCE WITH BOCA 1801.1.2.
8. CORNER POSTS ARE USED WHERE TWO PARTITIONS MEET. THREE 2" x 4" ARE COMBINED FOR STRENGTH AND TO PROVIDE WALLBOARD NAILING SURFACES.
9. IN ACCORDANCE WITH BOCA 2311.4.2.
10. CONSTRUCTION OF THE ENCLOSURE SHALL MEET ALL APPLICABLE BOCA CODES.
11. ALL ELECTRICAL EQUIPMENT AND WIRING SHALL MEET THE REQUIREMENTS OF NATIONAL FIRE PROTECTION ASSOCIATION, QUINCY, MA. (NFPA) 70, NATIONAL ELECTRICAL CODE.
12. ROOF TRUSSES SHALL BE DESIGNED AND INSTALLED IN ACCORDANCE WITH BOCA AND TRUSS PLATE INSTITUTE, MADISON, WI. ROOF TRUSS TO BE SUPPLIED BY TRUSTY BUILDING COMPONENTS, PENNINGTON, NJ., OR EQUIVALENT. THE REQUIRED DESIGN CRITERIA AND RELEVANT BUILDING CODES MUST BE PROVIDED TO THE TRUSS DESIGNER FOR EACH INDIVIDUAL ENCLOSURE.
13. INTERIOR WALLS SHALL BE FINISHED WITH 1/2" DRYWALL SHEETING.
14. ACTUAL LOCATION OF INTAKE LOUVER AND EXHAUST FANS TO BE FIELD DETERMINED DURING CONSTRUCTION.

NO.	DATE	REVISIONS

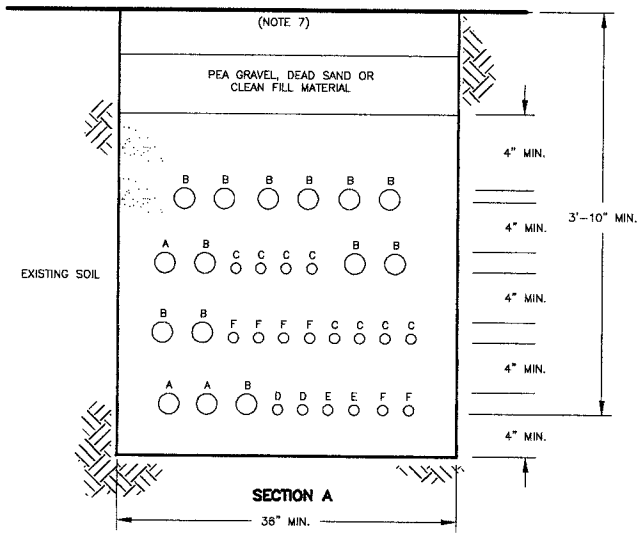
ENCLOSURE/COMPOUND ELEVATIONS

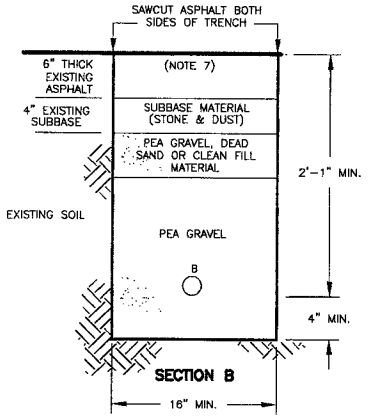
US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

GROUNDWATER & ENVIRONMENTAL SERVICES, Inc.
1340 CAMPUS PARKWAY WALL, N.J. 07719
PHONE (732) 919-0100 FAX (732) 919-0916

DWG. NO.	FORT MONMOUTH
SCALE	1" =3'
DRAWN BY:	CHECKED BY:
DESIGNED BY:	CHECKED BY:
DATE:	25 APRIL 1999
FIGURE	14

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.





NOTES:

1) ALL 90° TURNS SHALL BE ACHIEVED WITH 22.5° OR 45° ANGLE ELBOWS OR 12" MINIMUM RADIUS SWEEPS FOR THIN WALL ELECTRICAL CONDUIT.

2) ALL PVC PIPE IS SCH. 40 PVC, SOLVENT WELD. SLOPE SVE PIPING TOWARD THE FENCED COMPOUND AT A SLOPE OF 1" PER 50 FEET. GROUNDWATER AND SPARGE PIPING SLOPED TOWARD WELLS AT AT A SLOPE OF 1" PER 50 FEET.

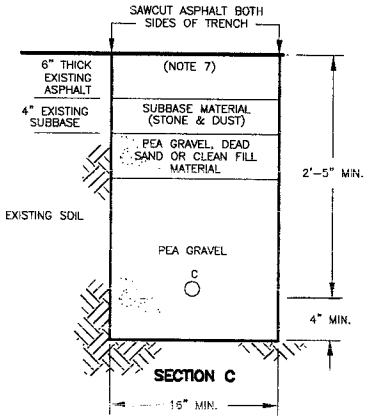
3) WHEN APPROPRIATE (BASED ON THE MATERIAL UTILIZED) BACKFILL SHALL BE COMPACTED TO A MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO TEST DESIGNATION T-180 OR ASTM TEST DESIGNATION D-1557.

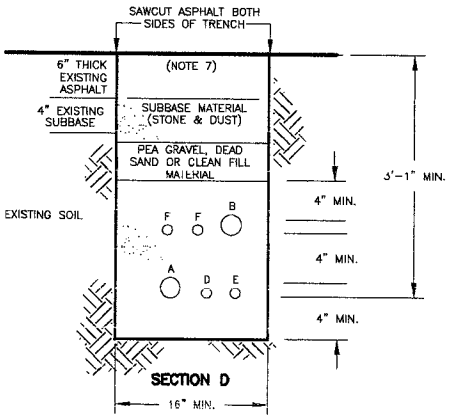
4) BACKFILL AND COMPACT EXCAVATION IN 6 INCH LIFTS.

5) THREE CONTINGENCY SVE PIPES SHALL BE INSTALLED IN TRENCH, ONE TO RW3, ONE TO RW4, AND THE OTHER TO END OF TRENCH NEAR MW4.

6) PRODUCT RECOVERY AND PRODUCT PUMP AIR SUPPLY LINES SHALL BE INSTALLED TO RW3 AND RW4 RESPECTIVELY.

7) REFER TO RESTORATION PLAN FOR FINAL EXCAVATION RESTORATION DETAILS.



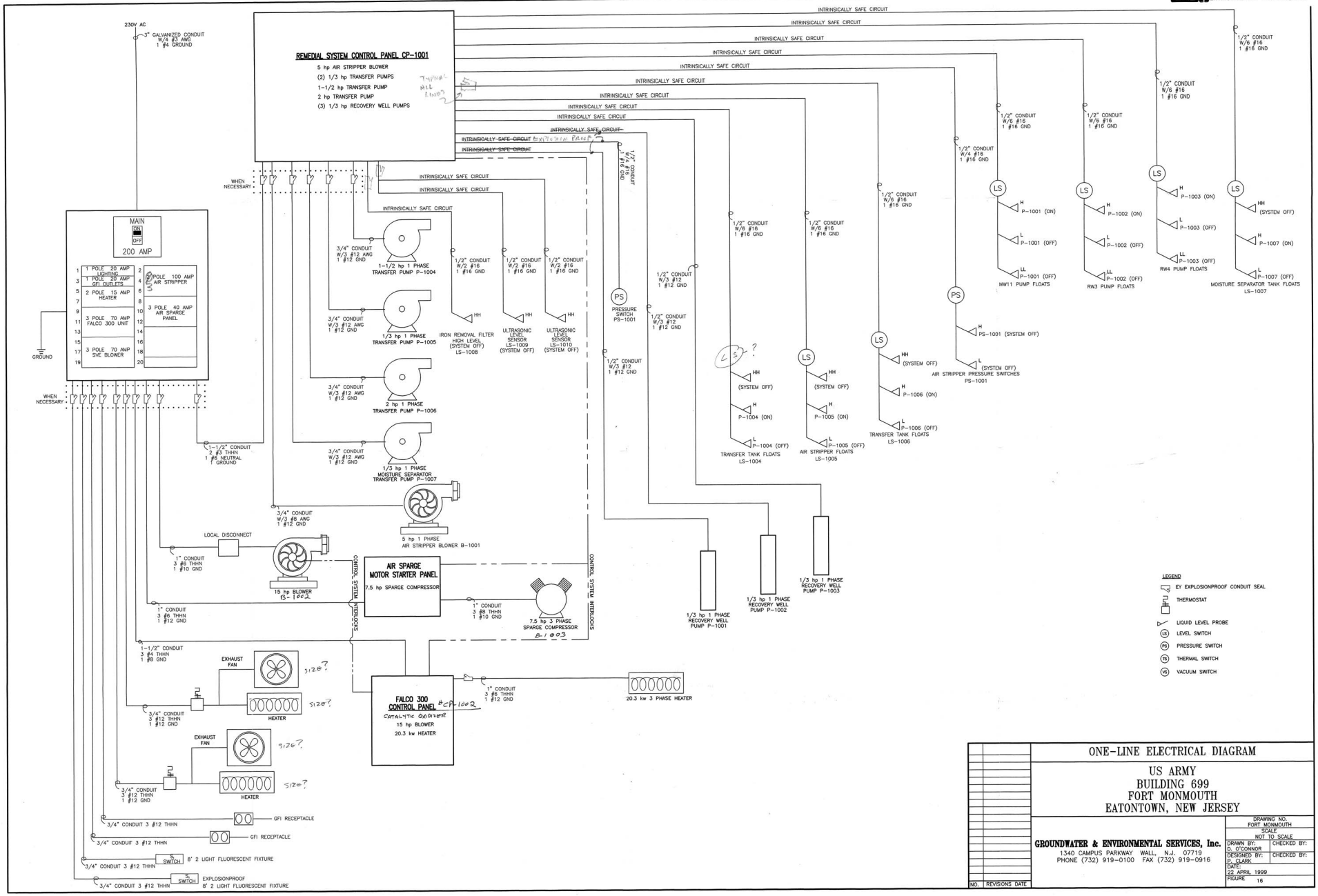


ITEM	SIZE	MATERIAL	DESCRIPTION
F	3/4"	THIN WALL METAL	ELECTRICAL CONDUIT
E	1"	SCH. 40 PVC	PRODUCT RECOVERY
D	1"	SCH. 40 PVC	PRODUCT PUMP AIR SUPPLY
C	1-1/2"	SCH. 40 PVC	AIR SPARGE
B	2"	SCH. 40 PVC	SOIL VAPOR EXTRACTION
A	2"	SCH. 40 PVC	GROUNDWATER RECOVERY

TRENCHING CROSS SECTIONS A THROUGH D

U.S. ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NOT TO SCALE	DATE 4-19-99	SOURCE NJ
	DWG # FORT MO	FIGURE 15



NO.	REVISIONS	DATE

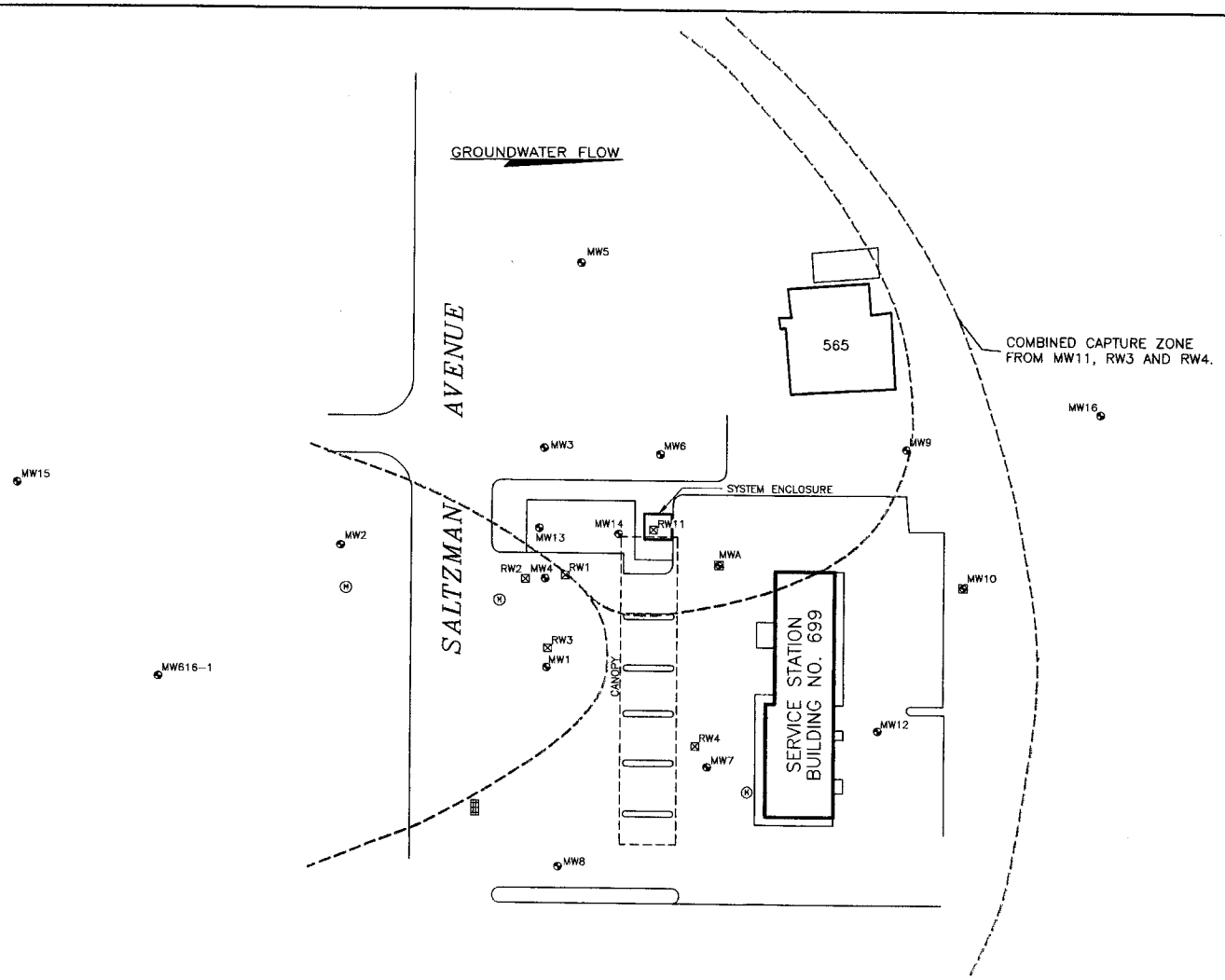
ONE-LINE ELECTRICAL DIAGRAM

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

GROUNDWATER & ENVIRONMENTAL SERVICES, Inc.
1340 CAMPUS PARKWAY WALL, N.J. 07719
PHONE (732) 919-0100 FAX (732) 919-0916

DRAWING NO.	FORT MONMOUTH
SCALE	NOT TO SCALE
DRAWN BY: D. O'CONNOR	CHECKED BY:
DESIGNED BY: P. CLARK	CHECKED BY:
DATE:	22 APRIL 1999
FIGURE	16

GROUNDWATER &
ENVIRONMENTAL SERVICES, INC.



LEGEND

- STORM SEWER INLET
- UTILITY MANHOLE
- PUMP ISLAND
- FENCE
- RECOVERY WELL
- MONITORING WELL
- ABANDONED MONITORING WELL

NOTES:

AN AVERAGE PUMPING RATE OF 5 gpm AT EACH OF RW11, RW3 AND RW4 WAS USED TO CALCULATE THE CAPTURE ZONE.

INDIVIDUAL CAPTURE ZONE FROM RW4 IS NOT SHOWN.

CALCULATED CAPTURE ZONE

US ARMY
BUILDING 699
FORT MONMOUTH
EATONTOWN, NEW JERSEY

NORTH	SCALE IN FEET	DATE	SOURCE
	0 30 60	5-17-99	NJ
		DWG # FORT MON	FIGURE 17

TABLES

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

4/2/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	2.89	2.91	0.02	13.18	13.20
MW1	15.81	---	2.65	---	13.16	13.16
MW2	16.64	---	2.85	---	13.79	13.79
MW3	15.80	---	2.80	---	13.00	13.00
MW4	15.92	---	2.72	---	13.20	13.20
MW5	15.48	---	2.69	---	12.79	12.79
MW6	15.78	---	2.88	---	12.90	12.90
MW8	15.96	---	3.13	---	12.83	12.83
MW9	16.20	---	3.10	---	13.10	13.10
RW11	17.14	---	13.57	---	3.57	3.57
MW12	16.66	---	3.51	---	13.15	13.15
MW13	16.21	---	1.70	---	14.51	14.51
MW14	15.98	---	1.56	---	14.42	14.42
MW15	17.04	---	3.19	---	13.85	13.85
MW16	15.27	NM	NM	NM	NM	NM
616-1	18.92	---	4.70	---	14.22	14.22

4/9/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	3.45	3.46	0.02	12.63	12.65
MW1	15.81	---	3.11	---	12.70	12.70
MW2	16.64	---	3.50	---	13.14	13.14
MW3	15.80	---	3.34	---	12.46	12.46
MW4	15.92	---	3.22	---	12.70	12.70
MW5	15.48	---	3.34	---	12.14	12.14
MW6	15.78	---	3.56	---	12.22	12.22
MW8	15.96	---	3.50	---	12.46	12.46
MW9	16.20	---	3.68	---	12.52	12.52
RW11	17.14	---	13.12	---	4.02	4.02
MW12	16.66	---	3.99	---	12.67	12.67
MW13	16.21	---	2.32	---	13.89	13.89
MW14	15.98	---	2.19	---	13.79	13.79
MW15	17.04	---	3.80	---	13.24	13.24
MW16	15.27	---	3.34	---	11.93	11.93
616-1	18.92	---	5.39	---	13.53	13.53

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

5/27/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	3.20	3.22	0.02	12.87	12.89
MW1	15.81	---	2.93	---	12.88	12.88
MW2	16.64	---	3.51	---	13.13	13.13
MW3	15.80	---	3.20	---	12.60	12.60
MW4	15.92	NM	NM	NM	NM	NM
MW5	15.48	---	3.21	---	12.27	12.27
MW6	15.78	---	3.44	---	12.34	12.34
MW8	15.96	---	3.40	---	12.56	12.56
MW9	16.20	---	3.72	---	12.48	12.48
RW11	17.14	13.69	13.70	0.01	3.44	3.45
MW12	16.66	---	3.88	---	12.78	12.78
MW13	16.21	---	1.88	---	14.33	14.33
MW14	15.98	---	1.76	---	14.22	14.22
MW15	17.04	---	3.94	---	13.10	13.10
MW16	15.27	NM	NM	NM	NM	NM
616-1	18.92	---	5.64	---	13.28	13.28

6/11/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	4.08	4.09	0.01	12.00	12.01
MW1	15.81	---	3.78	---	12.03	12.03
MW2	16.64	---	4.66	---	11.98	11.98
MW3	15.80	---	4.07	---	11.73	11.73
MW4	15.92	---	3.90	---	12.02	12.02
MW5	15.48	---	4.15	---	11.33	11.33
MW6	15.78	---	4.37	---	11.41	11.41
MW8	16.20	---	4.10	---	12.10	12.10
MW9	15.96	---	4.61	---	11.35	11.35
RW11	17.14	---	14.05	---	3.09	3.09
MW12	16.66	---	4.65	---	12.01	12.01
MW13	16.21	---	2.98	---	13.23	13.23
MW14	15.98	---	2.85	---	13.13	13.13
MW15	17.04	---	4.66	---	12.38	12.38
MW16	15.27	---	4.70	---	10.57	10.57
616-1	18.92	---	6.62	---	12.30	12.30

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

6/26/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	4.98	---	11.11	11.11
MW1	15.81	---	4.80	---	11.01	11.01
MW2	16.64	---	5.21	---	11.43	11.43
MW3	15.80	---	4.89	---	10.91	10.91
MW4	15.92	---	4.82	---	11.10	11.10
MW5	15.48	---	4.82	---	10.66	10.66
MW6	15.78	---	5.16	---	10.62	10.62
MW8	16.20	---	5.14	---	11.06	11.06
MW9	15.96	---	5.50	---	10.46	10.46
RW11	17.14	---	14.05	---	3.09	3.09
MW12	16.66	---	5.68	---	10.98	10.98
MW13	16.21	---	3.81	---	12.40	12.40
MW14	15.98	---	3.71	---	12.27	12.27
MW15	17.04	---	3.09	---	13.95	13.95
MW16	15.27	---	5.44	---	9.83	9.83
616-1	18.92	---	7.03	---	11.89	11.89

7/2/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	NM	NM	NM	NM
MW1	15.81	---	4.07	---	11.74	11.74
MW2	16.64	---	4.72	---	11.92	11.92
MW3	15.80	---	4.29	---	11.51	11.51
MW4	15.92	---	NM	NM	NM	NM
MW5	15.48	---	4.18	---	11.30	11.30
MW6	15.78	---	4.52	---	11.26	11.26
MW8	16.20	---	4.39	---	11.81	11.81
MW9	15.96	---	4.79	---	11.17	11.17
RW11	17.14	---	13.98	---	3.16	3.16
MW12	16.66	---	4.84	---	11.82	11.82
MW13	16.21	---	3.15	---	13.06	13.06
MW14	15.98	---	3.05	---	12.93	12.93
MW15	17.04	---	4.54	---	12.50	12.50
MW16	15.27	---	4.81	---	10.46	10.46
616-1	18.92	---	6.54	---	12.38	12.38

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

7/8/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	4.62	---	11.47	11.47
MW1	15.81	---	4.28	---	11.53	11.53
MW2	16.64	---	4.97	---	11.67	11.67
MW3	15.80	---	4.55	---	11.25	11.25
MW4	15.92	---	4.46	---	11.46	11.46
MW5	15.48	---	4.41	---	11.07	11.07
MW6	15.78	---	4.80	---	10.98	10.98
MW8	16.20	---	4.57	---	11.63	11.63
MW9	15.96	---	5.05	---	10.91	10.91
RW11	17.14	---	14.03	---	3.11	3.11
MW12	16.66	---	5.07	---	11.59	11.59
MW13	16.21	---	3.48	---	12.73	12.73
MW14	15.98	---	3.25	---	12.73	12.73
MW15	17.04	---	4.83	---	12.21	12.21
MW16	15.27	---	5.13	---	10.14	10.14
616-1	18.92	---	6.88	---	12.04	12.04

7/29/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	---	---	---	---
MW1	15.81	---	5.13	---	10.68	10.68
MW2	16.64	---	5.77	---	10.87	10.87
MW3	15.80	---	5.35	---	10.45	10.45
MW4	15.92	---	5.38	---	10.54	10.54
MW5	15.48	---	5.27	---	10.21	10.21
MW6	15.78	---	4.21	---	11.57	11.57
MW8	16.20	---	5.25	---	10.95	10.95
MW9	15.96	---	5.99	---	9.97	9.97
RW11	17.14	---	---	---	---	---
MW12	16.66	---	5.89	---	10.77	10.77
MW13	16.21	---	---	---	---	---
MW14	15.98	---	---	---	---	---
MW15	17.04	---	5.63	---	11.41	11.41
MW16	15.27	---	6.23	---	9.04	9.04
616-1	18.92	---	7.84	---	11.08	11.08

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

8/5/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	NM	NM	NM	NM
MW1	15.81	---	5.36	---	10.45	10.45
MW2	16.64	---	6.03	---	10.61	10.61
MW3	15.80	---	5.64	---	10.16	10.16
MW4	15.92	---	NM	NM	NM	NM
MW5	15.48	---	5.44	---	10.04	10.04
MW6	15.78	---	5.90	---	9.88	9.88
MW8	16.20	---	5.51	---	10.69	10.69
MW9	15.96	---	6.12	---	9.84	9.84
RW11	17.14	---	14.73	---	2.41	2.41
MW12	16.66	---	6.12	---	10.54	10.54
MW13	16.21	---	3.37	---	12.84	12.84
MW14	15.98	---	3.22	---	12.76	12.76
MW15	17.04	---	5.73	---	11.31	11.31
MW16	15.27	---	6.54	---	8.73	8.73
616-1	18.92	---	8.09	---	10.83	10.83

8/18/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	6.27	---	9.82	9.82
MW1	15.81	---	5.83	---	9.98	9.98
MW2	16.64	---	6.39	---	10.25	10.25
MW3	15.80	---	6.14	---	9.66	9.66
MW4	15.92	---	6.12	---	9.80	9.80
MW5	15.48	---	5.85	---	9.63	9.63
MW6	15.78	---	6.32	---	9.46	9.46
MW8	16.20	---	5.96	---	10.24	10.24
MW9	15.96	---	6.65	---	9.31	9.31
RW11	17.14	---	14.60	---	2.54	2.54
MW12	16.66	---	6.58	---	10.08	10.08
MW13	16.21	---	3.45	---	12.76	12.76
MW14	15.98	---	3.31	---	12.67	12.67
MW15	17.04	---	6.15	---	10.89	10.89
MW16	15.27	---	7.02	---	8.25	8.25
616-1	18.92	---	8.55	---	10.37	10.37

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

9/4/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	6.71	---	9.38	9.38
MW1	15.81	---	6.27	---	9.54	9.54
MW2	16.64	---	6.85	---	9.79	9.79
MW3	15.80	---	6.57	---	9.23	9.23
MW4	15.92	---	6.51	---	9.41	9.41
MW5	15.48	---	6.23	---	9.25	9.25
MW6	15.78	---	6.76	---	9.02	9.02
MW8	16.20	---	6.42	---	9.78	9.78
MW9	15.96	---	7.00	---	8.96	8.96
RW11	17.14	---	14.64	---	2.50	2.50
MW12	16.66	---	7.02	---	9.64	9.64
MW13	16.21	---	3.51	---	12.70	12.70
MW14	15.98	---	3.36	---	12.62	12.62
MW15	17.04	---	6.56	---	10.48	10.48
MW16	15.27	---	7.44	---	7.83	7.83
616-1	18.92	---	8.99	---	9.93	9.93

9/17/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	6.97	---	9.12	9.12
MW1	15.81	---	6.57	---	9.24	9.24
MW2	16.64	---	7.16	---	9.48	9.48
MW3	15.80	---	6.82	---	8.98	8.98
MW4	15.92	---	6.80	---	9.12	9.12
MW5	15.48	---	6.48	---	9.00	9.00
MW6	15.78	---	7.00	---	8.78	8.78
MW8	16.20	---	6.75	---	9.45	9.45
MW9	15.96	---	7.25	---	8.71	8.71
RW11	17.14	---	14.51	---	2.63	2.63
MW12	16.66	---	7.30	---	9.36	9.36
MW13	16.21	---	3.32	---	12.89	12.89
MW14	15.98	---	3.18	---	12.80	12.80
MW15	17.04	---	6.79	---	10.25	10.25
MW16	15.27	---	7.61	---	7.66	7.66
616-1	18.92	---	9.25	---	9.67	9.67

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

10/2/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	7.21	---	8.88	8.88
MW1	15.81	---	6.85	---	8.96	8.96
MW2	16.64	---	7.31	---	9.33	9.33
MW3	15.80	---	7.12	---	8.68	8.68
MW4	15.92	---	7.02	---	8.90	8.90
MW5	15.48	---	6.70	---	8.78	8.78
MW6	15.78	---	7.27	---	8.51	8.51
MW8	16.20	---	7.06	---	9.14	9.14
MW9	15.96	---	7.47	---	8.49	8.49
RW11	17.14	---	14.62	---	2.52	2.52
MW12	16.66	---	7.61	---	9.05	9.05
MW13	16.21	---	3.62	---	12.59	12.59
MW14	15.98	---	3.43	---	12.55	12.55
MW15	17.04	---	7.00	---	10.04	10.04
MW16	15.27	---	7.88	---	7.39	7.39
616-1	18.92	---	9.45	---	9.47	9.47

10/16/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	7.19	---	8.90	8.90
MW1	15.81	---	6.72	---	9.09	9.09
MW2	16.64	---	7.75	---	8.89	8.89
MW3	15.80	---	7.21	---	8.59	8.59
MW4	15.92	6.90	6.91	0.01	9.01	9.02
MW5	15.48	---	6.82	---	8.66	8.66
MW6	15.78	---	7.30	---	8.48	8.48
MW8	16.20	---	7.24	---	8.96	8.96
MW9	15.96	---	7.48	---	8.48	8.48
RW11	17.14	SHEEN	14.55	SHEEN	2.59	2.59
MW12	16.66	---	7.74	---	8.92	8.92
MW13	16.21	---	3.26	---	12.95	12.95
MW14	15.98	---	3.11	---	12.87	12.87
MW15	17.04	---	7.90	---	9.14	9.14
MW16	15.27	---	7.73	---	7.54	7.54
616-1	18.92	---	9.41	---	9.51	9.51

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY
11/12/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	7.49	7.58	0.09	8.51	8.58
MW1	15.81	7.29	8.50	1.21	7.31	8.22
MW2	16.64	---	8.17	---	8.47	8.47
MW3	15.80	---	7.63	---	8.17	8.17
MW4	15.92	7.91	8.57	0.66	7.35	7.85
MW5	15.48	---	7.10	---	8.38	8.38
MW6	15.78	---	7.74	---	8.04	8.04
MW8	16.20	---	7.51	---	8.69	8.69
MW9	15.96	---	7.84	---	8.12	8.12
RW11	17.14	15.71	15.72	0.01	1.42	1.43
MW12	16.66	---	8.09	---	8.57	8.57
MW13	16.21	---	3.51	---	12.70	12.70
MW14	15.98	---	3.35	---	12.63	12.63
MW15	17.04	---	7.50	---	9.54	9.54
MW16	15.27	---	8.07	---	7.20	7.20
616-1	18.92	---	10.01	---	8.91	8.91

11/25/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	7.60	---	8.49	8.49
MW1	15.81	7.41	8.65	1.24	7.16	8.09
MW2	16.64	---	8.31	---	8.33	8.33
MW3	15.80	---	7.71	---	8.09	8.09
MW4	15.92	7.97	8.51	0.54	7.41	7.82
MW5	15.48	---	7.23	---	8.25	8.25
MW6	15.78	---	7.87	---	7.91	7.91
MW8	16.20	---	7.78	---	8.42	8.42
MW9	15.96	---	7.95	---	8.01	8.01
RW11	17.14	---	15.53	---	1.61	1.61
MW12	16.66	---	8.27	---	8.39	8.39
MW13	16.21	---	4.32	---	11.89	11.89
MW14	15.98	---	3.50	---	12.48	12.48
MW15	17.04	---	7.70	---	9.34	9.34
MW16	15.27	---	7.73	---	7.54	7.54
616-1	18.92	---	10.14	---	8.78	8.78

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

12/4/98

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	7.60	---	8.49	8.49
MW1	15.81	7.42	8.71	1.29	7.10	8.07
MW2	16.64	---	8.41	---	8.23	8.23
MW3	15.80	---	7.69	---	8.11	8.11
MW4	15.92	7.85	8.82	0.97	7.10	7.83
MW5	15.48	---	7.29	---	8.19	8.19
MW6	15.78	---	7.80	---	7.98	7.98
MW8	16.20	---	7.85	---	8.35	8.35
MW9	15.96	---	7.91	---	8.05	8.05
RW11	17.14	15.53	15.54	0.01	1.60	1.61
MW12	16.66	---	8.36	---	8.30	8.30
MW13	16.21	---	4.20	---	12.01	12.01
MW14	15.98	---	3.47	---	12.51	12.51
MW15	17.04	---	7.57	---	9.47	9.47
MW16	15.27	---	7.61	---	7.66	7.66
616-1	18.92	---	10.00	---	8.92	8.92

1/22/99

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	5.22	---	10.87	10.87
MW1	15.81	5.50	5.62	0.12	10.19	10.28
MW2	16.64	---	3.87	---	12.77	12.77
MW3	15.80	---	4.89	---	10.91	10.91
MW4	15.92	---	5.14	---	10.78	10.78
MW5	15.48	---	4.89	---	10.59	10.59
MW6	15.78	---	4.85	---	10.93	10.93
MW8	16.20	---	6.10	---	10.10	10.10
MW9	15.96	---	5.09	---	10.87	10.87
RW11	17.14	---	14.20	---	2.94	2.94
MW12	16.66	---	6.61	---	10.05	10.05
MW13	16.21	---	2.25	---	13.96	13.96
MW14	15.98	---	2.12	---	13.86	13.86
MW15	17.04	---	4.58	---	12.46	12.46
MW16	15.27	---	5.64	---	9.63	9.63
616-1	18.92	---	4.90	---	14.02	14.02

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY

1/29/99

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	4.77	---	11.32	11.32
MW1	15.81	5.00	5.11	0.11	10.70	10.78
MW2	16.64	---	3.47	---	13.17	13.17
MW3	15.80	---	4.50	---	11.30	11.30
MW4	15.92	---	4.69	---	11.23	11.23
MW5	15.48	---	4.00	---	11.48	11.48
MW6	15.78	---	4.40	---	11.38	11.38
MW8	16.20	---	5.30	---	10.90	10.90
MW9	15.96	---	4.38	---	11.58	11.58
RW11	17.14	---	14.23	---	2.91	2.91
MW12	16.66	---	5.84	---	10.82	10.82
MW13	16.21	---	2.48	---	13.73	13.73
MW14	15.98	---	2.36	---	13.62	13.62
MW15	17.04	---	4.20	---	12.84	12.84
MW16	15.27	---	5.02	---	10.25	10.25
616-1	18.92	---	4.51	---	14.41	14.41

2/12/99

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	4.47	---	11.62	11.62
MW1	15.81	---	4.47	---	11.34	11.34
MW2	16.64	---	2.98	---	13.66	13.66
MW3	15.80	---	4.08	---	11.72	11.72
MW4	15.92	---	4.22	---	11.70	11.70
MW5	15.48	---	3.55	---	11.93	11.93
MW6	15.78	---	4.01	---	11.77	11.77
MW8	16.20	---	4.60	---	11.60	11.60
MW9	15.96	---	4.08	---	11.88	11.88
RW11	17.14	---	14.30	---	2.84	2.84
MW12	16.66	---	5.15	---	11.51	11.51
MW13	16.21	---	2.74	---	13.47	13.47
MW14	15.98	---	2.60	---	13.38	13.38
MW15	17.04	---	2.86	---	14.18	14.18
MW16	15.27	---	3.21	---	12.06	12.06
616-1	18.92	---	4.05	---	14.87	14.87

TABLE 1
GROUNDWATER MONITORING DATA
U.S. ARMY
FORT MONMOUTH - BUILDING 699 AREA
EATONTOWN, NEW JERSEY
2/19/99

Well ID	Casing Elevation (feet)	Depth to Product (feet)	Depth to Groundwater (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Adjusted GW Elevation (feet)
RW2	16.09	---	4.36	---	11.73	11.73
MW1	15.81	---	4.20	---	11.61	11.61
MW2	16.64	---	1.79	---	14.85	14.85
MW3	15.80	---	3.98	---	11.82	11.82
MW4	15.92	---	4.18	---	11.74	11.74
MW5	15.48	---	3.41	---	12.07	12.07
MW6	15.78	---	3.65	---	12.13	12.13
MW8	16.20	---	4.47	---	11.73	11.73
MW9	15.96	---	3.44	---	12.52	12.52
RW11	17.14	---	14.37	---	2.77	2.77
MW12	16.66	---	5.00	---	11.66	11.66
MW13	16.21	---	2.11	---	14.10	14.10
MW14	15.98	---	1.98	---	14.00	14.00
MW15	17.04	---	1.99	---	15.05	15.05
MW16	15.27	---	2.85	---	12.42	12.42
616-1	18.92	---	3.51	---	15.41	15.41

APPENDIX I

SERIAL # 46248

DWR-133M (10/93)

038

616 MW1

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
TRENTON, NJ

Mail to

'DEPE
reau Water Allocation
26
nton, NJ 08625

Permit No. 29 33760

MONITORING WELL PERMIT

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

COORD #: 29 . 14 . 444

Owner US Army - Ft Monmouth
Address Bldg 167 DEH Envir
Ft Monmouth NJ

Driller Shane Drilling
Address 23 Branch Ave
Oceanport NJ

Name of Facility Bldg 616
Address
Same as above

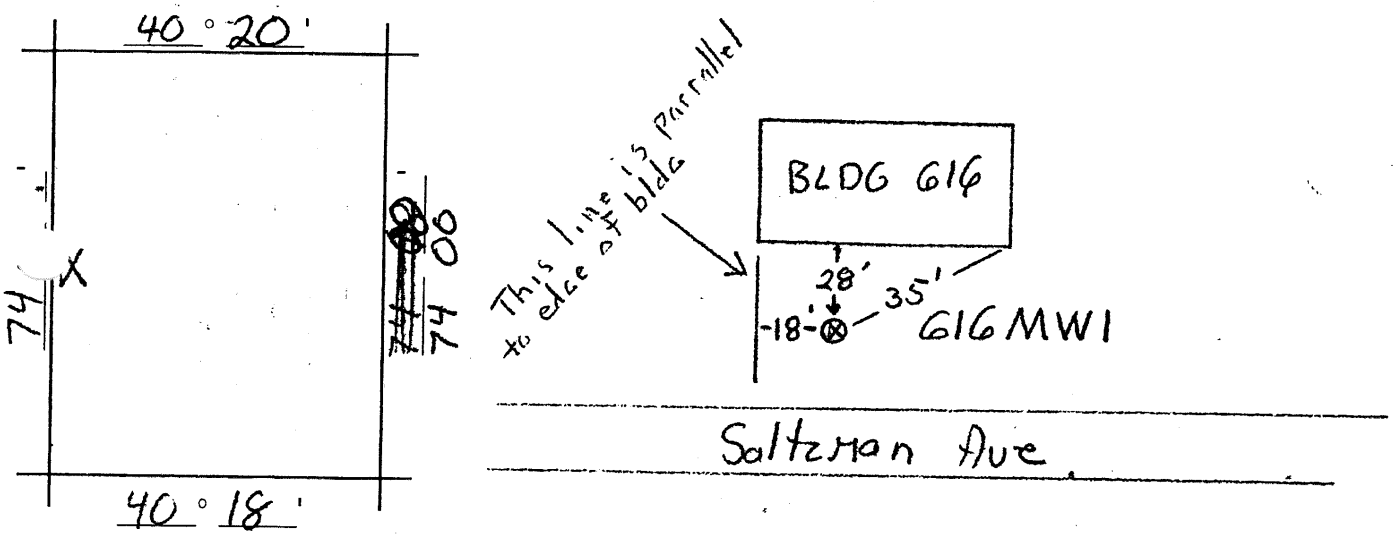
Diameter of Well(s)	4 Inches	Proposed Depth of Well(s)	20 Feet
# of Wells Applied for (max. 10)	1	Will pumping equipment be installed?	YES ☐ NO ☒
Type of Well (see reverse)	Monitor	If Yes, give pump capacity	NA GPM

LOCATION OF WELL(S)

Lot #	Block #	Municipality	County
NA	NA	Ft Monmouth	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)

RECEIVED JUL 27 1995 MONMOUTH REGIONAL HEALTH COMMISSION

CASE I.D. Number 94-12-8-1040-10

This Space for Approval Stamp

WELL PERMIT APPROVED
NJDEP
19 1995
BUREAU OF WATER ALLOCATION

FOR D.E.P.E. 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 7/10/95 Signature of Driller [signature] License # 1275

Signature of Owner [signature] SELFM-PWEV

COPIES: Water Allocation — White and Pink Health Dept — Yellow

DWR-138 M
11/94

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER ALLOCATION

MONITORING WELL RECORD

Well Permit No. _____ - _____
Atlas Sheet Coordinates _____ : _____ : _____

OWNER IDENTIFICATION - Owner _____
Address _____
City _____ State _____ Zip Code _____

WELL LOCATION - If not the same as owner please give address. Owner's Well No. _____
County _____ Municipality _____ Lot No. _____ Block No. _____
Address _____

TYPE OF WELL (as per Well Permit Categories) _____ Date well completed ____/____/____
Regulatory Program Requiring Well _____ Case I.D. # _____
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) _____ Tele. # _____

WELL CONSTRUCTION

Total depth drilled _____ ft.
Well finished to _____ ft.
Borehole diameter:
Top _____ in.
Bottom _____ in.
Vell was finished: ☐ above grade
☐ flush mounted
If finished above grade, casing height (stick up) above land surface _____ ft.
Was steel protective casing installed?
☐ Yes ☐ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.) [From land surface]	Diameter (inches)	Type and Material
Inner Casing				
Outer Casing (Not Protective Casing)				
Screen (Note slot size)				
Tail Piece				
Gravel Pack				
Annular Seal/Grout				
Method of Grouting				

Static water level after drilling _____ ft.
Water level was measured using _____
Well was developed for _____ hours at _____ gpm
Method of development _____
Was permanent pumping equipment installed? ☐ Yes ☐ No
Pump capacity _____ gpm
Pump type: _____
Drilling Method _____
Drilling Fluid _____ Type of Rig _____
Name of Driller _____
Health and Safety Plan submitted? ☐ Yes ☐ No
Level of Protection used on site (circle one) None D C B A
N.J. License No. _____
Name of Drilling Company _____

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

tify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature _____ Date _____

COPIES: White - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

THIS FORM MUST BE COMPLETED BY THE PERMITTEE AND/OR SURVEYOR

MONITORING WELL CERTIFICATION-FORM B-LOCATION CERTIFICATION

Name of Permittee:
Name of Facility: FORT MONMOUTH
Location:
NJPDES Number: NJ00 or ECRA Case Number:

LAND SURVEYOR'S CERTIFICATION

Well Permit Number: 29-33760-
This number must be permanently affixed to the well casing.

Longitude (to nearest second): West 74°-02'48"

Latitude (to nearest second): North 40°-18'-47"

Elevation of Top of Inner Casing (cap off) (one-hundredth of a foot): 18.92

Source of elevation datum (benchmark, nail, etc.) and year. (If an alternate datum has been approved by the Department, identify here, assume datum of 100', and give approximated actual elevation.) Source: GEODETIC FM-10

[x] 1927 [ ] 1983

Elev.:

Owners Well Number (As shown on application or plans): 616 MW-1 SU

Elevations are to be determined by double run, three wire leveling methods using balanced sights, commencing from a well marked and described point. This beginning point shall either be derived from Federal or State benchmarks if not more than 1000 feet from the site or from an alternate datum approved by the Department. Tolerances should meet third order standards, which are 0.05 ft x $(\text{mile})^{1/2}$. For sections less than 0.1 mile, let miles = 0.1.

AUTHENTICATION

I certify 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.

Thomas Pianetti
PROFESSIONAL LAND SURVEYOR'S SIGNATURE

THOMAS PIANETTI
PROFESSIONAL LAND SURVEYOR'S NAME
(Please print or type)

SEAL

GE 38975
PROFESSIONAL LAND SURVEYOR'S LICENSE #

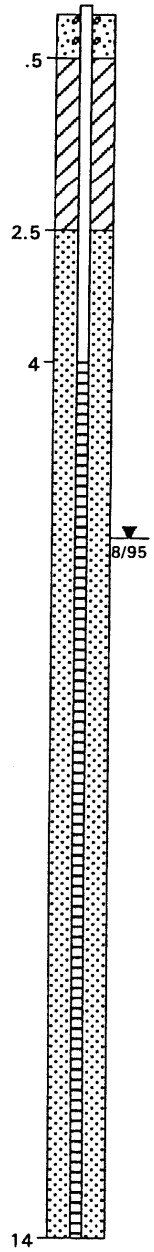
U.S. ARMY
FORT MONMOUTH
SELFM PW EV

LOG OF BORING 616-MW1

Produced for Charles Appleby

Project Name	: BLDG. 616	Completion Date	: 8/17/95
NJDEP Case #	: 29-33760	Northing	: N 539584.356
Logged By	: Shore Drilling	Easting	: E 2172306.050
Start Date	: 8/17/95	Driller	: R. Barnes

29-33760
ELEV: 18.92



Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Samples	Blows/Ft
0	Topsoil and Roots				
2	Brown clayey, dry moist		CL	1	15
				2	12
4	Green + black silty clay, mottled moist			3	14
6				4	16
8			CL	5	16
10				6	15
12	Iron stained area		CL		
14					
16					

Well Construction Information

Well Construction

Date Completed	: 8/17/95
Hole Diameter	: 8 in
Drill Method	: HSA
Company Rep	: R. Barnes

Well Casing

Material	: PVC
Diameter	: 4 in
Joints	: Threaded

Well Screen

Material	: PVC
Diameter	: 4 in
Joints	: Threaded
Opening	: 20 Slot
Sand Pack	: # 2 Morie Sand
Annulus Seal	: Bentonite/Portland : Tremmie

Well Screen

Material	: PVC
Diameter	: 4 in

NOTES

Well #1 is 616 MW1

2-21-1996 C:\616\GEO\616-mw.ge3

Groundwater & Environmental Services, Inc.

Project: Fort Monmouth
Owner: DPW
Location: Bldg 616
Permit No: 2933760
Well number: 616 MW1
Total Depth: 14.0 Diameter: 4"
Casing Elevation:
Water Level: Init: Static:
Screen Dia.: 4"
Length: 10.0' Slot Size: 20
Casing Dia.: 4"
Length: ≈6.5' Type: PVC
Drilling Method: H.S.A.
Sample Method: Split Spoon
Completion Details: Stick-up
Driller: SHORE Log By: R. BARNES Date: 8-17-95

Boring Log

Sketch Map

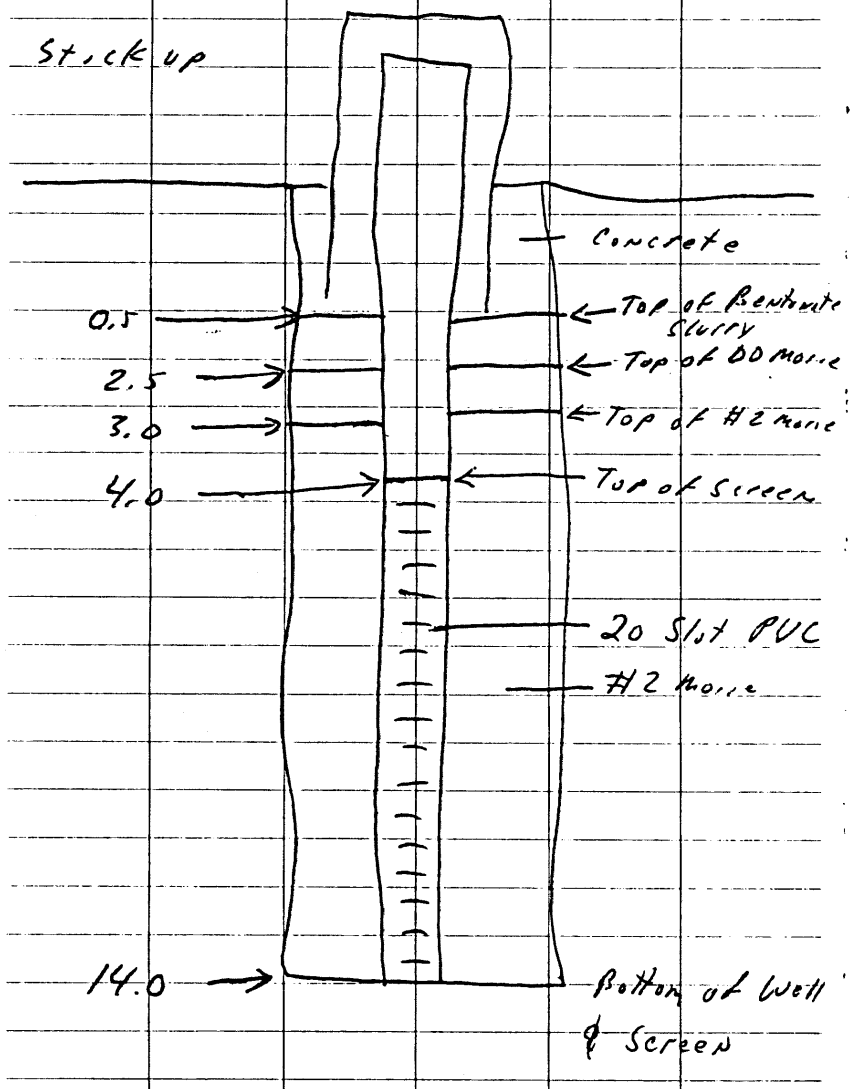
Blows Per Ft	Depth (feet)	Sample No.	Well Const.	PID (ppm)	Blow Count	Rec. (Ft)	Lithology	Unified Symbol
15	1			0	8, 6	1.6	Topsoil & Roots DRY	Topsoil
	2				9, 6		Br Clayey [illegible] Moist	ML-SM
12	3			0	8, 5	1.0		
	4				7, 6			
14	5	X		0	5, 7	1.2	Green & Blk Silty Clay [illegible] Moist	ML
	6				7, 7			
16	7			0	9, 7	1.5	Wet at 6'	
	8				9, 9			
16	9			0	9, [illegible]	1.4		
	10				[illegible]			
15	11			0	4, 7	1.6	OR [illegible] Ft	
	12				3, 8			
	13				Refusal			
	14							
	15						F.O.R. at 15 Ft	
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

(44): 8-14-75 1 Hues

Fort Monmouth

Well Construction For WKCC

"616 MW1"



1446
1450
1455
1509
1515
1610

WELL ID NO. 699/1

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 . 23677
Atlas Sheet Coordinates 29 : 13 : 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code 07703

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 1
County Monmouth Municipality ~~OCEANPORT BORO~~ Lot No. ~~TAXEXEMPT~~ Block No. ~~TAX~~
Address Bldg 699, Saltzman Ave, Fort Monmouth NJ 07703

TYPE OF WELL (as per Well Permit Categories) ~~MONITORING~~ Date well completed 11/2/89
Regulatory Program Requiring Well — Case I.D. # —

CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater & Environ Svcs Inc Tele. # 201-530-4787

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface _____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	Sch 40 PVC Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	2	15	4	Sch 40 PVC .02
Tail Piece	—	—		
Gravel Pack	2	15		#2 Morie Gravel
Annular Seal/Grout	.5	1.5		Bentonite Pellets
Method of Grouting	0 - .5 Slurry			

Static water level after drilling _____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development Purged with Pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: ~~Centrifugal pump~~ NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller Gregg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J 1472
Name of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Delfino for Gregg Myers Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GESI GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

29 13 C-65
2923677-1

Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No 2923677-1

Well Number 1 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 4' Static

Screen Diameter 4" Length 13' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch 40 PVC

Drilling Method Auger Sample Method Continuous Split Spoon

Completion Details Flush mount, cement collar, inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 11/2/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description		Comments
1			ASPHALT & BALLAST		
2			SAND	Dark green medium (-) to fine SAND trace silt.	
3				Orange-tan-brown medium to fine SAND, little clay.	PHC odor, slightly moist
4					
5				Dark green fine SAND, trace silt alternating with orange brown medium to fine SAND.	PHC odor, saturated
6					
7					
8			CLAY	Gray-orange: CLAY, trace fine sand	
9			SAND	Orange-brown medium to fine SAND some clay, trace silt. Changing to Dark green-orange-medium to fine sand, little clay at 11.0'	
10					
11					PHC odor, saturated
12					
13		10			
14					
15			END HOLE		
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

WELL ID NO. 699,

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 - 23678
Atlas Sheet Coordinates 29 : 13 : 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code 07703

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 2
County Monmouth Municipality ~~OCEANPORT BORO~~ Lot No. ~~TAXEXEMPT~~ Block No. ~~TAX~~
Address Bldg 699, Saltzman Ave, Fort Monmouth NJ 07703

TYPE OF WELL (as per Well Permit Categories) ~~MONITORING~~ Date well completed 11/2/89
Regulatory Program Requiring Well _____ Case I.D. # _____
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater Environ Svcs, Inc Tele. # 201-530-4787

WELL CONSTRUCTION
Total depth drilled 17 ft.
Well finished to 17 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface _____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	Sch40 PVC FJT Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	1.5	17	4	Sch40 PVC FJT .02
Tail Piece	—	—		
Gravel Pack	1.5	17		#2 Morie Gravel
Annular Seal/Grout	.5	1.5		Bentonite Pellets
Method of Grouting	0 — .5 Slurry			

Static water level after drilling _____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller Greg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J1472
Name of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Delfino for Greg Myers Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GESI GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Project Fort Monmouth Owner E-Systems, Inc

Location Fort Monmouth Eatontown Permit No 2923678-9

Well Number 2 Total Depth 17' Diameter 10"

Casing Elevation Water Level: Initial 5' Static

Screen Diameter 4" Length 15.5' Slot Size .020"

Casing Diameter 4" Length 1.5' Type Sch 40 PVC

Drilling Method Auger Sample Method Split Spoon everY 5'

Completion Details Flush mount, cement collar, Inner locking cap

Sketch Map

29 13 665

2923678 9

Driller B.L. Myers Log By J. Gallagher Date Drilled 11/2/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description		Comments
1			SAND	Dark brown to black SAND trace clay and silt	
2					
3					
4		0	SAND	Dark green to black fine SAND, little silt, trace clay.	Slightly moist, no odor.
5					
6					
7					
8				Dark green-fine SAND, some clay	Saturated
9					
10		0			
11					
12			CLAY	Black CLAY, little silt, trace fine sand	Saturated
13					
14		0			
15					
16					
17			END HOLE		
18					
19					
20					
21					
22					
23					
24					
25					

WELL ID NO. 699/3

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 . 23679
Atlas Sheet Coordinates 29 : 13 : 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 3
County Monmouth Municipality ~~OCEANPORT BORO~~ Lot No. ~~TAXEXEMP~~ Block No. TAX
Address Bldg 699 Saltzman Ave, Fort Monmouth NJ 07703

TYPE OF WELL (as per Well Permit Categories) ~~MONITORING~~ Date well completed 11/21/89
Regulatory Program Requiring Well — Case I.D. # —
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater & Environ Svcs Inc Tele. # 201-530-4787

WELL CONSTRUCTION
Total depth drilled 15 ft.
Well finished to 15 ft.
ehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface _____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	1.5	4	Sch 40 PVC FJT Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	~~[illegible]~~ 2	15	4	Sch 40 PVC FJT 20
Tail Piece	—			
Gravel Pack	1.5	15		#Morie Gravel
Annular Seal/Grout	.5	1.5		Bentonite Pellets
Method of Grouting	0-.5 Slurry			

Static water level after drilling _____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: ~~Centrifugal pump~~ NA
Drilling Method Auge
Drilling Fluid None Type of Rig TH-10
Name of Driller Greg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J 1472
me of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Delfino for Greg Myers Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

29-13-65
2923679-1

Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No 2923679-1

Well Number 3 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 4' Static

Screen Diameter 4" Length 13' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch. 40 PVC

Drilling Method Auger Sample Method Split Spoon every 5'

Completion Details Flush mount, with manhole cover, inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 11/2/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description		Comments
1			ASPHALT, BALLAST STONE		
			SAND	Dark green SAND, some clay.	PHC odor
2					
3			SAND	Dark green-gray medium to fine SAND, little clay	Water encountered @ 4'
4					
5					
6					
7					
8					
9					
10					
11					
12			SAND	Dark green-orange med to fine SAND, some clay.	
13					
14					
15			END HOLE		
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

GES GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

Project Fort Monmouth Owner E-System Inc.

Location Fort Monmouth Eatontown Permit No 2933680-7

Well Number 4 Total Depth 20' Diameter 10"

Casing Elevation Water Level: Initial 3' Static

Screen Diameter 4" Length 18' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch 40 PVC

Drilling Method Auger Sample Method Continuous Split Spoon

Completion Details Flush mount, with manhole, Inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 11/2/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description		Comments
			ASPHALT, BALLAST		
1			SAND	Dark green SAND, some clay, odor	PHC odor
2					
3			SAND	Dark green fine SAND, little clay	Saturated PHC odor
4					
5		185			
6					
7					
8					
9					
10					
11		170	SAND	Dark green to orange medium to fine SAND little clay	Saturated PHC odor
12					
13					
14					
15					Saturated, PHC odor
16			CLAY	Black CLAY, little fine sand	
17					
18					
19					
20			END HOLE		
21					
22					
23					
24					
25					

WELL ID NO. 699/5

WR-138 M
89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 - 23808
Atlas Sheet Coordinates 29 : 13 : 629

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 5
County Monmouth Municipality OCEANPORT BORO Lot No. TAX Block No. EXEMPT
Address Bldg 699, Saltzman Ave, Fortmonmouth, NJ 07703

TYPE OF WELL (as per Well Permit Categories) Date well completed 11/30/89
Regulatory Program Requiring Well MONITORING Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater Environ SVCS, Inc Tele. # 201-530-4787

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	3	4	PVC Sch 40 FJT .50 in
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	3	15	4	Sch 40 PVC FJT .02
Tail Piece	—	—		
Gravel Pack	3	15		#2 Morie Gravel
Annular Seal/Grout	1	3		Bentonite Pellets
Method of Grouting	0 - 1 Slurry			

Static water level after drilling ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2 gpm
Method of development Purged with pump
Was parmanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller Anthony Kull
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J1317
Name of Drilling Company ANTHONY A. KULL

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable state rules and regulations.

Driller's Signature Teresa Dellino for Anthony Kull Date 7/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No 2923808-1

Well Number 5 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 5.0' Static

Screen Diameter 4" Length 12' Slot Size .020"

Casing Diameter 4" Length 3' Type Sch 40 PVC

Drilling Method Auger Sample Method Split Spoon

Completion Details Flush mount, with manhole cover, inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 11/30/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
			ASPHALT	
1			SILT Dark Brown-Black SILT, some clay, trace fine sand	No odor or sheen
2				
3			SAND Dark green-orange fine SAND, little(-) clay	Blows 3,4,4,10 No odor or sheen
4				
5				Groundwater encountered @ 5'
6				
7				Blows 2,4,4,5
8				
9				
10				
11			Black coarse (-) to fine SAND	No odor
12			SAND Dark green fine SAND, some (-) clay	Blows 4,4,6,8
13				
14				
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

WELL ID NO. 699/6

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. ~~29~~ ~~23800~~
Atlas Sheet Coordinates ~~29~~ : ~~13~~ : ~~629~~

OWNER IDENTIFICATION - Owner US ARMY
Address 107 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 6
County Monmouth Municipality Lot No. Block No.
Address Bldg 699, Saltzman Ave OCEANPORT BORO, Fort Monmouth TAX NJ EXEMPT

TYPE OF WELL (as per Well Permit Categories) Date well completed 12/1/89
Regulatory Program Requiring Well MONITORING Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater Svcs Tele. # 201-530-4787

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) (From land surface)	Depth to Bottom (ft.) (From land surface)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	Sch 40 PVC FJT Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	2	15	4	Sch 40 PVC FJT .020
Tail Piece	—	—		
Gravel Pack	1	15		#2 Morie Gravel
Annular Seal/Grout	15	1		Bentonite Pellets
Method of Grouting	Slurry 0-.5			

Static water level after drilling ____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 1 gpm
Method of development purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller ~~[illegible]~~ Anthony A. Kull
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J1317
Name of Drilling Company ANTHONY A. KULL

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Delfino for Anthony A. Kull Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GROUNDWATER AND ENVIRONMENTAL SERVICES, INC

Sketch Map

Project Fort Monmouth Owner E-Systems Inc.

Location Fort Monmouth Eatontown Permit No 2923803-9

Well Number 6 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 4.5' Static

Screen Diameter 4" Length 14' Slot Size .020"

Casing Diameter 4" Length 1' Type Sch 40 PVC

Drilling Method Auger Sample Method Split Spoon

Completion Details Flush mount, with manhole cover, Inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 12/1/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
			ASPHALT	
1			FINE SAND Dark green fine SAND, little clay	
2			Dark green fine SAND, some clay	PHC odor water contacted at 4.5' Blows 7,4,4,5
3				
4				
5				
6				
7				
8			Light green-brown med (-) to fine SAND, trace clay	
9				
10				
11				
12			Dark green-Black fine SAND little clay	Blows 5,4,5,8
13				
14				
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

02 21 AM

WELL ID NO. 699/7

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 -23810
Atlas Sheet Coordinates 29 : 13 : 629

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 7
County Bldg 699 Municipality Lot No. Block No.
Address Saltzman Ave, OCEANPORT BORO Fort Monmouth NJ 07703 TAX EXEMPT

TYPE OF WELL (as per Well Permit Categories) Date well completed 12/1/89
Regulatory Program Requiring Well MONITORING Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater & Environ Svcs Inc Tele. # 201-530-4787

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) (From land surface)	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	3	4	Sch 40 PVC FJ Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	3	15	4	Sch 40 PVC FJ Solid
Tail Piece	—	—		
Gravel Pack	3	15		#2 Morie Gravel
Annular Seal/Grout	1.5	3		Bentonite Pellets
Method of Grouting	Slurry 0-1.5			

Static water level after drilling ____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development Purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity N/A gpm
Pump type: NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller Anthony Kull
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J 1317
Name of Drilling Company ANTHONY A. KULL

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Sellino for Anthony A. Kull Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No. 2923810-2

Well Number 7 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 3' Static

Screen Diameter 4" Length 12" Slot Size .020"

Casing Diameter 4" Length 3' Type Sch 40 PVC

Drilling Method Auger Sample Method Split Spoon

Completion Details Flush mount, with manhole cover, Inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 12/1/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
1			ASPHALT	
2			SILT & SAND — Black SILT & Fine SAND, Some gravel, trace cobbles	Blows 7,8,7,8 Water @ 3'
3			Fine SAND — Dark-green-black fine SAND, Trace Clay fine (-) gravel	
4				
5				
6			Fine SAND — Light gray to orange med (-) to fine SAND, little clay	Blows 3,3,4,4, Saturated PHC odor
7			Green fine SAND, some clay	
8				
9				
10				
11				
12				
13				
14				
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

WELL ID NO. 699/8

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 23811
Atlas Sheet Coordinates 29 : 13 : 629

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 8
County Monmouth Municipality OCEANPORT BORO Lot No. TAX Block No. BLOCK
Address Bldg 699 Saltzman Ave, Fort Monmouth NJ

TYPE OF WELL (as per Well Permit Categories) MONITORING Date well completed 12/1/89
Regulatory Program Requiring Well Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater & Environ Svcs, Inc Tele. # 201-530-4887

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	Sch40PVC FJT Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	2	15	4	Sch 40 PVC FJT .02
Tail Piece	—	—		
Gravel Pack	2	15		#2 Morie Gravel
Annular Seal/Grout	1	2		Bentonite Pellets
Method of Grouting	Slurry 0-1'			

Static water level after drilling ____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: NA
Drilling Method Auger
Drilling Fluid None Type of Rig TH-10
Name of Driller Anthony A. Kull
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J1317
Name of Drilling Company ANTHONY A. KULL

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa DeFino for Anthony Kull Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

GES GROUNDWATER AND ENVIRONMENTAL SERVICES, INC.

Sketch Map

Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No 2923811-1

Well Number 8 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 4' Static

Screen Diameter 4" Length 13' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch. 40 PVC

Drilling Method Auger Sample Method Split Spoon

Completion Details Flush mount, with manhole cover, inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 12/1/89

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
1			ASPHALT	
2			Fine SAND — Light brown coarse (-) to fine SAND, little coarse to fine gravel, trace cobbles	
3				
4			Fine SAND — Light brown-green Fine SAND, little Silt, trace clay	PHC odor Blows 8,8,4,5
5				
6			Dark green-gray med to fine SAND	water encountered @ 4'
7				
8			Light brown-orange Fine SAND, trace clay	odor
9				
10				odor
11				
12				
13			SAND — Dark green-orange med to fine SAND, some clay.	
14				
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

699 MW09

MONITORING WELL RECORD

Well Permit No. 29 . 24639
Atlas Sheet Coordinates 29 13 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DRIVE
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No.
County Municipality ~~OCEANPORT BORO~~ Lot No. ~~NA~~ Block No ~~NA~~
Address

TYPE OF WELL (as per Well Permit Categories) ~~MONITORING~~ Date well completed 5 / 1 / 90
Regulatory Program Requiring Well UST Case I.D. # —
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) G.E.S. - Tony Kull Tele. # (908) 530-4787

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) (From land surface)	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	PVC Sch40 FJT
Outer Casing (Not Protective Casing)				
Screen (Note slot size)	2	15	4	PVC Sch40 FJT .02
Tail Piece				
Gravel Pack	2	15		#2 Morie
Annular Seal/Grout	1	2		BENTONITE
Method of Grouting	0	1		PorTHANDI Slurry

Static water level after drilling 3 ft.
Water level was measured using Meter
Well was developed for hours at gpm
Method of development
Was permanent pumping equipment installed? ☐ Yes ☐ No
Pump capacity gpm
Pump type
Drilling Method AUGER
Drilling Fluid NONE Type of Rig TH-10
Name of Driller Gregg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J 1472
Name of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.) N.A.

0 - 15' BROWN to GREEN SAND
15' BLACK CLAY.

Driller used this form.

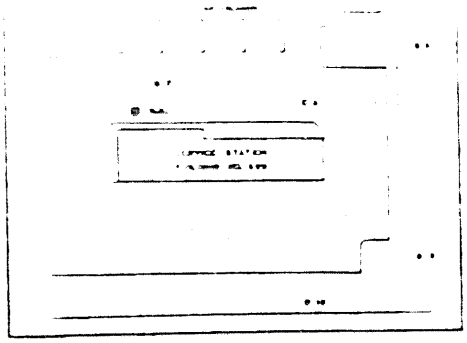
I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations

Driller's Signature Gregg Myers Date 5/3/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept

WELL ID NO. 699/9

Location Map



Project Fort Monmouth Owner E Systems, Inc

Location Fort Monmouth Eatontown Permit No. 2224633

Well Number 3 Total Depth 15' Diameter 12"

Casing Elevation Water Level: Initial 5.0' Static

Screen Diameter 4" Length 13' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch 40 PVC

Drilling Method Auger Sample Method Split Spoon

Completion Details Flush mount, with manhole cover, inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 5/1/90

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
1			0-2' SAND Brown-black Silt, medium (-) to fine SAND trace fine Gravel	No odor slightly moist
2				
3			2-4' SAND Brown fine SAND, trace Silt	
4		0	4-8' SAND Light Brown fine SAND, some Silt little Clay	Groundwater encountered @ 4'
5				
7			SAND Green-brown SAND, some clay	No odor or sheen
8				
9		0	9-10' CLAY Gray, some orange fine Sand	
10				
11			10-12' SAND Green-gray to orange coarse to fine SAND, some Clay	
12				
13			12-15' CLAY Light-brown, some fine Sand	
14		0		
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
24				
25				

WELL ID NO. 699/4

DWR-138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 - 23680
Atlas Sheet Coordinates 29 : 13 : 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DR.
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. 4
County Monmouth Municipality ~~OCEANPORT BORO~~ Lot No. ~~TAX~~ Block No. ~~TAX~~
Address Bldg 699, Saltzman Ave, Fort Monmouth NJ 07703

TYPE OF WELL (as per Well Permit Categories) ~~MONITORING~~ Date well completed 11/2/89
Regulatory Program Requiring Well — Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Groundwater & Environ Svcs, Inc Tele. # 201-531-4787

WELL CONSTRUCTION
Total depth drilled 20 ft.
Well finished to 20 ft.
Drill hole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	2	4	Sch40 PVC Solid
Outer Casing (Not Protective Casing)	—	—		
Screen (Note slot size)	2	20	4	Sch40 PVC .02
Tail Piece	—	—		
Gravel Pack	1.5	20		#2 Morie Gravel
Annular Seal/Grout	.5	1.5		Bentonite Pellets
Method of Grouting	0 - .5 slurry			

Static water level after drilling ____ ft.
Water level was measured using interface probe
Well was developed for 1 hours at 2-3 gpm
Method of development purged with pump
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity NA gpm
Pump type: ~~Centrifugal Pump~~ NA
Drilling Method Auger
Drilling Fluid none Type of Rig TH-10
Name of Driller Greg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J1472
Name of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Theresa Delfino for Greg Myers Date 2/15/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

DWR 138 M
6/89

New Jersey Department of Environmental Protection
Division of Water Resources

MONITORING WELL RECORD

Well Permit No. 29 - 24640
Atlas Sheet Coordinates 29 : 13 : 665

OWNER IDENTIFICATION - Owner US ARMY
Address 167 RIVERSIDE DRIVE
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No.
County Municipality OCEANPORT BORO Lot No. NA Block No. NA
Address

TYPE OF WELL (as per Well Permit Categories) Date well completed 5/1/90
Regulatory Program Requiring Well MONITORING UST Case I.D. # -
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) G.E.S. Tony Kull Tele. # (201) 530-4787

WELL CONSTRUCTION

Total depth drilled 14 ft.
Well finished to 14 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ft.
Was steel protective casing installed? ☐ Yes ☒ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	1	4	PVC Sch40 FJT
Outer Casing (Not Protective Casing)				
Screen (Note slot size)	1	14	4	PVC Sch40 FJT.02
Tail Piece				
Gravel Pack	1	14		#2 Morie
Annular Seal/Grout	.5'	1		BENTONITE
Method of Grouting	0	.5		Portland + Sacrete (Manhole) Slurry.

Static water level after drilling 3 ft.
Water level was measured using METER
Well was developed for hours at gpm
Method of development
Was permanent pumping equipment installed? ☐ Yes ☐ No
Pump capacity gpm
Pump type:
Drilling Method AUGER
Drilling Fluid NONE Type of Rig TH-10
Name of Driller Gregg Myers
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. J 1472
Name of Drilling Company B.L. MYERS BROS., INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.) NA.

0 - 14' Brown to Green Sand
14' Black Clay.

WELL SEALED 10/14/92

DRILLER USED THIS FORM.

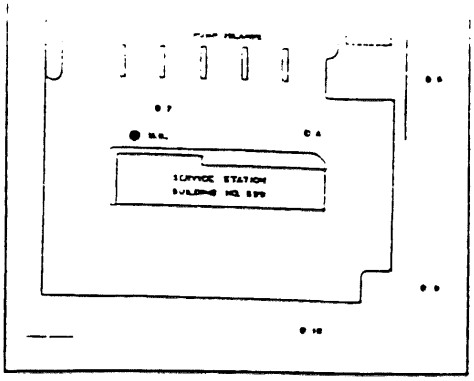
I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Gregg Myers Date 5/3/90

COPIES: White & Green - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

WELL ID NO. 699/10

Sketch Map



Project Fort Monmouth Owner E-Systems, Inc.

Location Fort Monmouth Eatontown Permit No 2924640

Well Number 10 Total Depth 15' Diameter 10"

Casing Elevation Water Level: Initial 5.0' Static

Screen Diameter 4" Length 13' Slot Size .020"

Casing Diameter 4" Length 2' Type Sch .40 PVC

Drilling Method Auger Sample Method: Split Spoon

Completion Details Flush mount, with manhole cover, Inner locking cap

Driller B.L. Myers Log By J. Gallagher Date Drilled 5/1/90

Depth (Ft)	Well Constr	HNu ppm	Lithological Description	Comments
1			0-2' SAND Brown, fine SAND little Gravel	No odor or sheen
2			2-3' SILT Black SILT & fine Sand, trace Gravel	
3			3-4' SILT Brown, fine Sand, some SILT trace Clay	Groundwater encountered @4'
4				
5		0	4-7' SAND Light green coarse to fine SAND little Clay	
8		0	7-12' CLAY Orange CLAY & fine Sand	Saturated, no odor
9				
10			12-15' CLAY Light green CLAY, some fine Sand	
11				
12			Black CLAY, little Sand	No odor
13		0		
14				
15			END HOLE @ 15'	
16				
17				
18				
19				
20				
21				
22				
25				

DWR 138 M
12/91

New Jersey Department of Environmental Protection and Energy
Bureau of Water Allocation

MONITORING WELL RECORD

Well Permit No. 29 289077
Atlas Sheet Coordinates 29 — 14 — 444

OWNER IDENTIFICATION - Owner U.S. ARMY FORT MONMOUTH
Address BLDG. 167 D & H ENVIRONMENTAL
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. MW-
County Municipality OCEANPORT BORO Lot No. N/A Block No. N/A
Address

TYPE OF WELL (as per Well Permit Category) MONITORING Date well completed 10.14.92
Regulatory Program Requiring Well UST Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) E-Systems Tele. #

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 10 in.
Bottom 10 in.
Well was finished: ☐ above grade ☒ flush mounted
If finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☒ Yes ☐ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	5	4	PVC
Outer Casing (Not Protective Casing)				
Screen (Note slot size)	5	15	4	PVC .020
Tail Piece				
Gravel Pack	3	5		Pack #2
Annular Seal/Grout	1	2		Pellets
Method of Grouting				

Static water level after drilling 7.1 ft.
Water level was measured using Electric tape
Well was developed for 1 hours at 2 gpm
Method of development S. Bailer
Was permanent pumping equipment installed? ☐ Yes ☒ No
Pump capacity N/A gpm
Pump type: N/A
Drilling Method HSA
Drilling Fluid None Type of Rig Auger
Name of Driller Karl D. Hitchburger
Health and Safety Plan submitted? ☐ Yes ☒ No
Level of Protection used on site (circle one) None D C B A
N.J. License No. J-530
Name of Drilling Company ~~TAMARCO DRILLING CORP.~~

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

0'
Tight sands & silts Tan to Brown
ALMOST clay like as deeper
GREEN To Black in color
15'

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations

Driller's Signature K.D. Hitch Date 10/16/92

COPIES: White & Green - DEPE Canary - Driller Pink - Owner Goldenrod - Health Dept.

SERIAL # 46232

38

DWR-133M (10/93)

Mail to
DEPE
eau Water Allocation
26
on, NJ 08625

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
TRENTON, NJ

Permit No. 29 33753

MONITORING WELL PERMIT

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

COORD # : 29 . 14 . 442

Owner US Army - Fort Monmouth
Address Bldg 167 DEH Envir
Ft Monmouth NJ

Name of Facility Bldg 699
Address
Same as Above

Driller Shore Drilling
Address 23 Branch Ave
Oceanport NJ

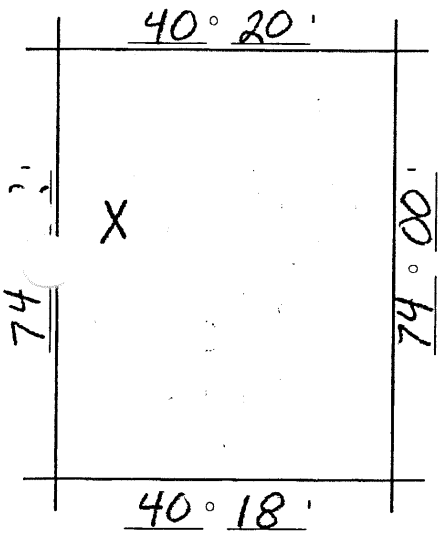
Diameter of Well(s)	4 Inches	Proposed Depth of Well(s)	20 Feet
# of Wells Applied for (max. 10)	1	Will pumping equipment be installed? YES ☐ NO ☒	
Type of Well (see reverse)	Monitor	If Yes, give pump capacity	N/A GPM

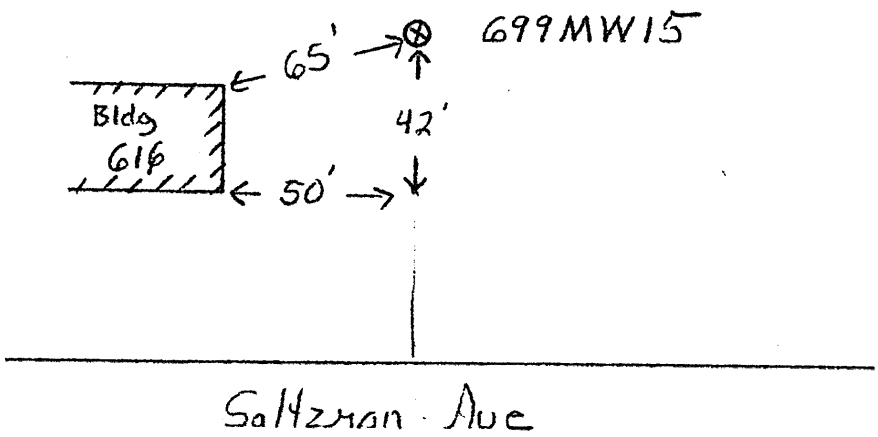
LOCATION OF WELL(S)

Lot #	Block #	Municipality	County
N/A	N/A	Ft Monmouth	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)

RECEIVED JUL 27 1995 MONMOUTH COUNTY REGIONAL HEALTH COMMISSION

89-10-19-1329
CASE I.D. Number
~~C91-2844~~ C4
~~13-4-12-1-139-29~~

This Space for Approval Stamp

WELL PERMIT APPROVED
N J D E P
JUL 19 1995
BUREAU OF WATER ALLOCATION

FOR D.E.P.E. 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 7/10/95 Signature of Driller [signature] License # 1275

Signature of Owner [signature] SELFM-PW-EV

COPIES: Water Allocation White and Pink

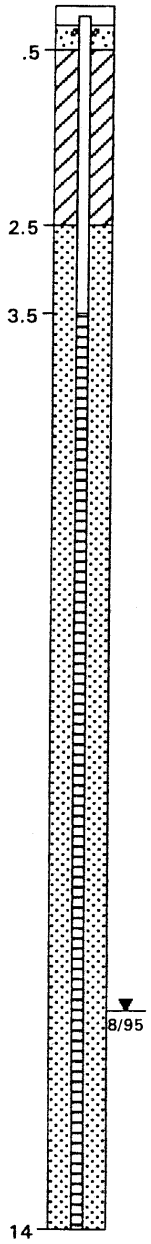
U.S. ARMY
FORT MONMOUTH
SELFM PW EV

LOG OF BORING 699-MW15

Produced for Chuck Appleby

Project Name	: BLDG. 699	Completion Date	: 8/17/95
NJDEP Case #	: 89-10-19-1329	Northing	: N 539685.549
Logged By	: Shore Drilling	Easting	: E 2172905.342
Start Date	: 8/17/95	Driller	: R. Barnes

29-33753
ELEV: 17.04



Depth in Feet	DESCRIPTION	USCS	Samples	Blows/Ft
0	Topsoil and roots, dry			
	Fill, brown-green clayey, dry		1	9
2	Black-green clayey moist, mottled		2	13
4		SM	3	10
6			4	13
8	Green-black clay and silt		5	18
10		CL	6	15
12				
14				
16				

Well Construction Information

Well Construction

Date Completed	: 8/17/95
Hole Diameter	: 8 in
Drill Method	: HSA
Company Rep	: R. Barnes

Well Casing

Material	: PVC
Diameter	: 4 in
Joints	: Threaded

Well Screen

Material	: PVC
Diameter	: 4 in
Joints	: Threaded
Opening	: 20 Slot
Sand Pack	: # 2 Morie Sand
Annulus Seal	: Bentonite/Portland : Tremmie

Well Screen

Material	: PVC
Diameter	: 4 in

NOTES

Well #1 is 699 MW15

2-28-1996 C:\699\GEO\699 mw15.ge3

DWR-138 M
11/94

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER ALLOCATION

MONITORING WELL RECORD

Well Permit No. _____ - _____
Atlas Sheet Coordinates _____ : _____ : _____

OWNER IDENTIFICATION - Owner _____
Address _____
City _____ State _____ Zip Code _____

WELL LOCATION - If not the same as owner please give address. Owner's Well No. _____
County _____ Municipality _____ Lot No. _____ Block No. _____
Address _____

TYPE OF WELL (as per Well Permit Categories) _____ Date well completed ____/____/____
Regulatory Program Requiring Well _____ Case I.D. # _____

CONSULTING FIRM/FIELD SUPERVISOR (if applicable) _____ Tele. # _____

WELL CONSTRUCTION

Total depth drilled _____ ft.

Well finished to _____ ft.

Borehole diameter:
Top _____ in.
Bottom _____ in.

Well was finished: ☐ above grade
☐ flush mounted

If finished above grade, casing height (stick up) above land surface _____ ft.

Was steel protective casing installed?
☐ Yes ☐ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.) [From land surface]	Diameter (inches)	Type and Material
Inner Casing				
Outer Casing (Not Protective Casing)				
Screen (Note slot size)				
Tail Piece				
Gravel Pack				
Annular Seal/Grout				
Method of Grouting				

Static water level after drilling _____ ft.
Water level was measured using _____
Well was developed for _____ hours at _____ gpm
Method of development _____
Was permanent pumping equipment installed? ☐ Yes ☐ No
Pump capacity _____ gpm
Pump type: _____
Drilling Method _____
Drilling Fluid _____ Type of Rig _____
Name of Driller _____
Health and Safety Plan submitted? ☐ Yes ☐ No
Level of Protection used on site (circle one) None D C B A
N.J. License No. _____
Name of Drilling Company _____

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

ertify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature _____ Date _____

COPIES: White - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

THIS FORM MUST BE COMPLETED BY THE PERMITTEE AND/OR SURVEYOR

MONITORING WELL CERTIFICATION-FORM B-LOCATION CERTIFICATION

Name of Permittee:
Name of Facility: FORT MONMOUTH
Location:
NJPDES Number: NJ00 or ECRA Case Number:

LAND SURVEYOR'S CERTIFICATION

Well Permit Number: 29-33753
This number must be permanently affixed to the well casing.

Longitude (to nearest second): West 74°-02'-48"

Latitude (to nearest second): North 40°-18'-48"

Elevation of Top of Inner Casing (cap off) (one-hundredth of a foot): 17.04

Source of elevation datum (benchmark, nail, etc.) and year. (If an alternate datum has been approved by the Department, identify here, assume datum of 100', and give approximated actual elevation.) Source: GEODETIC FM-1(

[x] 1927 [ ] 1983

Elev.:

Owners Well Number (As shown on application or plans): 699 MW-15

Elevations are to be determined by double run, three wire leveling methods using balanced sights, commencing from a well marked and described point. This beginning point shall either be derived from Federal or State benchmarks if not more than 1000 feet from the site or from an alternate datum approved by the Department. Tolerances should meet third order standards, which are 0.05 ft x $(\text{mile})^{1/2}$. For sections less than 0.1 mile, let miles = 0.1.

AUTHENTICATION

I certify 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.

Thomas Pianetti
PROFESSIONAL LAND SURVEYOR'S SIGNATURE

THOMAS PIANETTI
PROFESSIONAL LAND SURVEYOR'S NAME
(Please print or type)

SEAL

GE 38975
PROFESSIONAL LAND SURVEYOR'S LICENSE #

Groundwater & Environ. ntal Services, Inc.

Project: FORT MONMOUTH
Owner: DPW
Location: Bldg 615/617
Permit No: 2933753
Well number: 679MW15
Total Depth: 14.0 Diameter: 4"
Casing Elevation:
Water Level: Init: 11.1 Static:
Screen Dia.: 4" Length: 10.0' Slot Size: 20
Casing Dia.: 4" Length: ≈ 3.5 Type: PVC
Drilling Method: H.S.A. Sample Method: SPLIT-SPOON
Completion Details: FLUSH MOUNT
Driller: SHORE Log By: R. BARNES Date:

Boring Log

Sketch Map

Blows Per Ft	Depth (feet)	Sample No.	Well Const.	PID (ppm)	Blow Count	Rec. (Ft)	Lithology	Unified Symbol
9	1			0	4, 4	1.6	TOPSOIL [illegible]	Topsoil [illegible]
	2				5, 4		[illegible]	ML-SM
3	3			0	4, 7	1.2	[illegible]	
	4				8, 6		[illegible]	
10	5	1		0	3, 5	1.1	[illegible]	
	6				5, 3		[illegible]	
8	7			0	3, 6	1.2	[illegible]	
	8				7, 6			
18	9			0	[illegible]	1.1		
	10				[illegible]			
15	11			0	6, 6	1.9	[illegible]	[illegible]-ML
	12				9, 9			
	13				Auger		[illegible]	
	14							CL
	15						[illegible]	
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

(42)

Fort Monmouth

0645 Arrive at GES Mob Equip

0700 Leave for site

0730 Arrive on-site and sign in

0800 Set up on well 699 MW16 &

START Driving Spoons Collect Sample at 0815 (6-8)

0830 Finish Driving Spoons, START (6-8)

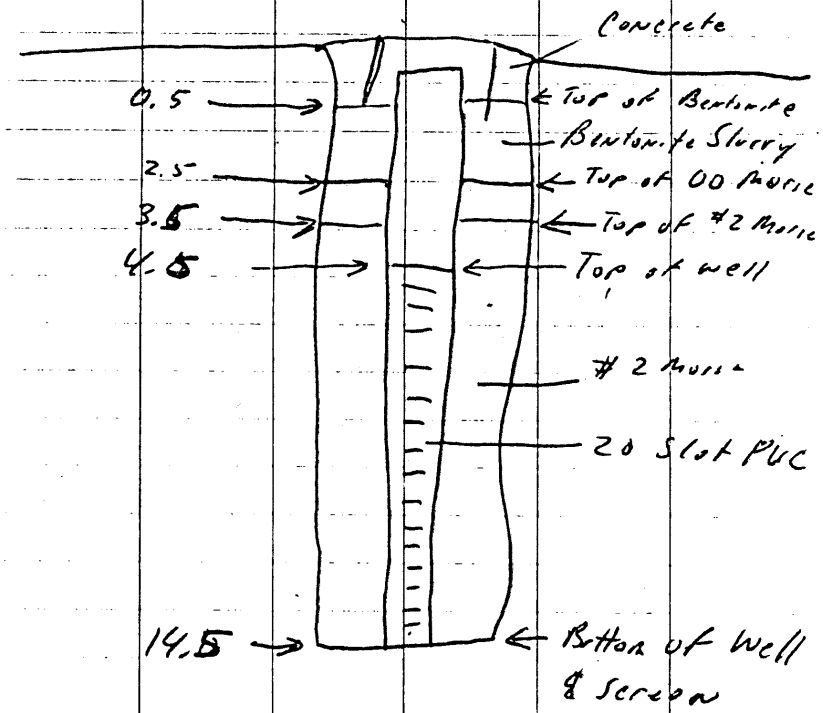
INSTALLING Well to 14.0 ft

Below Grade

Well 699 MW16 & ~~MW~~

And 699 MW15 Flush mounts

Both the same construction



SERIAL # 46235

38

DWR-133M (10/93)

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
TRENTON, NJ

Mail to

DEPE
eau Water Allocation
26
nton, NJ 08625

Permit No. 293375

MONITORING WELL PERMIT

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

COORD #: 29.14.442

Owner US Army - Ft Monmouth
Address Bldg 167 DEH Envir
Ft Monmouth NJ

Driller Shore Drilling
Address 23 Branch Ave
Oceanport NJ

Name of Facility Bldg 699
Address
Same as Above

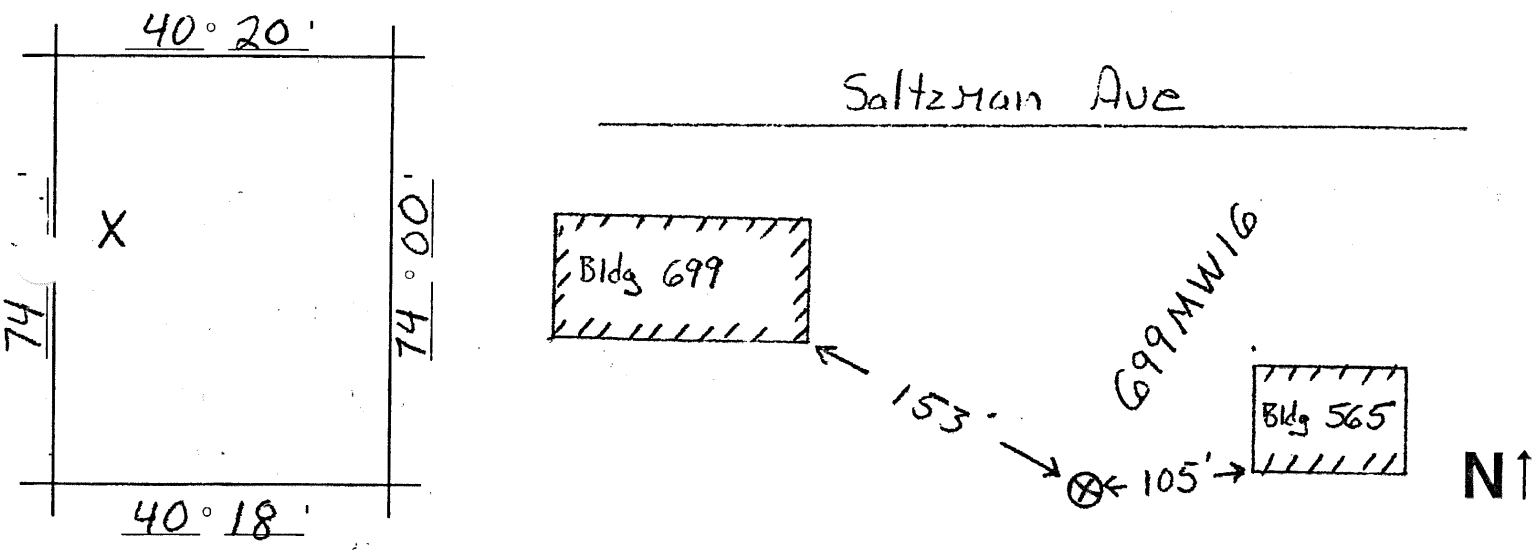
Diameter of Well(s)	4 Inches	Proposed Depth of Well(s)	20 Feet
# of Wells Applied for (max. 10)	7	Will pumping equipment be installed? YES ☐ NO ☒	
Type of Well (see reverse)	Monitor	If Yes, give pump capacity	NA GPM

LOCATION OF WELL(S)

Lot #	Block #	Municipality	County
N/A	N/A	Ft Monmouth	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)

RECEIVED
JUL 27 1995
MONMOUTH COUNTY
REGIONAL HEALTH COMMISSION #1

CASE I.D. Number 89-10-19-1329

This Space for Approval Stamp

WELL PERMIT APPROVED
NJDEP
19 1995
BUREAU OF WATER ALLOCATION

FOR D.E.P.E. 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 7/10/95 Signature of Driller [signature] License # 1275

Signature of Owner [signature] SELFM-PW-EV

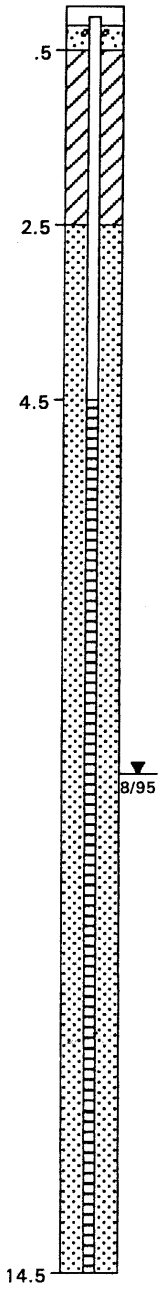
U.S. ARMY
FORT MONMOUTH
SELFM PW EV

LOG OF BORING 699-MW16

Produced for Chuck Appleby

Project Name	: BLDG. 699	Completion Date	: 8/17/95
NJDEP Case #	: 89-10-19-1329	Northing	: N 539080.021
Logged By	: Shore Drilling	Easting	: E 2173141.399
Start Date	: 8/17/95	Driller	: R. Barnes

29-33757
ELEV: 15.27



Depth in Feet	DESCRIPTION	USCS	Samples	Blows/Ft
0	Topsoil and roots, dry			
	Fill, brown-green clayey, dry		1	13
2	Black-green clayey moist, mottled		2	14
4		CL	3	9
6			4	5
8	Green-black clay and silt		5	9
10		CL	6	12
12	Black clay	CL		
14				
16				

Well Construction Information

Well Construction

Date Completed	: 8/17/95
Hole Diameter	: 8 in
Drill Method	: HSA
Company Rep	: R. Barnes

Well Casing

Material	: PVC
Diameter	: 4 in
Joints	: Threaded

Well Screen

Material	: PVC
Diameter	: 4 in
Joints	: Threaded
Opening	: 20 Slot
Sand Pack	: # 2 Morie Sand
Annulus Seal	: Bentonite/Portland : Tremmie

Well Screen

Material	: PVC
Diameter	: 4 in

NOTES

Well #1 is 699 MW16

2-28-1996 C:\699\GEO\699 mw16.ge3

DWR-138 M
11/94

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER ALLOCATION

MONITORING WELL RECORD

Well Permit No. _____ - _____
Atlas Sheet Coordinates _____ : _____ : _____

OWNER IDENTIFICATION - Owner _____
Address _____
City _____ State _____ Zip Code _____

WELL LOCATION - If not the same as owner please give address. Owner's Well No. _____
County _____ Municipality _____ Lot No. _____ Block No. _____
Address _____

TYPE OF WELL (as per Well Permit Categories) _____ Date well completed ____/____/____
Regulatory Program Requiring Well _____ Case I.D. # _____

CONSULTING FIRM/FIELD SUPERVISOR (if applicable) _____ Tele. # _____

WELL CONSTRUCTION

Total depth drilled _____ ft.

Well finished to _____ ft.

Borehole diameter:
Top _____ in.
Bottom _____ in.

Well was finished: ☐ above grade
☐ flush mounted

If finished above grade, casing height (stick up) above land surface _____ ft.

Was steel protective casing installed?
☐ Yes ☐ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.) [From land surface]	Diameter (inches)	Type and Material
Inner Casing				
Outer Casing (Not Protective Casing)				
Screen (Note slot size)				
Tail Piece				
Gravel Pack				
Annular Seal/Grout				
Method of Grouting				

Static water level after drilling _____ ft.
Water level was measured using _____
Well was developed for _____ hours at _____ gpm
Method of development _____
Was permanent pumping equipment installed? ☐ Yes ☐ No
Pump capacity _____ gpm
Pump type: _____
Drilling Method _____
Drilling Fluid _____ Type of Rig _____
Name of Driller _____
Health and Safety Plan submitted? ☐ Yes ☐ No
Level of Protection used on site (circle one) None D C B A
N.J. License No. _____
Name of Drilling Company _____

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature _____ Date _____

COPIES: White - DEP Canary - Driller Pink - Owner Goldenrod - Health Dept.

THIS FORM MUST BE COMPLETED BY THE PERMITTEE AND/OR SURVEYOR

MONITORING WELL CERTIFICATION-FORM B-LOCATION CERTIFICATION

Name of Permittee:
Name of Facility: FORT MONMOUTH
Location:
NJPDES Number: NJ00 or ECRA Case Number:

LAND SURVEYOR'S CERTIFICATION

Well Permit Number: 29-33757-
This number must be permanently affixed to the well casing.

Longitude (to nearest second): West 74°-02'-45"

Latitude (to nearest second): North 40°-18'-42"

Elevation of Top of Inner Casing (cap off) (one-hundredth of a foot): 15.27

Source of elevation datum (benchmark, nail, etc.) and year. (If an alternate datum has been approved by the Department, identify here, assume datum of 100', and give approximated actual elevation.) Source: GEODETIC FM-105

[x] 1927 [ ] 1983

Elev.:

Owners Well Number (As shown on application or plans): 699 MW-16

Elevations are to be determined by double run, three wire leveling methods using balanced sights, commencing from a well marked and described point. This beginning point shall either be derived from Federal or State benchmarks if not more than 1000 feet from the site or from an alternate datum approved by the Department. Tolerances should meet third order standards, which are 0.05 ft x $(\text{mile})^{1/2}$. For sections less than 0.1 mile, let miles = 0.1.

AUTHENTICATION

I certify 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.

Thomas Pianetti
PROFESSIONAL LAND SURVEYOR'S SIGNATURE

THOMAS PIANETTI
PROFESSIONAL LAND SURVEYOR'S NAME
(Please print or type)

SEAL

GE 38975
PROFESSIONAL LAND SURVEYOR'S LICENSE #

Groundwater & Environm. .ntal Services, Inc.

Project: Fort Monmouth Owner: DPW

Location: Bldg 699/565 Permit No: 2933757

Well number: 699 MW 16 Total Depth: 40 Diameter: 4"

Casing Elevation: _____ Water Level: Init: 6.3 Static: _____

Screen Dia.: 4" Length: 10' Slot Size: 20

Casing Dia.: 4" Length: [illegible] Type: PVC

Drilling Method: H.S.A. Sample Method: SPLIT-SPOON

Completion Details: FLUSH MOUNT

Driller: SHORE Log By: R. BARNES Date: 8-17-95

Boring Log

Sketch Map

Blows Per Ft	Depth (feet)	Sample No.	Well Const.	PID (ppm)	Blow Count	Rec. (Ft)	Lithology	Unified Symbol
							Top Soil & Fill	Top Soil & Fill
13	1			0	5, 7	1.7	[illegible]	[illegible] SM
	2				6, 6			
14	3			0	7 5	1.2	[illegible]	
	4				9 8			
9	5			0	5 4	1.4	[illegible] SILT [illegible]	
	6				5 4			
5	7	X		0	2 3	1.5	[illegible]	ML/SC –
	8				2 3			
9	9			0	3 4	1.7		CL
	10				5.2			
12	11			0	4.5	1.8		
	12				4.7			
	13				Refusal			
	14							
	15						[illegible]	
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

(42) 6-17-93 Thurs

Fort Monmouth

0645 Arrive at GES Mob Equip

0700 Leave for site

0730 Arrive on-site and sign in

0800 Set up on Well 699 MW16 &

START Driving Spoons Collect Sample at 0815 (6-8)

0830 Finish Driving Spoons, START (6-8)

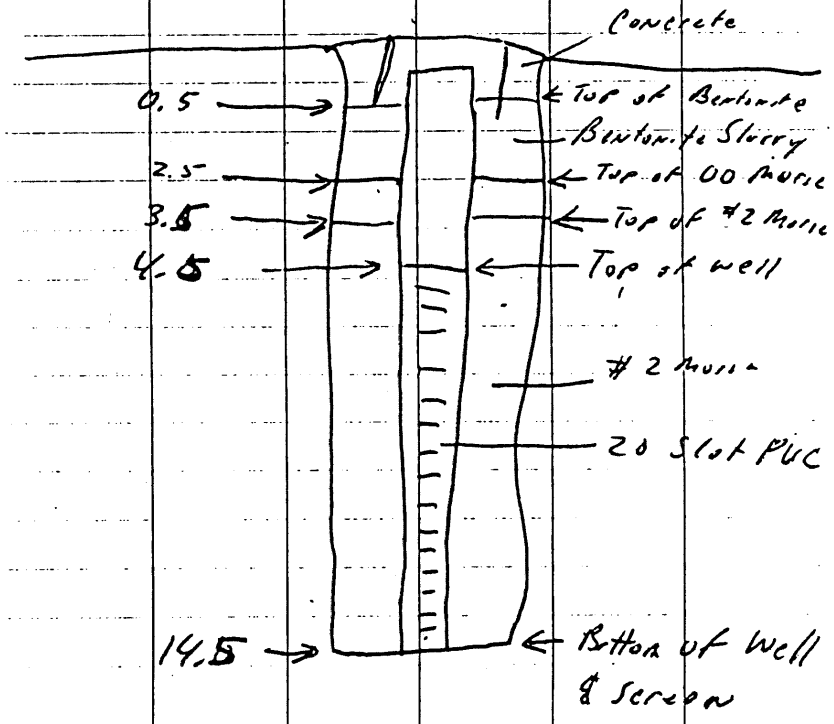
INSTALLING Well to 14.0 ft

Below Grade

Well 699 MW16 & ~~MW~~

And 699 MW15 Flush mounts

Both the same construction



RW-11

DWR-138 M
12/91

New Jersey Department of Environmental Protection and Energy
Bureau of Water Allocation

MONITORING WELL RECORD

Well Permit No. 29 - 28031
Atlas Sheet Coordinates 29 : 14 : 444

OWNER IDENTIFICATION - Owner U S ARMY
Address EVANS AREA BLDG. 690
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No R-1 (BLDG 699)
County Municipality OCEANPORT BORO Lot No. N/A Block No N/A
Address

TYPE OF WELL (as per Well Permit Categories) Date well completed 5/20/92
Regulatory Program Requiring Well recovery Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) US Army / CHUCK APPLEBY Tele. #

WELL CONSTRUCTION

Total depth drilled 20 ft.
Well finished to 20 ft.
Borehole diameter:
Top 16 in.
Bottom 16 in.
Well was finished: ☐ above grade ☑ flush mounted
If finished above grade, casing height (stick up) above land surface ft.
Was steel protective casing installed? ☑ Yes ☐ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.)	Diameter (inches)	Type and Material
Inner Casing	0	5	10	PVC SCH. 40
Outer Casing (Not Protective Casing)				
Screen (Note slot size)	5	20	10	PVC. SCH 40 20 SLOT
Tail Piece				
Gravel Pack	4	20	16	ROCKBOS #2
Annular Seal/Grout	0	4	16	BENT/CEMENT-BENT
Method of Grouting	TREMIE			

Static water level after drilling 6 ft.
Water level was measured using LINE PROBE
Well was developed for — hours at — gpm
Method of development N/A
Was permanent pumping equipment installed? ☐ Yes ☑ No
Pump capacity N/A gpm
Pump type:
Drilling Method HSA
Drilling Fluid Type of Rig DEDERICH D-120
Name of Driller WILLIAM SHAHAN
Health and Safety Plan submitted? ☑ Yes ☐ No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. 1289
Name of Drilling Company TABASCO DRILLING CORP.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

0
BRN F-C SAND, LITTLE F. GRAVEL, TR SILT.
4
BLK. F. SAND, SOME SILT.
20 BLK CLAYEY SILT (MARL)

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Date 5-20-92

COPIES: White & Green - DEPE Canary - Driller Pink - Owner Goldenrod - Health Dept.

DWR-103M (7/92) SERIAL # 37092

Mail to
Water Allocation
CN 029
Trenton, N.J. 08625

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
TRENTON, NJ

Permit No. 2930968

MONITORING WELL PERMIT

38

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

COORD #: 29.13656

Owner US ARMY FORT MONMOUTH
Address FORT MONMOUTH, NJ 07703

Driller TYREE ORGANIZATION, LTD
Address 1550 RT 130 S
BURLINGTON, NJ

Name of Facility GENERAL SITE (MAIN POST)
Address BUILDING T-600
FORT MONMOUTH, NJ 07703

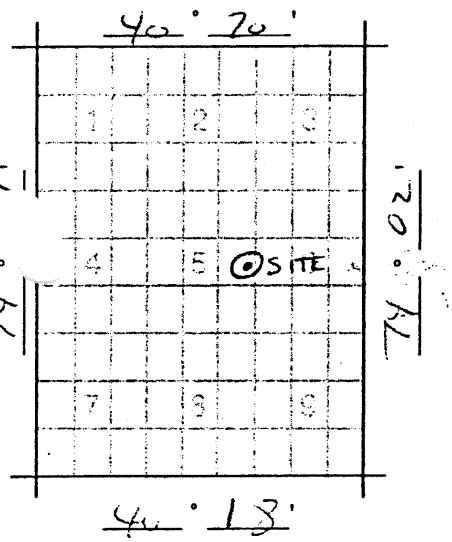
Diameter of Well(s)	4 Inches	Proposed Depth of Well(s)	15 Feet
# of Wells Applied for (max. 10)	1	Will pumping equipment be installed? YES ☐ NO ☒	
Type of Well (see reverse)	MONITOR/OBSERVE	If Yes, give pump capacity	GPM

LOCATION OF WELL(S)

Lot #	Block #	Municipality	County
		FORT MONMOUTH	MONMOUTH

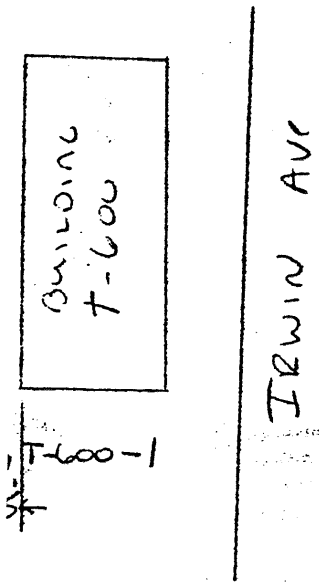
State Atlas Map No. 29

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.



This well will be grouted in the near future. Well casing is broken @ the screen.

To be Abandoned.



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

- ☐ Spill Fund Case
- ☐ ECRA Case
- ☐ CERCLA (Superfund) Site
- ☐ RCRA Site
- ☒ Underground Storage Tank
- ☐ NJPDES Municipal Discharge Permit
- ☐ NJPDES Industrial Discharge Permit
- ☐ Water and Hazardous Waste Enforcement Case
- ☐ Water Supply Aquifer Test Observation Well
- ☐ Other (explain) _____

Case I.D. Number
93-11-9-0923-00

This Space for Approval Stamp

WELL PERMIT APPROVED
Dept. of Environmental Protection
Water Resources/Water Allocation
APR 5 1994

FOR D.E.P.E. 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 March 25, 1994
Signature of Driller _____ License # 1421
Signature of Owner _____ SELFM-PW-EV

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

DWR-138 M
12/91

New Jersey Department of Environmental Protection and Energy
Bureau of Water Allocation

MONITORING WELL RECORD

Well Permit No. [illegible] - [illegible]
Atlas Sheet Coordinates [illegible] : [illegible] : [illegible]

OWNER IDENTIFICATION - Owner U.S. ARMY FORT MONMOUTH
Address
City FORT MONMOUTH State NJ Zip Code

WELL LOCATION - If not the same as owner please give address. Owner's Well No. Bldg. 600 MW-1
County MONMOUTH Municipality OCEANPORT BORO Lot No. N/A Block No. N/A
Address

TYPE OF WELL (as per Well Permit Categories) MONITORING Date well completed 7/8/94
Regulatory Program Requiring Well UST Case I.D. # 93 119 [illegible]
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Tele. #

WELL CONSTRUCTION

Total depth drilled 15 ft.
Well finished to 15 ft.
Borehole diameter:
Top 8 in.
Bottom 8 in.
Well was finished: ☐ above grade ☑ flush mounted
Finished above grade, casing height (stick up) above land surface ____ ft.
Was steel protective casing installed? ☐ Yes ☑ No

	Depth to Top (ft.) [From land surface]	Depth to Bottom (ft.) [From land surface]	Diameter (inches)	Type and Material
Inner Casing	[illegible]	2'	4"	PVC
Outer Casing (Not Protective Casing)	15'			
Screen (Note slot size)	2'/1	15/15'	4"	20 SLOT PVC
Tail Piece				
Gravel Pack	1'	15'	—	#2
Annular Seal/Grout	6"	1'		Bentonite
Method of Grouting	Pour			

Static water level after drilling 4' ft.
Water level was measured using TAPE
Well was developed for 1 hours at 10 gpm
Method of development Pump
Was permanent pumping equipment installed? ☐ Yes ☑ No
Pump capacity ____ gpm
Pump type:
Drilling Method Auger
Drilling Fluid Type of Rig B-80
Name of Driller Michael E Beck
Health and Safety Plan submitted? ☑ Yes ☐ No
Level of Protection used on site (circle one) None D C B A
N.J. License No. 1421
Name of Drilling Company TYREE ENVIRONMENTAL, INC.

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

0-1' Concrete
1'-4' Brown Sand + Silt
4'-6' Green Clay-Silt
6-15' Brown Sand med To Fine

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable state rules and regulations.

Driller's Signature Michael E Beck Date 7-11-94

COPIES: White & Green - DEPE Canary - Driller Pink - Owner Goldenrod - Health Dept.

MONITORING WELL CERTIFICATION-FORM B-LOCATION CERTIFICATION

Name of Permittee: U.S. ARMY
Name of Facility: FORT MONMOUTH
Location: MONMOUTH COUNTY, NJ
Case ~~NJPDES~~ Number: 93-11-9-0923-00

LAND SURVEYOR'S CERTIFICATION

Well Permit Number: 29-30968-
This number must be permanently affixed to the well casing.

Longitude (to nearest second): West 74° 02' 42.88"

Latitude (to nearest second): North 40° 18' 48.90"

Elevation of Top of Inner Casing (cap off) (one-hundredth of a foot): 16.36

Elevation of ground level (1/100th ft.) 16.71

Source of elevation datum (benchmark, nail, etc.) and year. (If an alternate datum has been approved by the Department, identify here, assume datum of 100', and give approximated actual elevation.) Source: FM-106

☑ 1927 ☐ 1983

Elev.:

Owners Well Number (As shown on application or plans): BLDG 600 MW-1

Elevations are to be determined by double run, three wire leveling methods using balanced sights, commencing from a well marked and described point. This beginning point shall either be derived from Federal or State benchmarks if not more than 1000 feet from the site or from an alternate datum approved by the Department. Tolerances should meet third order standards, which are 0.05 ft x $(\text{mile})^{1/2}$. For sections less than 0.1 mile, let miles = 0.1.

AUTHENTICATION

I certify 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.

Wayne W Burgett
PROFESSIONAL LAND SURVEYOR'S SIGNATURE

WAYNE W BURGETT
PROFESSIONAL LAND SURVEYOR'S NAME
(Please print or type)

SEAL

31654
PROFESSIONAL LAND SURVEYOR'S LICENSE #

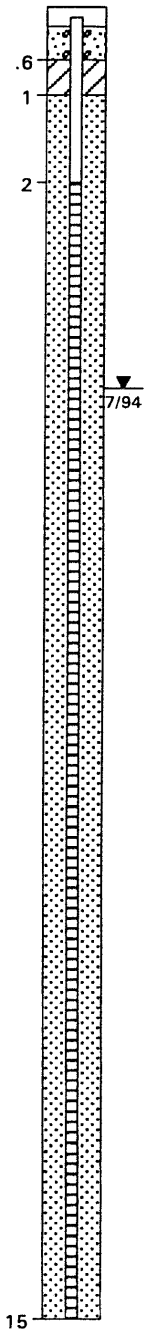
U.S. ARMY
FORT MONMOUTH
SELFM PW EV

LOG OF BORING 600-mw1

Produced for Charles Appleby

Project Name	: BLDG. 600	Completion Date	: 7/8/94
NJDEP Case #	: 93-11-9-0923-00	Northing	: N 539779.403
Logged By	: TYREE INC.	Easting	: E 2173301.334
Start Date	: 7/8/94	Driller	: M. Beck

29-30968
ELEV: 16.36



Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Samples	Blows/Ft
0	Concrete		14		
2	Brown sand and silt		SM		
4	Green clay-silt		CL		
6	Brown sand medium to fine		SW		
8					
10					
12					
14					
16					

Well Construction Information

Well Construction

Date Completed	: 7/15/94
Hole Diameter	: 8 in
Drill Method	: HSA
Company Rep	: M. Beck

Well Casing

Material	: PVC
Diameter	: 4 in
Joints	: Threaded

Well Screen

Material	: PVC
Diameter	: 4 in
Joints	: Threaded
Opening	: 20 Slot
Sand Pack	: # 2 Morie Sand
Annulus Seal	: Bentonite/Portland : Tremmie

Well Screen

Material	: PVC
Diameter	: 4 in

NOTES

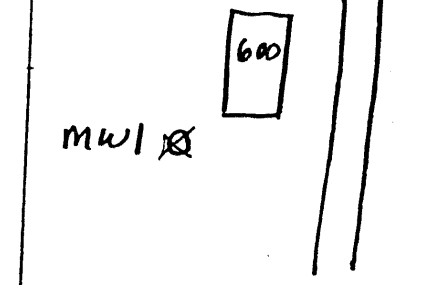
Well #1 is 600 MW1

2-28-1996 C:\600\GEO\600 mw1.ga3

FIELD LOG OF BORING

SHEET 1 OF 1

LOCATION OF BORING: Ft Monmouth Bldg 600



PROJECT: US Army Fort Monmouth	BORING NO: 1
	TOTAL DEPTH: 15
JOB NO: SELF PWEV	LOGGED BY: V Swanson
PROJ. MGR.: J Capritti	EDITED BY: C. Appleby
DRILLING CONTRACTOR: Tyree	
DRILL RIG TYPE: Mobil B 80	
DRILLERS NAME: Mike Beck	
SAMPLING METHODS: Split Spoon	
HAMMER WT.: 140	DROP: 30"
STARTED, TIME: 1100	DATE: 7/8/94
COMPLETED, TIME: 1400	DATE: 7/8/94
BORING DEPTH (ft): 15	
CASING DEPTH (ft): 2	
WATER DEPTH (ft): 5	
TIME: 1300	
DATE: 7/8/94	
BACKFILLED, TIME: 1300	DATE: 7/8/94 BY: Tyree MB
SURFACE ELEV:	DATUM:

SAMPLE DEPTH	SAMPLER TYPE	BLOWS / 6 IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min./ft.)	PID READING (ppm)	ODOR (Y / N ?)	GRAPHIC WELL CONST.	DEPTH IN FEET	GRAPHIC LOG	CONDITIONS
0-2	SS	12	6	24			0	N	Screen → Casing, Grout, Bentonite			Red Clay and Fine Sand.
		8	6							1	SC	
		11	6									
		19	6									
2-4	SS	25	6	24			0	N		2		Fine Brown Sand.
		12	6									
		11	6							3	SW	4' water level
		23	6				0	N				
4-6		6	6	18						4		Fine ~~Brown~~ Sand. (damp) sample at 6', took sample.
		2	6									
		4	6							5		to 8', then Fine Green
		7	6				0					Sand and Till and Some
6-8										6		clay
								Y		7	SC	Fine Green Sand and Till
												and some clay
8-10							0	Y		8		Same. - 8-10' slight smell
												took extra VO sample.
										9	SC	
12-15							0			10		Same
							0					Same. to 15'

APPENDIX II

TABLE 1
PUMP TEST RESULTS
OF 6/23/92 & 6/25/92
OUR FILE #5068-9201

WELL#	STATIC LEVEL (FT. BELOW GRADE).	MAX YIELD (GPM)	RECOVERY	RECHARGE FT./MIN.	DEPTH OF WELL(FT.)	DRAWDOWN (FT.)	SPECIFIC CAPACITY (GPM/FT.)
1	5.3	1.807	23 MIN.	0.18	14.4	7.4	0.24
2	4.35	.709	3HR. 48 MIN. TO 5.9*	DND	16.5	11.85	0.06
3	5.1	1.961	1 HR. 12 MIN. (5.2)*	0.14	14.4	9.3	0.21
4	4.7	.217	2 HR. 35 MIN. (5.3)*	0.09	6.6	1.5	0.14
5	4.3	1.11	52 MIN. (4.5)*	0.18	14.5	10.2	0.11
6	4.75	.792	1 HR. 54 MIN. (5.0)*	0.16	14.0	7.75	0.10
7	4.9	COULD NOT DEVELOP	----------	------	13.0	8.1	-------
8	5.2	2.273	46 MIN.	0.74	13.5	6.8	0.33
9	5.1	1.176	57 MIN. (5.3)*	0.08	13.75	7.4	0.16
10	5.0	COULD NOT DEVELOP	----------	------	14.25	19.25	-------

*WELL RECOVERED TO THE LEVEL INDICATED IN FEET BELOW GRADE

TABLE 2
MONITORING WELL COMMENTS

WELL DESIGNATION	DIAMETER (INCHES)	RECOMMENDATION/ POTENTIAL USE
MW A	3	CLOSURE
MW C	3	CLOSURE
MW 1	4	FUTURE WATER INJECTION
MW 2	4	CLOSURE
MW 3	4	FREE PRODUCT RECOVERY
MW 4	4	FREE PRODUCT RECOVERY
MW 5	4	OBSERVATION
MW 6	4	OBSERVATION
MW 7	4	CLOSURE
MW 8	4	OBSERVATION
MW 9	4	OBSERVATION
MW 10	4	CLOSURE
RW -1	4	FUTURE WATER INJECTION
RW -2	4	FUTURE WATER INJECTION

TABLE 3

AQUIFER CHARACTERICS

Well #	R (ft)	T (gpd/ft)	S
1	91	404	.062
2	160.5	330	.016
3	69.5	289	.068
4	59.5	N/A	N/A
5	146.1	440	.025
6	41	542	.218
8	183.1	528	.019
9	135.3	460	.023
10	163.5	455	.018
RW-2	70	314	.087
AVG.	**N/A**	**418**	**.060**

R - Distance to observation well from pumping well

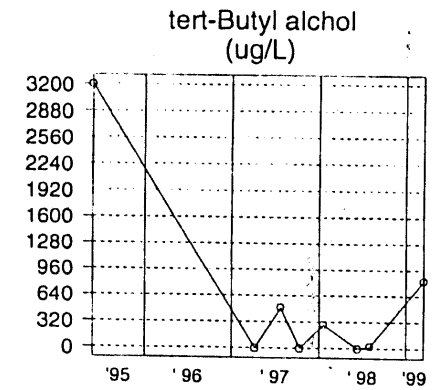
T - Transmissivity

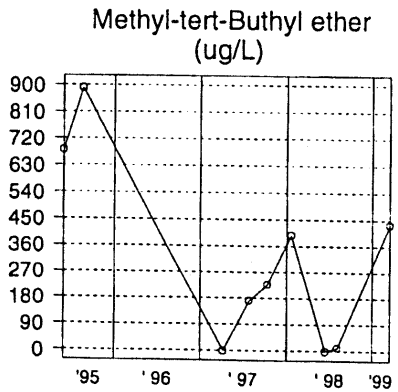
S - Coefficient of Storage

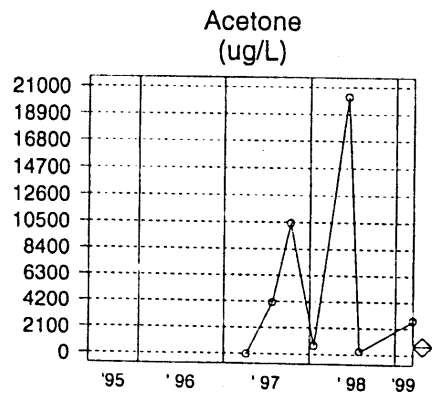
K - Hydraulic Conductivity = T ave/b = 32.15

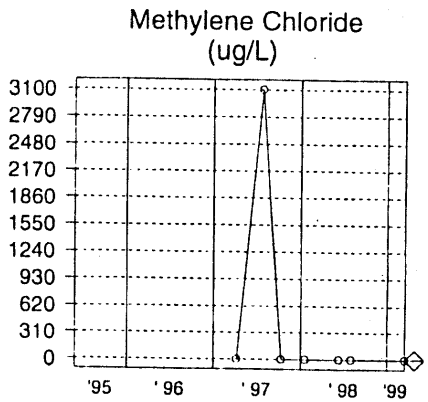
APPENDIX III

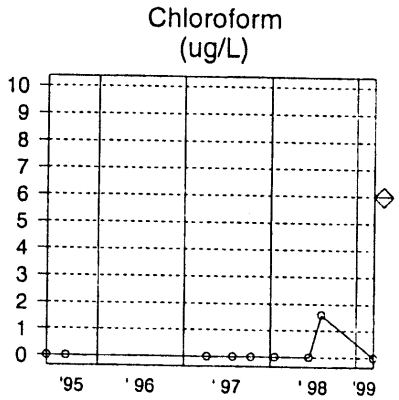
APPENDIX IV

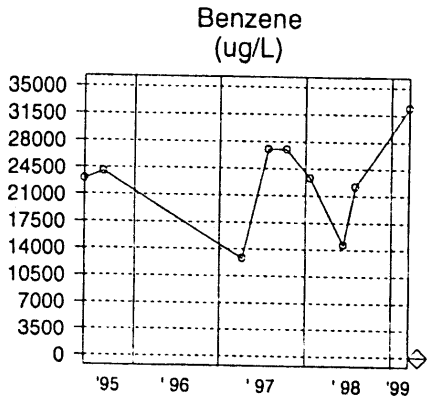


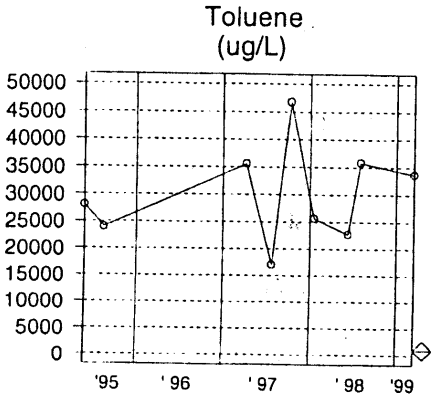


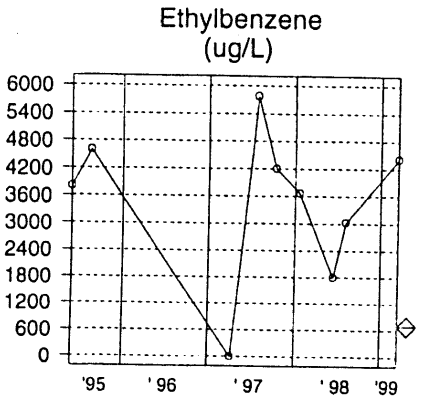


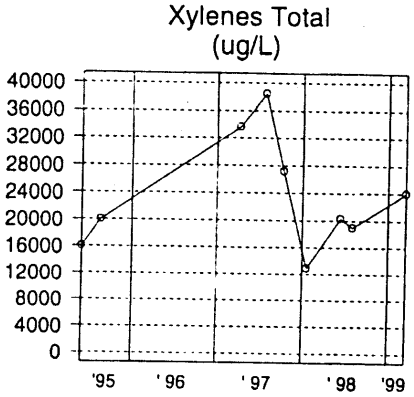












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Sampling Dates:
05/24/95 - 03/11/99

LEGEND:

PARAMETER

o = Date Sampled

NJDEP Criteria

FORT MONMOUTH

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Well 1 of 13, Graph

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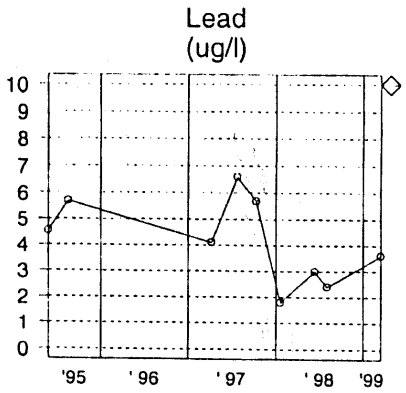

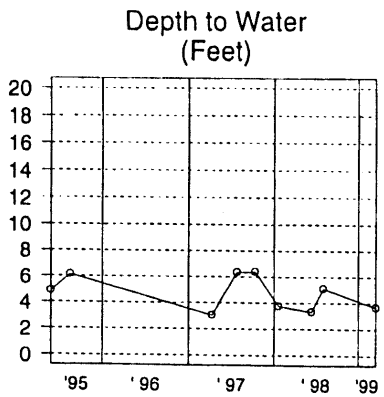

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Sampling Dates:
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LEGEND:

PARAMETER

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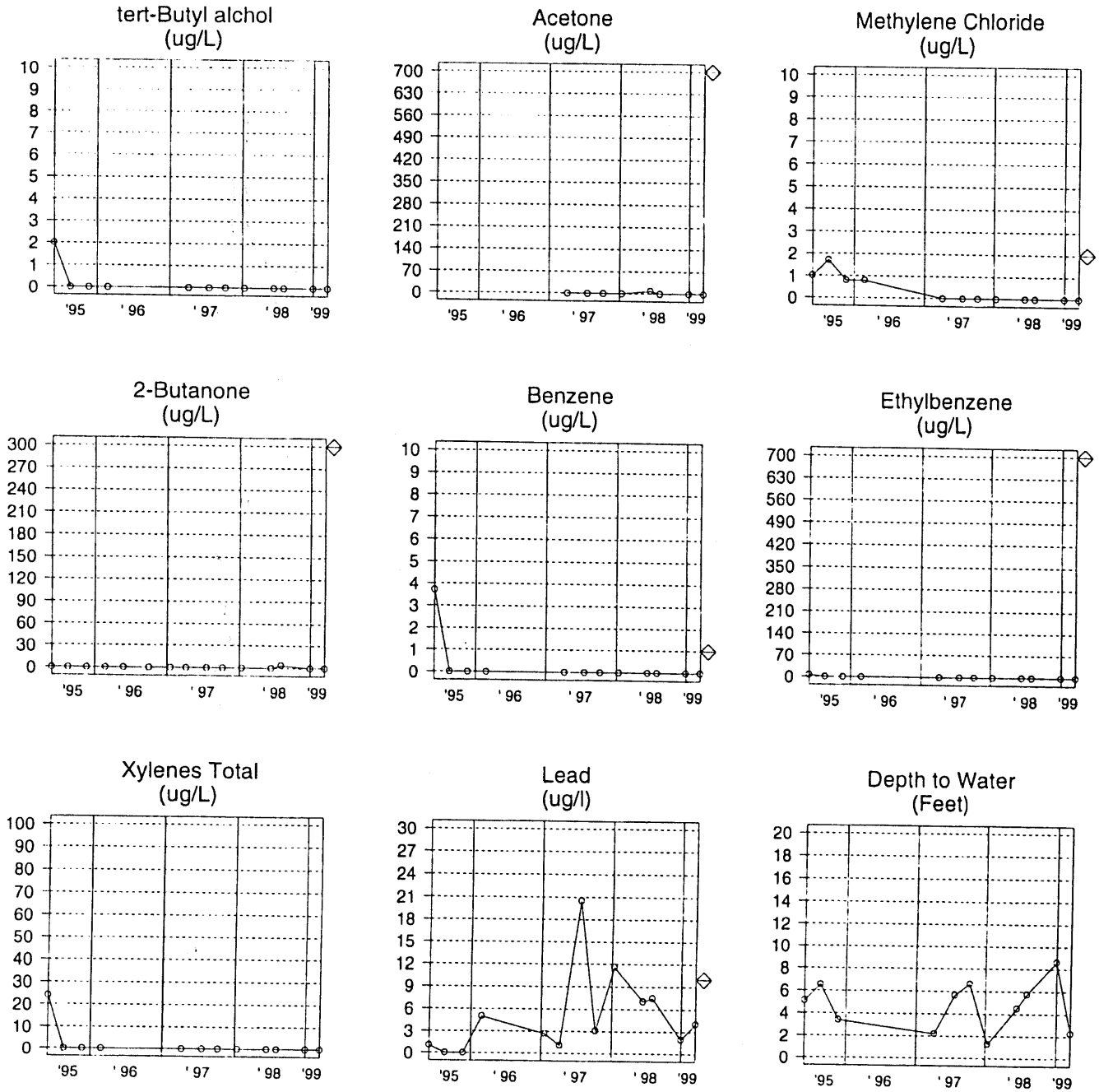

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LEGEND:

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o = Date Sampled

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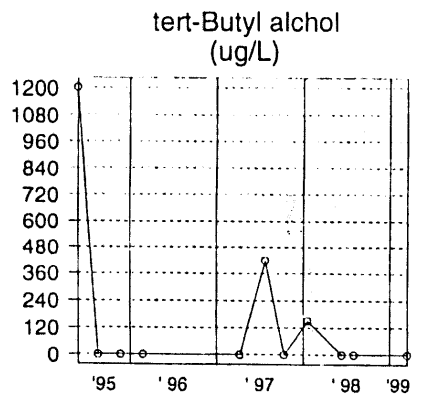

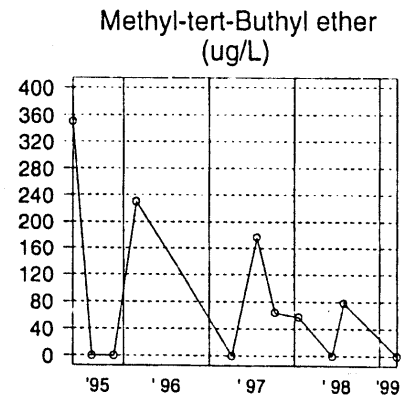

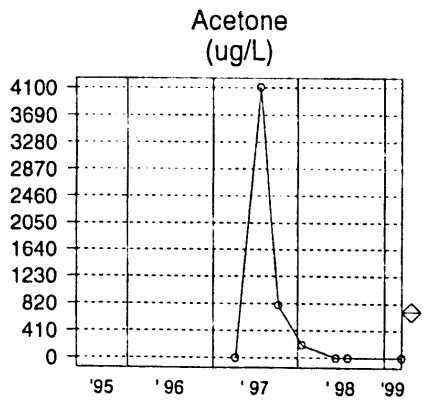

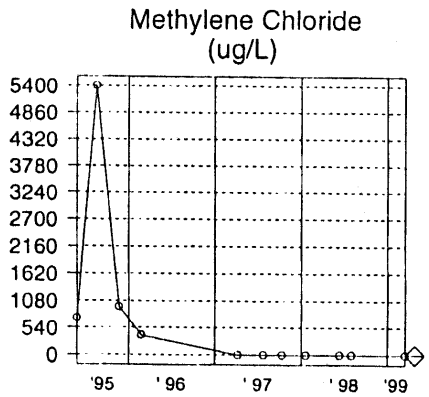

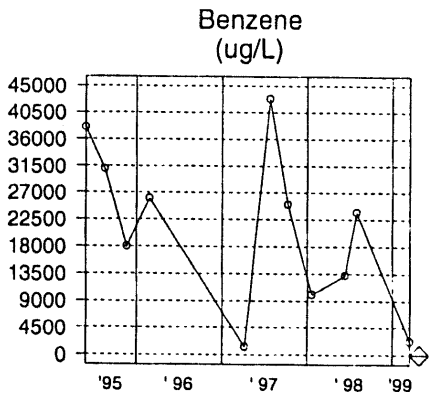

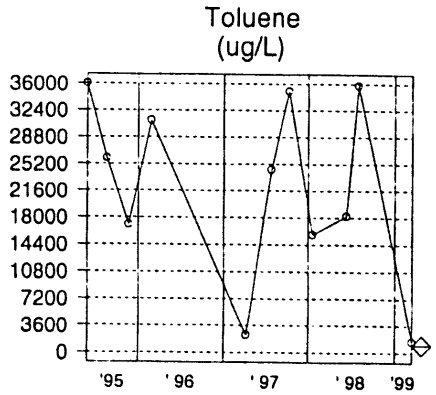

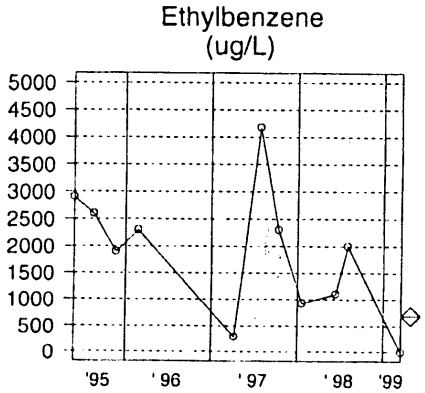

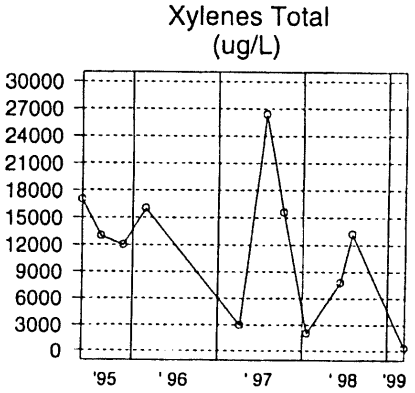

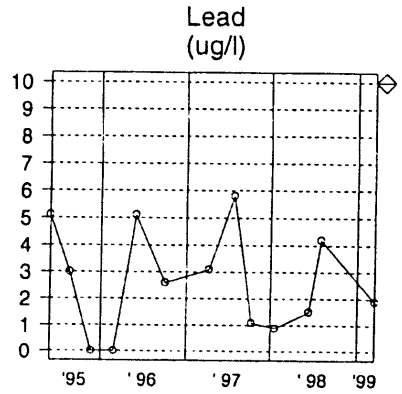

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o = Date Sampled

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Well 3 of 13, Graph

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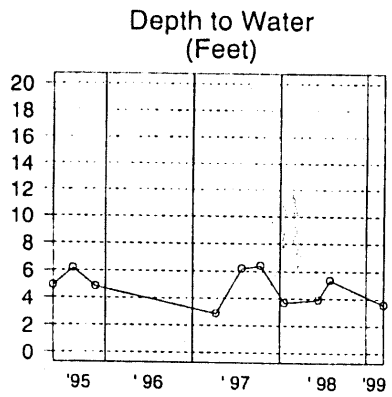

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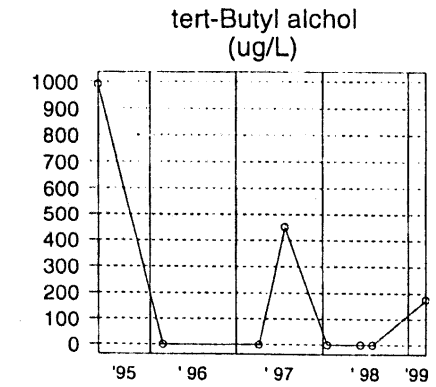

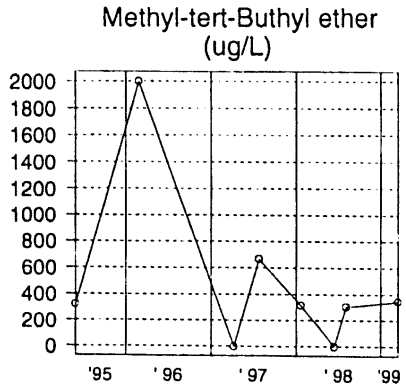

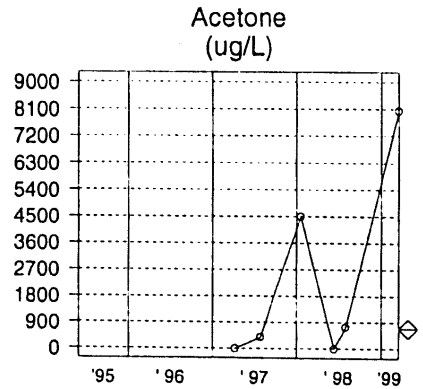

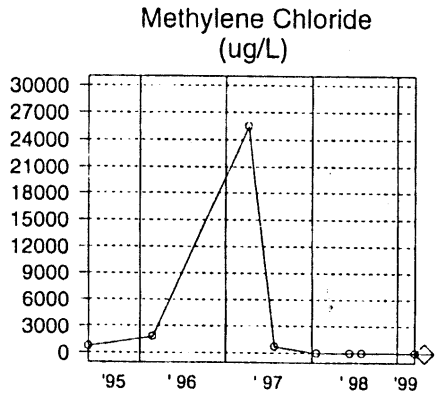

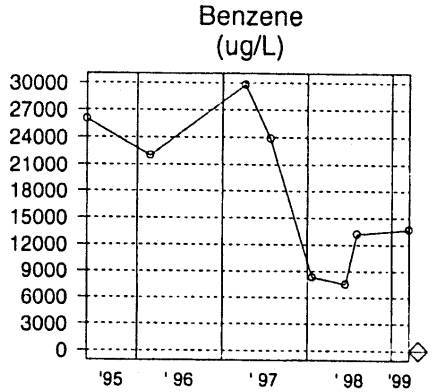

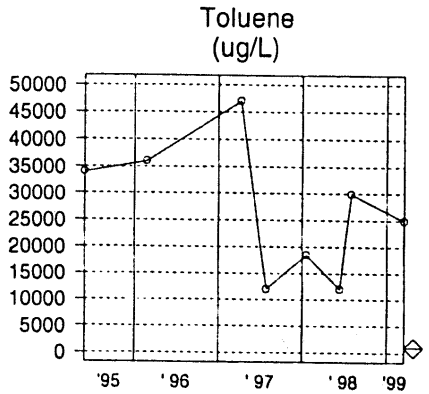

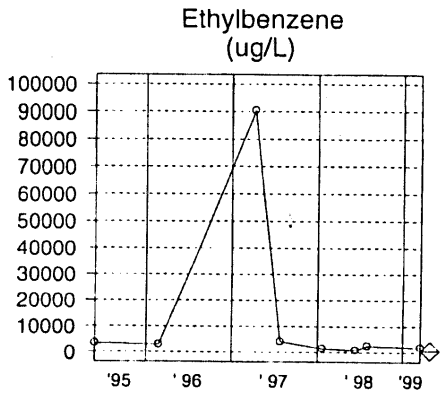

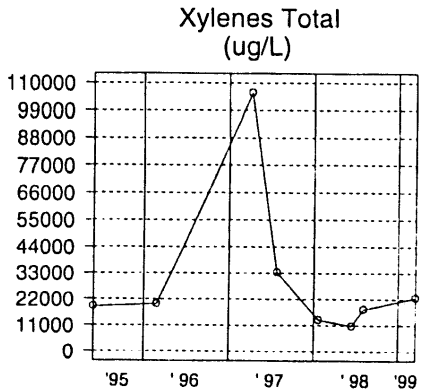

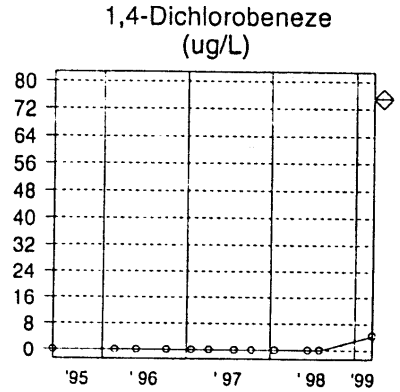

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Sampling Dates:
05/24/95 - 03/11/99

LEGEND:

PARAMETER

o = Date Sampled

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Well 4 of 13, Graph

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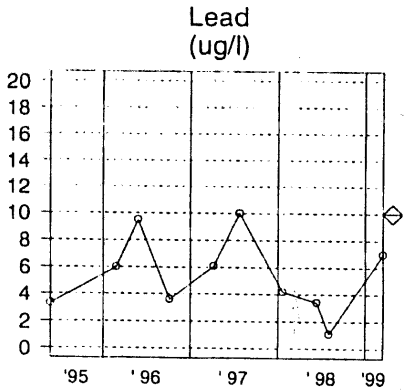

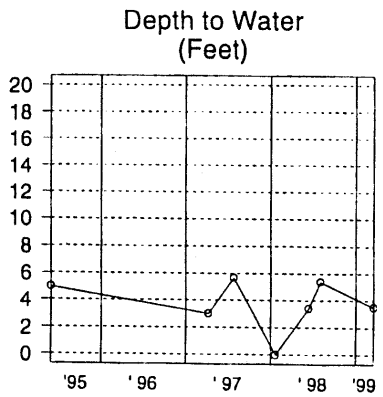

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Sampling Dates:
05/24/95 - 03/11/99

LEGEND:

PARAMETER

o = Date Sampled

NJDEP Criteria

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Well 4 of 13, Graph

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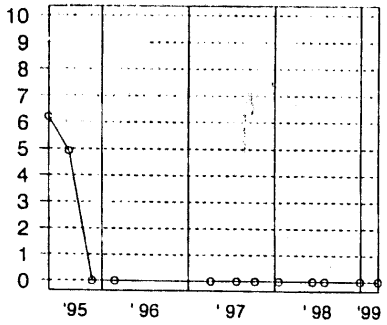
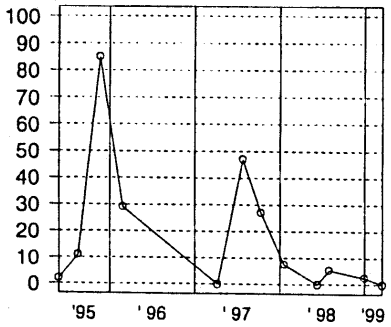
04-13-1999 c:\mtech46\fm\699a\gw\699a.wsf

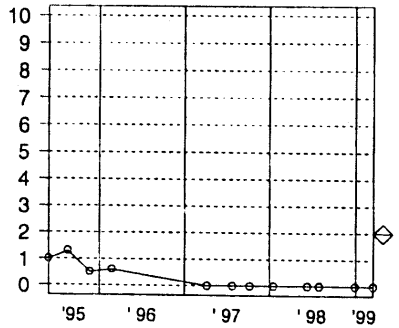
tert-Butyl alchol
(ug/L)



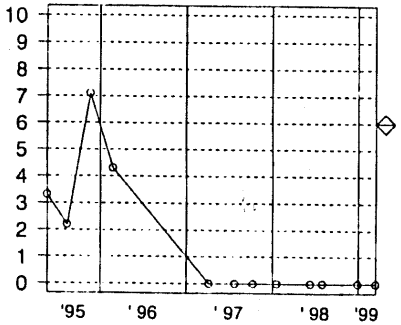
Methyl-tert-Buthyl ether
(ug/L)



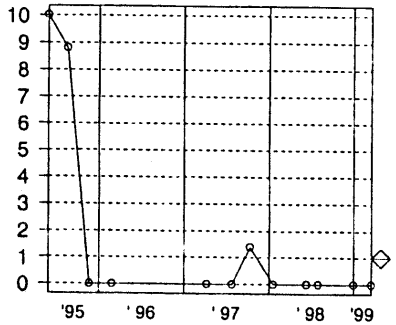
Methylene Chloride
(ug/L)



Chloroform
(ug/L)



Benzene
(ug/L)



Ethylbenzene
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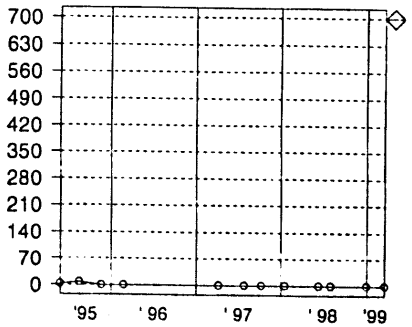
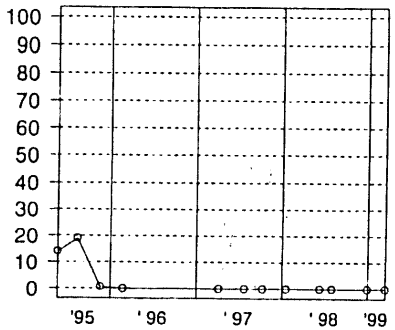
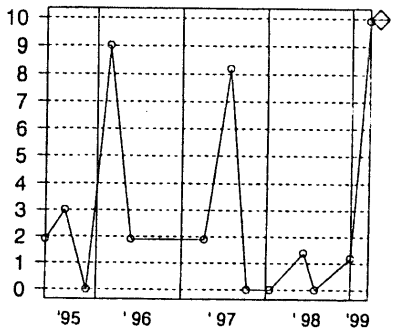


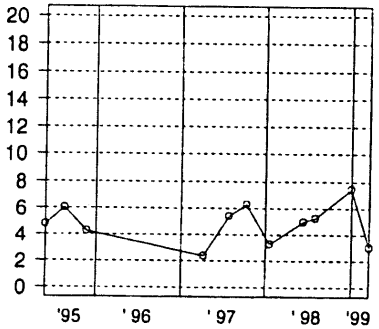
Xylenes Total
(ug/L)



Lead
(ug/l)



Depth to Water
(Feet)



SOURCE: 0699MW05

Sampling Dates:
05/24/95 - 03/11/99

LEGEND:

PARAMETER

o = Date Sampled

NJDEP Criteria

FORT MONMOUTH

GW MONITORING
Bldg. 699

Well 5 of 13, Graph

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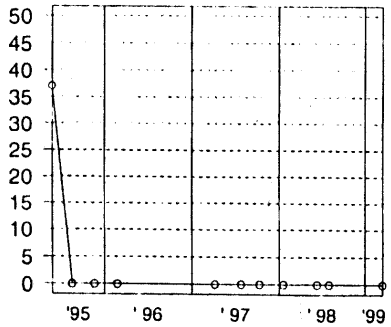
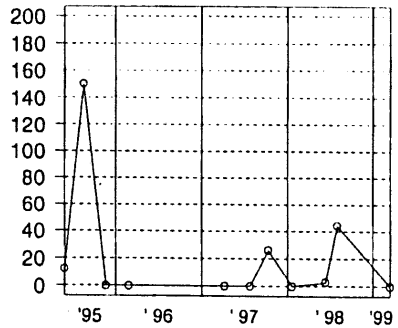
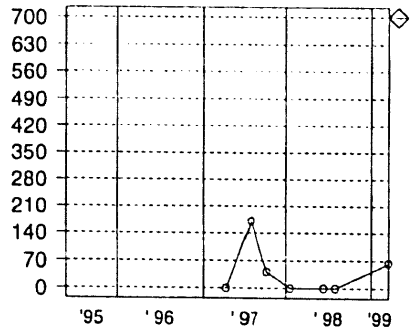
tert-Butyl alchol
(ug/L)



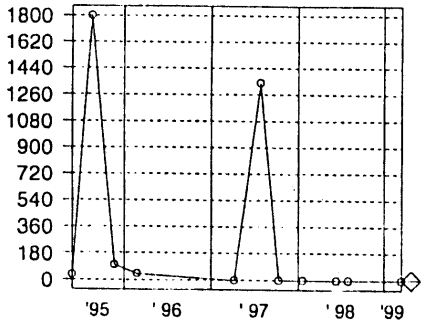
Methyl-tert-Buthyl ether
(ug/L)



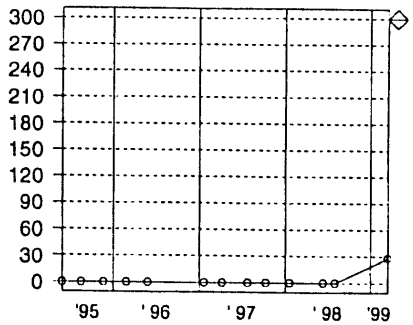
Acetone
(ug/L)



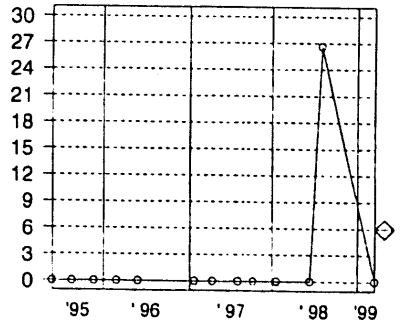
Methylene Chloride
(ug/L)



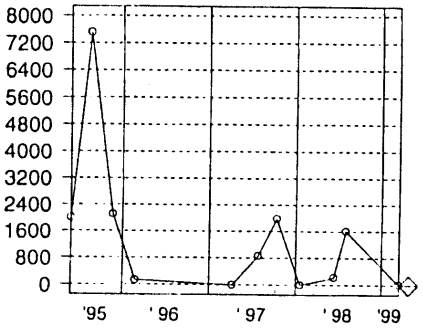
2-Butanone
(ug/L)



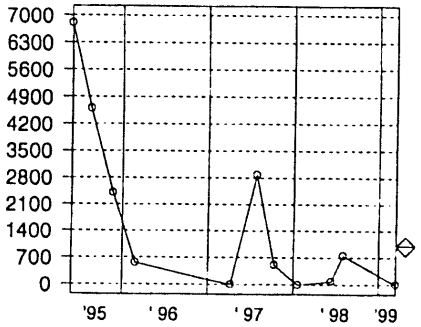
Chloroform
(ug/L)



Benzene
(ug/L)



Toluene
(ug/L)



Ethylbenzene
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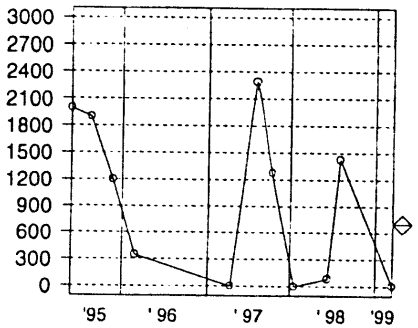

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05/24/95 - 03/10/99

LEGEND:

PARAMETER

o = Date Sampled

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Well 6 of 13, Graph

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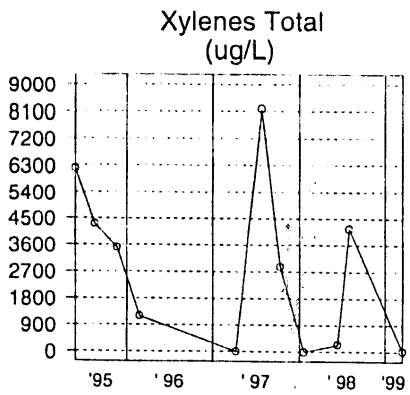

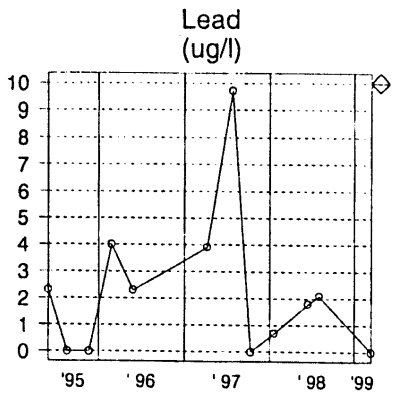

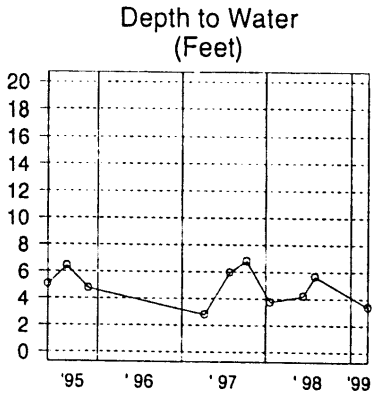

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Sampling Dates:
05/24/95 - 03/10/99

LEGEND:

PARAMETER

o = Date Sampled

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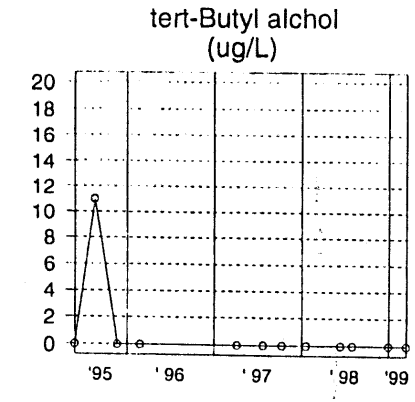

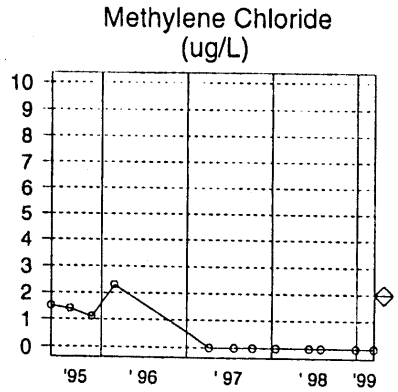

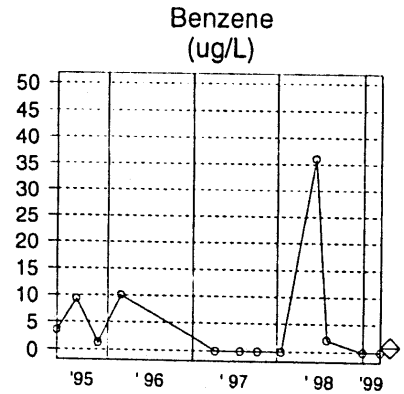

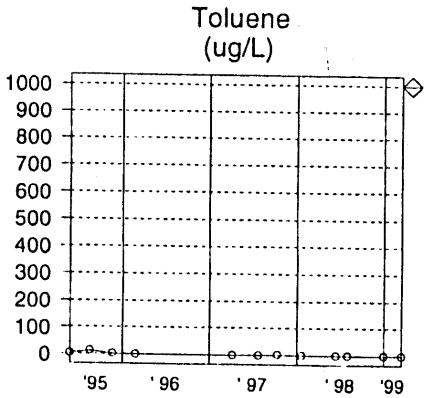

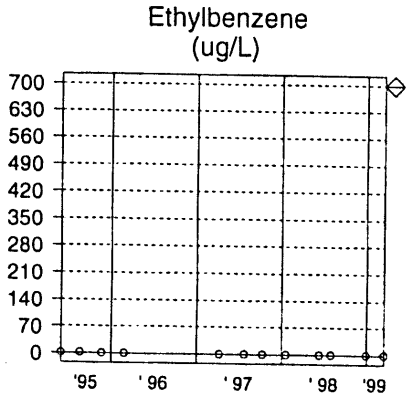

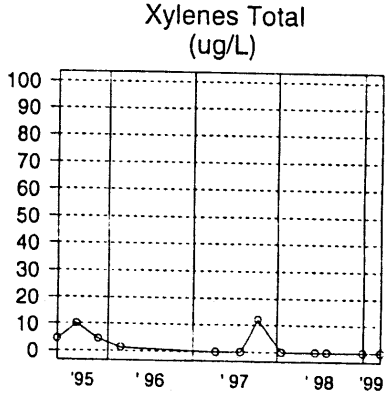

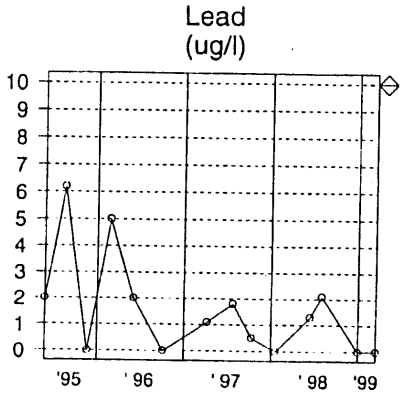

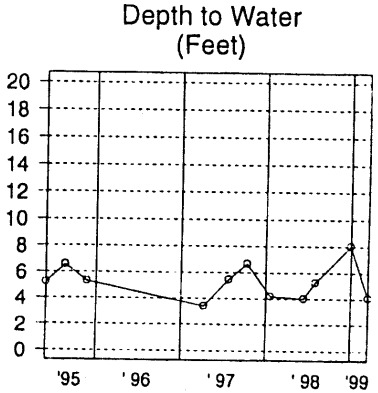

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Sampling Dates:
05/24/95 - 03/10/99

LEGEND:

PARAMETER

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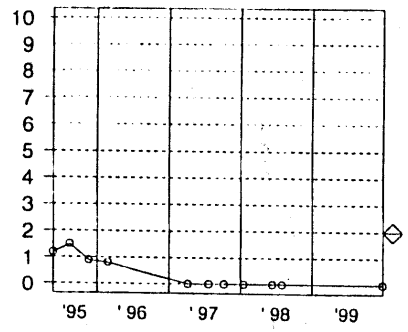
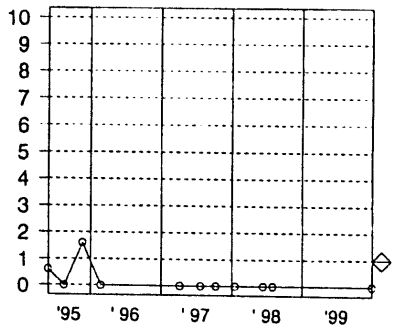
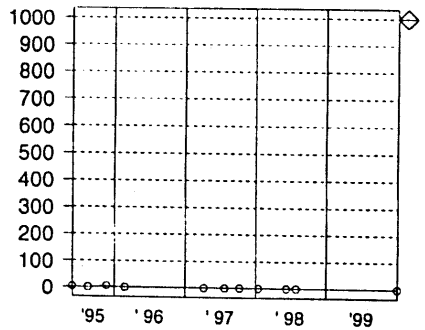
Methylene Chloride
(ug/L)



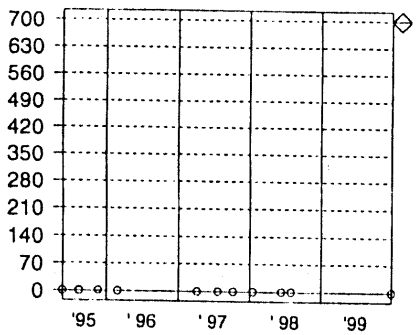
Benzene
(ug/L)



Toluene
(ug/L)



Ethylbenzene
(ug/L)



Xylenes Total
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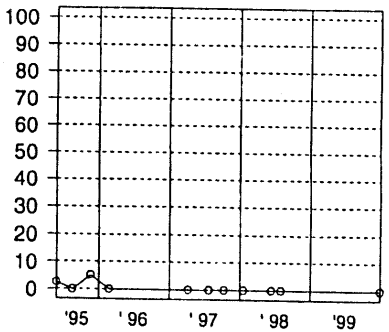
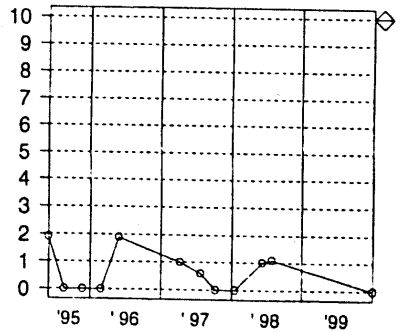
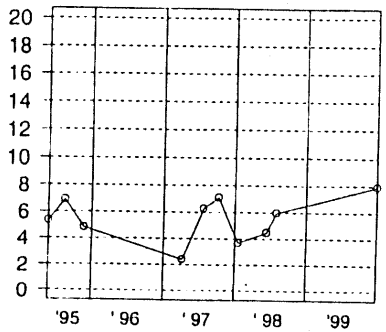


Lead
(ug/l)



Depth to Water
(Feet)



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LEGEND:

PARAMETER

o = Date Sampled

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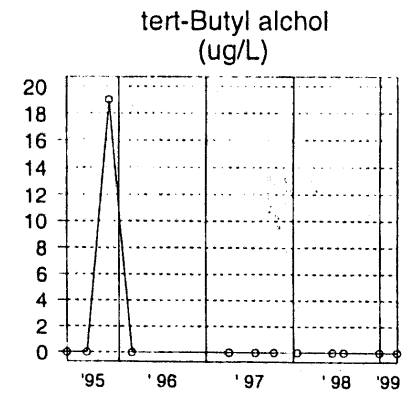

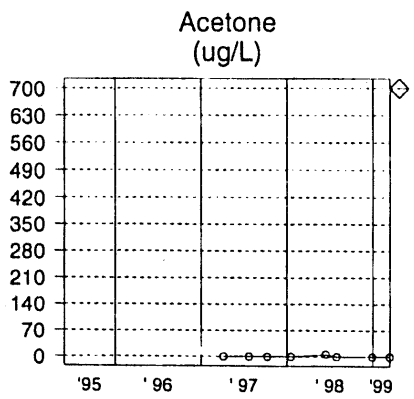

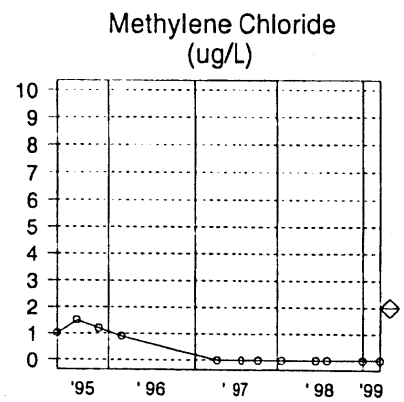

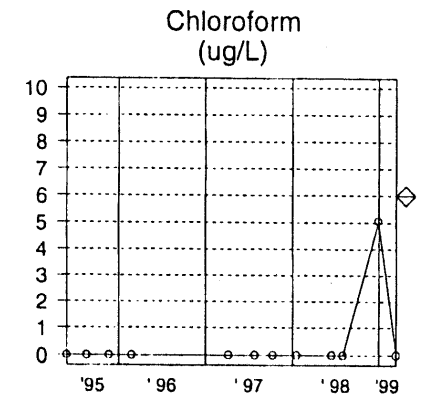

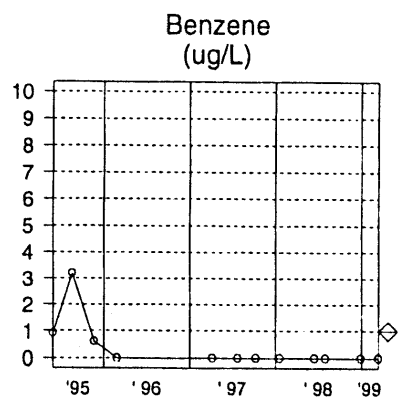

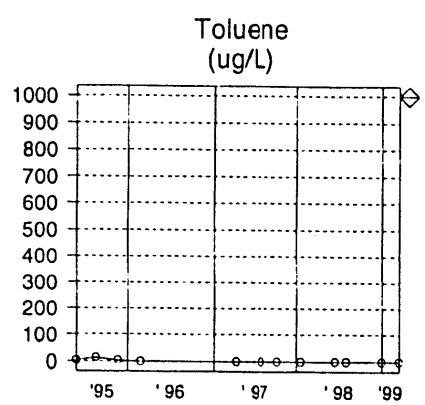

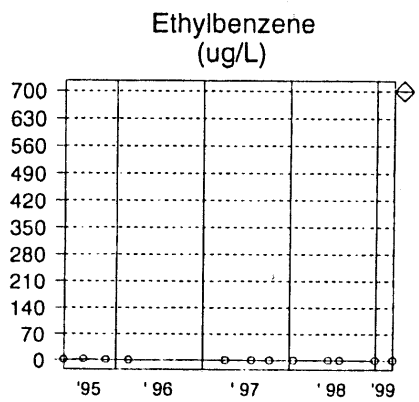

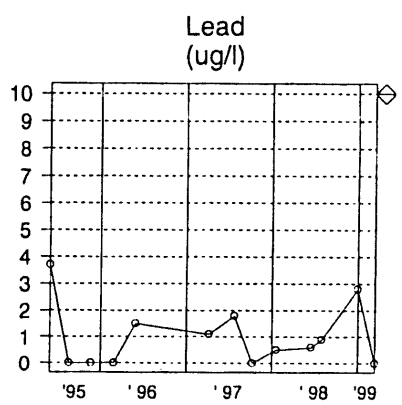

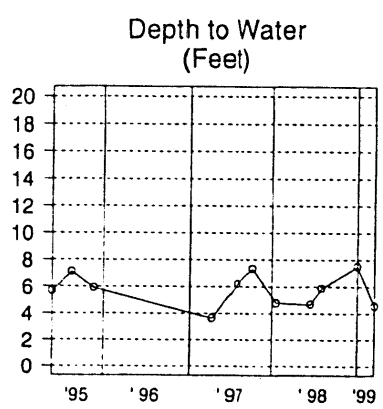

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Well 9 of 13, Graph

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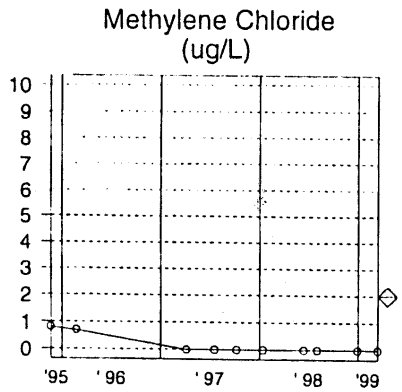

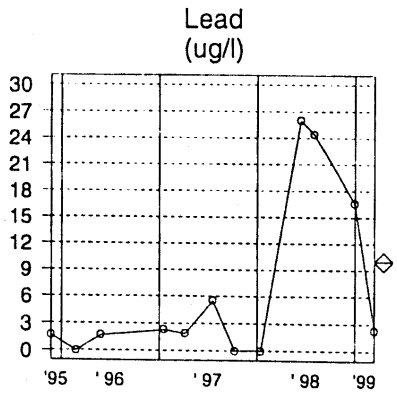

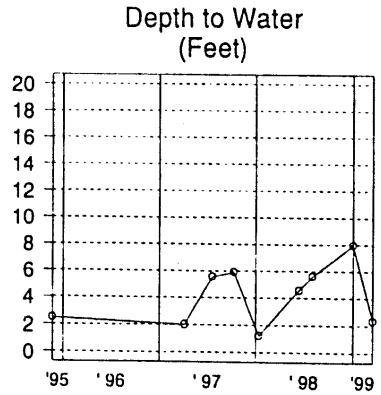

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NJDEP Criteria

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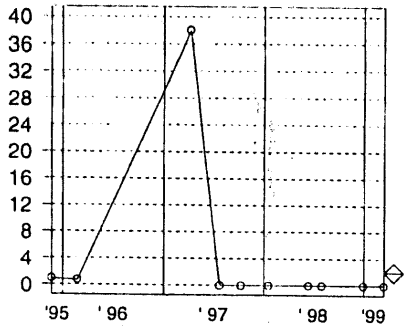
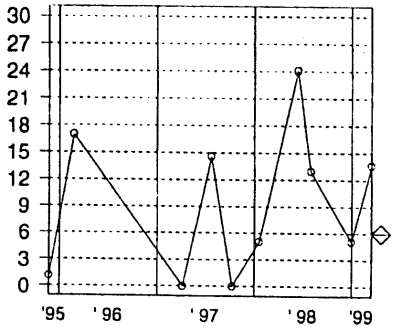
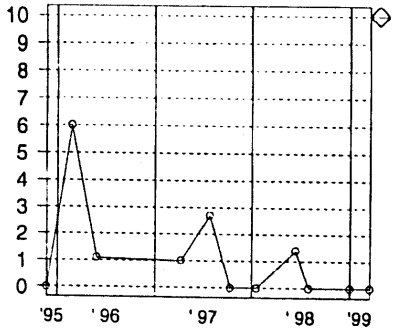
Methylene Chloride
(ug/L)



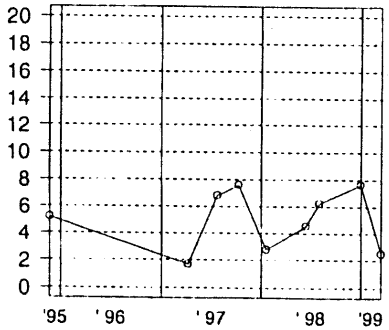
Chloroform
(ug/L)



Lead
(ug/l)



Depth to Water
(Feet)



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o = Date Sampled

NJDEP Criteria

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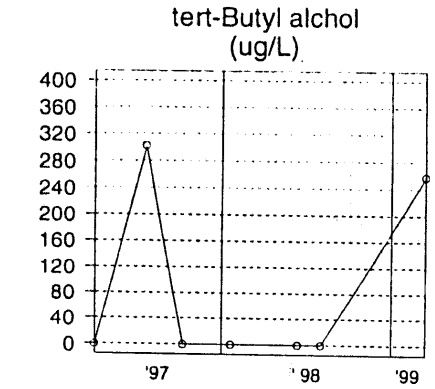

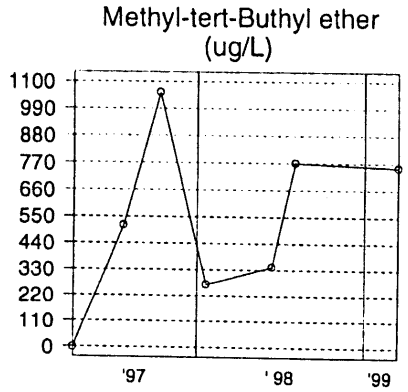

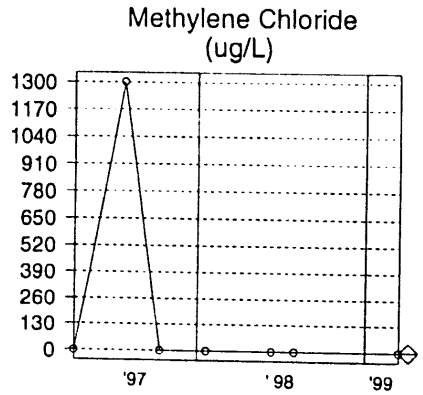

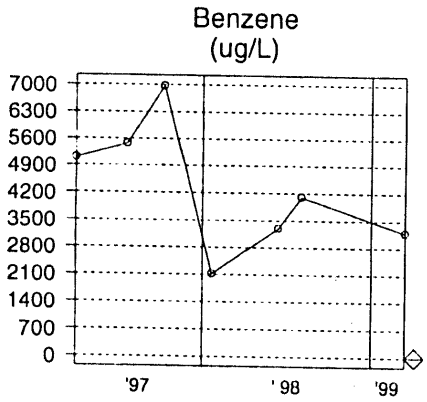

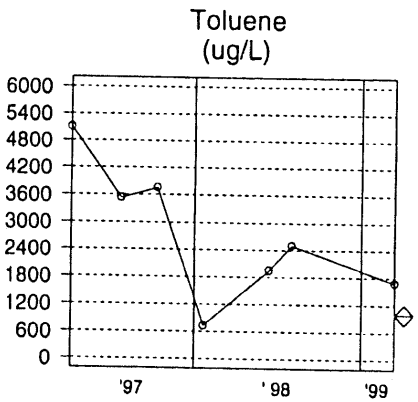

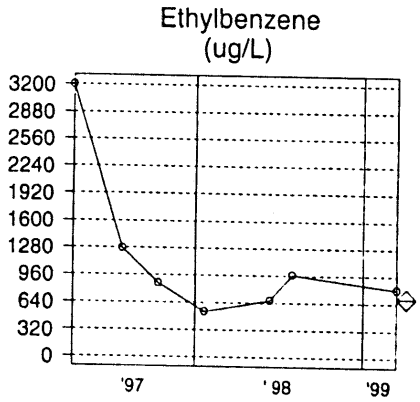

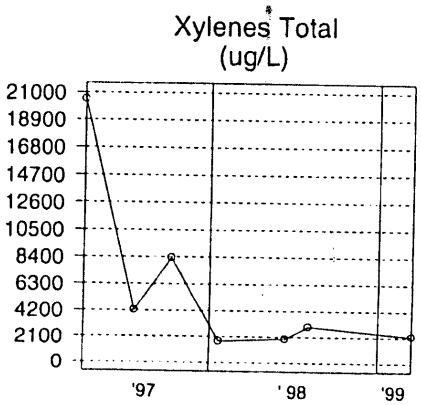

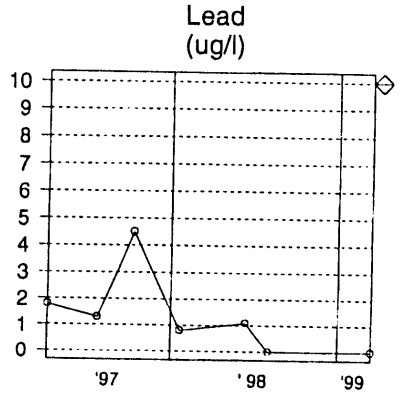

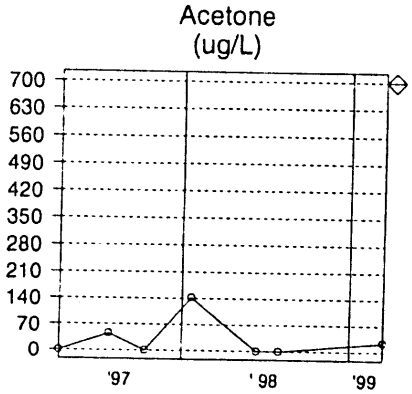

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Sampling Dates:
04/04/97 - 03/09/99

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PARAMETER

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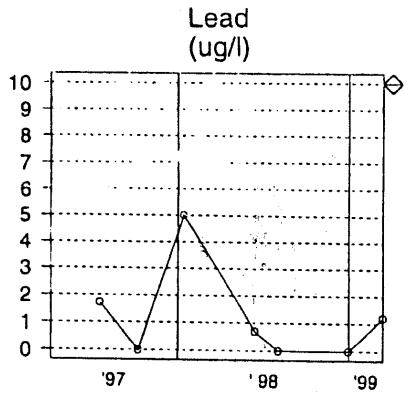

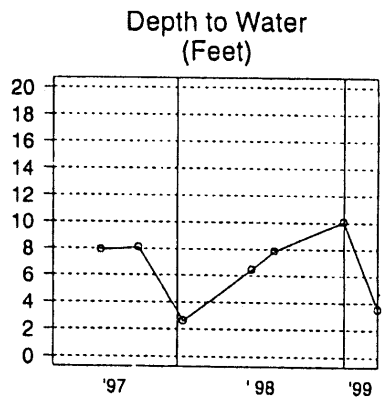

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04/02/97 - 03/09/99

LEGEND:

PARAMETER

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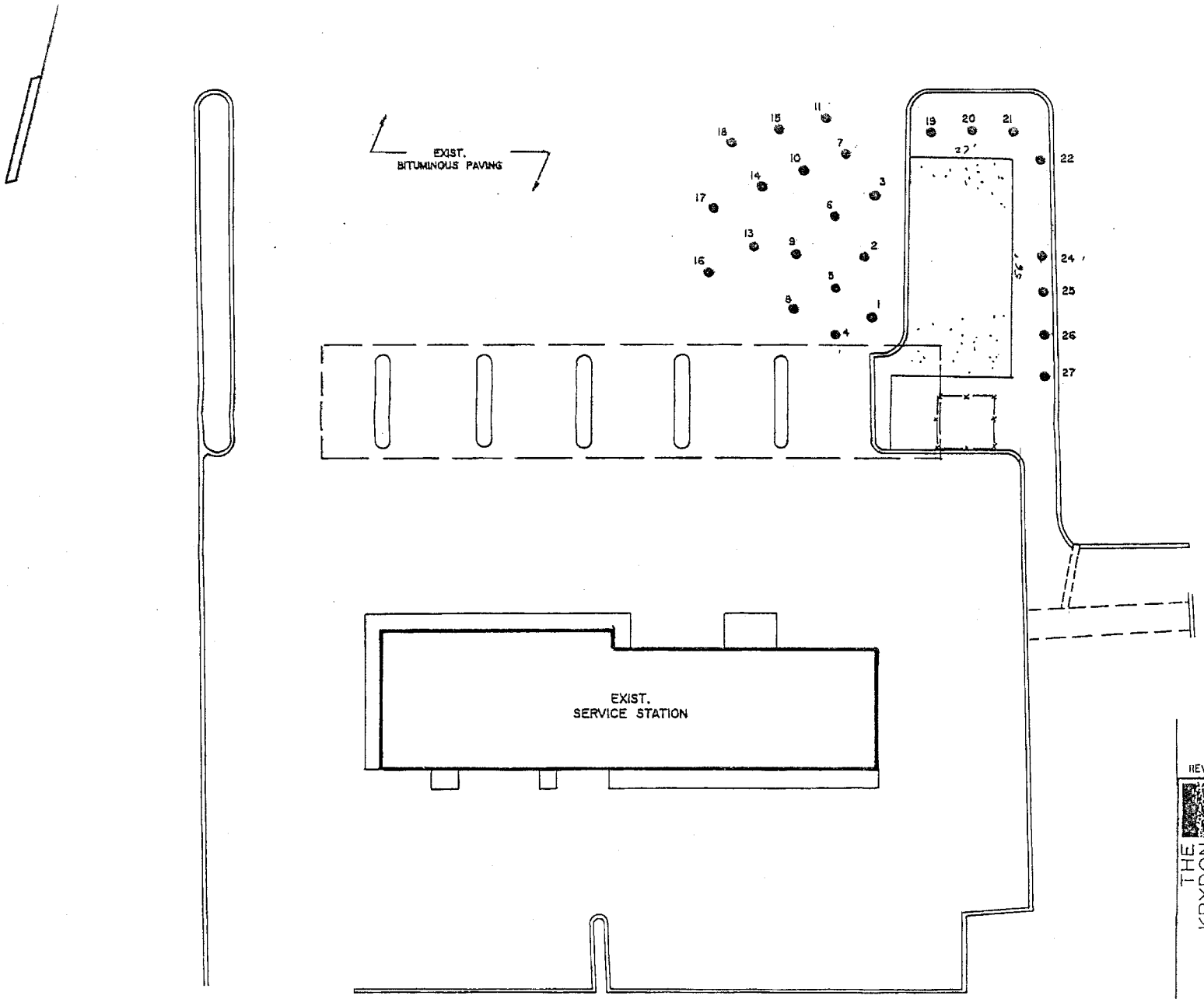
APPENDIX V

TABLE 3
Soil Analysis Summary Data
May 30, 1993

SAMPLE	BENZENE	TOLUENE	XYLENES	ETHYLBENZENE	LEAD	TICs	VOCs*
3701	14	200	500	100	ND	814	1451
3702	5.3	77	232	33	8.89	347.3	675
3703	~10	16	470	63	ND	693	1331
3704	~.73	37	142	28	9.56	287	743.2
3705	9	98	233	38	8.79	378	598
3706	ND	40	147.9	22	9.40	209	442.8
3707	22	220	510	68	8.54	820	1465
3708	~12	140	349	54	12.0	543	980
3709	~5.8	60	139	20	11.4	219	364.3
3710	54	470	900	140	ND	1584	2481
3711	32	300	570	90	9.06	992	1892
3712	ND	100	314	50	12.5	464	912
3713	ND	110	326	51	16.6	487	968
3714	ND	92	287	43	9.2	422	870
3715	~9.3	180	470	78	8.79	728	1288
3716	ND	59	199	32	8.80	290	577.8
3717	ND	51	200	29	8.33	280	657
3718	90	680	1200	200	9.30	2170	2877
3719	20	230	500	77	6.12	827	1242
3720	~3.7	68	184	27	17.9	279	516
3721	ND	71	257	36	ND	364	714
3722	~9.4	200	540	80	17.2	820	1277
3723	60	530	1000	160	11.2	1354	2137
3724	ND	26	130	18	ND	174	493
3725	ND	25	85	15	ND	125	306.7
3726	ND	ND	ND	ND	ND	ND	ND
3727	ND	ND	ND	ND	ND	ND	ND

Results reported in milligrams per kilogram; mg/kg.

* -Does not include J and B compounds.



REV.	DATE	DWN. BY	CHK'D BY	DE

THE KRYDON GROUP
ENGINEERS, SCIENTIST & PLANNERS
221 W. CLEMENTS BRIDGE RD., BARRINGTON, N.J. 08007
(609) 546-3303

SITE PLAN
"SERVICE STATION BLDG.

FORT MONMOUTH, MONMOUTH COUNTY, N

DANIEL T. DRISCOLL
N.J. PROFESSIONAL ENGINEER LIC. #GE319
P.A. PROFESSIONAL ENGINEER LIC. #03466

APPENDIX VI

Departme the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

Pump and Treat System
Performance Summary
January 1998 to April 1999

Date of Visit	1/2/98	1/6/98	1/22/98	2/5/98	2/17/98	3/19/98	3/26/98	4/2/98	4/9/98	5/29/98	6/5/98	6/11/98	6/18/98	6/26/98	7/2/98	7/8/98	7/14/98	7/24/98
GROUNDWATER SYSTEM																		
Interval (Days)	0	4	16	14	12	32	7	7	7	50	7	6	7	8	6	6	6	10
System Status (Up / Down / Off)																		
On Arrival	O	D	D	U	U	U	U	U	U	O	U	U	U	U	U	U	D	U
On Departure	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
FLOW RATES (gpm)																		
Flow Rate on Arrival																		
MW-11 (Total Influent)	0.00	0.00	0.00	2.34	2.51	2.21	1.15	0.82	0.74	0.00	3.76	3.87	3.89	3.79	3.87	3.97	0.00	3.23
GAC Effluent	0.00	0.00	0.00	2.34	2.51	2.21	1.15	0.82	0.74	0.00	3.76	3.87	3.89	3.79	3.87	3.97	0.00	3.23
Flow Rate on Departure																		
MW-11 (Total Influent)	2.21	2.35	2.38	2.34	2.51	2.33	1.55	0.82	0.74	3.81	3.76	3.87	3.89	3.79	3.87	3.97	3.94	3.23
GAC Effluent	2.21	2.35	2.38	2.34	2.51	2.33	1.55	0.82	0.74	3.81	3.76	3.87	3.89	3.79	3.87	3.97	3.94	3.23
Total Gallons Pumped	0	396	710	22,934	44,532	101,261	112,708	123,458	127,346	133,813	145,455	152,953	162,104	173,582	180,721	188,598	190,846	198,788
Gallons Pumped Since Last Visit	0	396	314	22,224	21,598	56,729	11,447	10,750	3,888	6,467	11,642	7,498	9,151	11,478	7,139	7,877	2,248	7,942
Daily Average Flow (gpd)	0	198	39	1,587	1,800	1,773	1,635	1,536	555	808	1,663	1,250	1,307	1,435	1,190	1,313	749	794
SYSTEM PRESSURES (psi)																		
Pressure on Arrival																		
Sediment Filter	9.0	8.0	7.0	7.0	6.0	6.0	5.0	4.0	4.0	N/A	34.0	37.0	36.0	N/A	36.0	36.0	36.0	38.0
GAC1 Influent	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0	2.0
GAC1 Effluent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC2 Influent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC2 Effluent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC3 Influent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC3 Effluent	0.0	2.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0
Pressure on Departure																		
Sediment Filter	9.0	8.0	7.0	7.0	6.0	6.0	5.0	4.0	4.0	30.0	34.0	37.0	36.0	N/A	36.0	36.0	36.0	38.0
GAC1 Influent	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0	2.0
GAC1 Effluent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC2 Influent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC2 Effluent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC3 Influent	2.0	4.0	4.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	N/A	2.0	2.0	2.0	2.0
GAC3 Effluent	0.0	2.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0
GW ANALYTICAL RESULTS (ppb)																		
Influent (ppb)																		
Benzene										4,765.75	4,623.64				5,011.03			
Toluene										3,042.45	2,806.56				2,785.15			
Ethylbenzene										945.67	1,017.51				1,029.23			
Xylene										2,881.72	2,764.26				2,688.37			
Total BTEX										11,635.59	11,211.97				11,513.78			
Effluent (ppb)																		
Benzene										ND	ND				ND			
Toluene										ND	ND				ND			
Ethylbenzene										ND	ND				ND			
Xylene										ND	ND				ND			
Total BTEX										ND	ND				ND			
Mass Removal (lbs/hr)																		
Monthly Mass Removal Rate (gpd)																		
Cumulative Mass Removed (gal)																		

Departme the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

Pump and Treat System
Performance Summary
January 1998 to April 1999

Date of Visit	7/28/98	8/5/98	8/12/98	8/18/98	8/25/98	9/4/98	9/11/98	9/17/98	9/23/98	10/2/98	10/9/98	10/16/98	10/22/98	10/30/98	11/4/98	11/12/98	11/19/98	11/25/98
GROUNDWATER SYSTEM																		
Interval (Days)	4	8	7	6	7	9	7	6	6	9	7	7	6	8	4	8	7	6
System Status (Up / Down / Off)																		
On Arrival	D	U	U	U	U	U	U	U	U	U	U	U	D	U	U	U	U	U
On Departure	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
FLOW RATES (gpm)																		
Flow Rate on Arrival																		
MW-11 (Total Influent)	0.00	2.90	3.37	3.51	3.58	3.44	3.41	3.35	3.41	3.33	3.34	3.34	0.00	3.45	3.36	3.42	2.96	2.67
GAC Effluent	0.00	2.90	3.37	3.51	3.58	3.44	3.41	3.35	3.41	3.33	3.34	3.34	0.00	3.45	3.36	3.42	2.96	2.67
Flow Rate on Departure																		
MW-11 (Total Influent)	3.20	2.90	3.37	3.51	3.58	3.44	3.41	3.35	3.41	3.33	3.34	3.42	3.32	3.45	3.36	3.42	2.96	2.67
GAC Effluent	3.20	2.90	3.37	3.51	3.58	3.44	3.41	3.35	3.41	3.33	3.34	3.42	3.32	3.45	3.36	3.42	2.96	2.67
Total Gallons Pumped	198,900	209,522	219,192	227,747	237,167	250,709	259,507	266,762	274,149	284,044	291,680	299,596	299,778	307,891	312,934	320,863	326,919	332,029
Gallons Pumped Since Last Visit	112	10,622	9,670	8,555	9,420	13,542	8,798	7,255	7,387	9,895	7,636	7,916	182	8,113	5,043	7,929	6,056	5,110
Daily Average Flow (gpd)	56	1,328	1,381	1,426	1,346	1,505	1,257	1,209	1,231	1,099	1,091	1,131	61	1,014	1,261	991	865	852
SYSTEM PRESSURES (psi)																		
Pressure on Arrival																		
Sediment Filter	40.0	38.0	36.0	36.0	34.0	32.0	32.0	33.0	34.0	34.0	34.0	32.0	34.0	32.0	34.0	32.0	36.0	34.0
GAC1 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC1 Effluent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC2 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC2 Effluent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC3 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC3 Effluent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pressure on Departure																		
Sediment Filter	40.0	38.0	36.0	36.0	34.0	32.0	32.0	33.0	34.0	34.0	34.0	32.0	34.0	32.0	34.0	32.0	36.0	34.0
GAC1 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC1 Effluent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC2 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC2 Effluent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC3 Influent	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
GAC3 Effluent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GW ANALYTICAL RESULTS (ppb)																		
Influent (ppb)																		
Benzene		4,496.13				3,077.36				3,296.54					4,227.78			
Toluene		2,799.17				1,693.03				1,238.67					1,397.20			
Ethylbenzene		1,051.45				692.19				768.98					810.93			
Xylene		3,174.47				2,049.41				1,757.07					1,873.96			
Total BTEX		11,521.22				7,511.99				7,061.26					8,309.87			
Effluent (ppb)																		
Benzene		0.91				ND				ND					ND			
Toluene		ND				ND				ND					ND			
Ethylbenzene		ND				ND				ND					ND			
Xylene		ND				ND				ND					ND			
Total BTEX		0.91				ND				ND					ND			
Mass Removal (lbs/hr)																		
Monthly Mass Removal Rate (gpd)																		
Cumulative Mass Removed (gal)																		

Departme the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

Pump and Treat System
Performance Summary
January 1998 to April 1999

Date of Visit	12/4/98	12/15/98	1/22/99	1/29/99	2/5/99	2/12/99	2/19/99	2/24/99	3/4/99	3/11/99	3/19/99	3/26/99	3/30/99	4/9/99
GROUNDWATER SYSTEM														
Interval (Days)	9	11	38	7	7	7	7	5	8	7	7	7	4	10
System Status (Up / Down / Off)														
On Arrival	U	D	O	U	U	U	U	U	U	O	U	U	U	U
On Departure	U	O	U	U	U	U	U	U	U	U	U	U	U	U
FLOW RATES (gpm)														
Flow Rate on Arrival														
MW-11 (Total Influent)	3.16	0.00	0.00	2.45	2.57	2.96	2.91	2.92	2.78	0.00	2.87	2.99	3.07	3.08
GAC Effluent	3.16	0.00	0.00	2.45	2.57	2.96	2.91	2.92	2.78	0.00	2.87	2.99	3.07	3.08
Flow Rate on Departure														
MW-11 (Total Influent)	3.16	0.00	2.75	2.45	2.57	2.96	2.91	2.92	2.78	2.82	2.87	2.99	3.07	3.08
GAC Effluent	3.16	0.00	2.75	2.45	2.57	2.96	2.91	2.92	2.78	2.82	2.87	2.99	3.07	3.08
Total Gallons Pumped	337,681	337,869	337,877	345,956	355,194	365,709	377,248	385,917	399,598	410,461	424,631	434,518	440,621	454,981
Gallons Pumped Since Last Visit	5,652	188	8	8,079	9,238	10,515	11,539	8,669	13,681	10,863	14,170	9,887	6,103	14,360
Daily Average Flow (gpd)	628	17	8	1,154	1,320	1,502	1,648	1,734	1,710	1,552	2,024	1,412	1,526	1,436
SYSTEM PRESSURES (psi)														
Pressure on Arrival														
Sediment Filter	30.0	N/A	38.0	38.0	36.0	36.0	36.0	35.0	36.0	38.0	38.0	36.0	25.0	30.0
GAC1 Influent	2.0	N/A	4.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	5.0	2.0	2.0	2.0
GAC1 Effluent	2.0	N/A	3.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	5.0	2.0	2.0	2.0
GAC2 Influent	2.0	N/A	3.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	5.0	2.0	2.0	2.0
GAC2 Effluent	2.0	N/A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	5.0	2.0	2.0	2.0
GAC3 Influent	2.0	N/A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	N/A	5.0	2.0	2.0	2.0
GAC3 Effluent	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0
Pressure on Departure														
Sediment Filter	30.0	N/A	38.0	38.0	36.0	36.0	36.0	35.0	36.0	38.0	23.0	36.0	25.0	30.0
GAC1 Influent	2.0	N/A	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
GAC1 Effluent	2.0	N/A	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
GAC2 Influent	2.0	N/A	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
GAC2 Effluent	2.0	N/A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
GAC3 Influent	2.0	N/A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
GAC3 Effluent	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0
GW ANALYTICAL RESULTS (ppb)														
Influent (ppb)														
Benzene			2,619.55		3,500.40				3,141.57					
Toluene			616.31		1,136.56				1,369.48					
Ethylbenzene			347.89		738.96				718.54					
Xylene			2,327.21		1,611.62				1,731.08					
Total BTEX			5,910.96		6,987.54				6,960.67					
Effluent (ppb)														
Benzene			ND		ND				ND					
Toluene			ND		ND				ND					
Ethylbenzene			ND		ND				ND					
Xylene			ND		ND				ND					
Total BTEX			ND		ND				ND					
Mass Removal (lbs/hr)														
Monthly Mass Removal Rate (gpd)														
Cumulative Mass Removed (gal)														

APPENDIX VII

Data Log Ft Monmouth

Test Start: 4/17/98 11:19:45 GW Pump/VEGE/Air Sparge Test 2

elapsed time (sec)	MP-3(15ft) Press Resp (in WC)	MP-5(12ft) Press Resp (in WC)	MP-4 (9ft) Press Resp (in WC)	MP-2(6ft) Press Resp (in WC)	MP-1(3ft) Press Resp (in WC)	Casing Vacuum (inHg)	Pw+ (psi)	MP-3(15ft) GW DD (feet)	MP-5(12ft) GW DD (feet)	MP-4 (9ft) GW DD (feet)	MP-2(6ft) GW DD (feet)	MP-1 GW DD (feet)	RW-2 GW DD (feet)	IW Flow (scfm)	LoVac Air Flow (scfm)
5	0.00	0.01	0.05	-0.24	-0.29	0.04	0.00	0.61	0.72	0.68	0.00	-0.04	0.11	0.00	104.13
10	0.00	0.01	0.05	-0.23	-0.29	0.05	0.00	0.61	0.72	0.68	0.00	-0.04	0.17	0.00	103.84
15	0.00	0.01	0.05	-0.24	-0.30	0.04	0.00	0.61	0.72	0.68	0.01	-0.04	1.81	0.00	121.05
20	0.00	0.01	0.05	-0.24	-0.30	0.04	0.00	0.61	0.72	0.68	0.01	-0.04	2.33	0.00	203.02
25	0.00	0.01	0.05	-0.22	-0.29	0.03	0.00	0.61	0.71	0.68	0.00	-0.06	1.31	0.00	202.96
30	0.00	0.01	0.05	-0.22	-0.29	0.05	0.00	0.61	0.72	0.68	0.00	-0.04	0.66	0.00	199.17
35	0.00	0.01	0.05	-0.22	-0.29	0.05	0.00	0.61	0.72	0.68	0.00	-0.04	0.50	0.00	173.15
40	0.00	0.01	0.05	-0.22	-0.31	0.05	0.00	0.61	0.71	0.68	0.00	-0.06	0.53	0.00	150.39
45	0.00	0.01	0.05	-0.23	-0.32	0.02	0.00	0.61	0.72	0.68	0.00	-0.05	0.35	0.00	132.04
50	0.00	0.01	0.05	-0.24	-0.34	5.63	0.00	0.61	0.71	0.68	0.00	-0.05	0.22	0.00	121.19
55	0.01	0.01	0.05	-0.26	-0.35	5.63	0.00	0.60	0.71	0.67	-0.01	-0.05	0.25	0.00	100.60
60	0.01	0.01	0.05	-0.28	-0.40	5.59	0.00	0.61	0.72	0.68	0.01	-0.05	0.16	0.00	82.00
65	0.01	0.01	0.05	-0.30	-0.43	5.54	0.00	0.61	0.71	0.67	0.01	-0.06	0.11	0.00	66.05
70	0.01	0.01	0.05	-0.30	-0.43	5.54	0.00	0.61	0.72	0.68	0.00	-0.06	0.15	0.00	51.91
75	0.01	0.01	0.05	-0.35	-0.48	5.55	0.00	0.60	0.71	0.68	0.01	-0.06	0.16	0.00	38.59
80	0.01	0.01	0.05	-0.38	-0.55	5.52	0.00	0.61	0.72	0.68	0.01	-0.06	0.17	0.00	31.81
85	0.01	0.01	0.05	-0.41	-0.56	5.47	0.00	0.61	0.72	0.68	0.01	-0.06	0.11	0.00	17.24
90	0.01	0.01	0.05	-0.44	-0.60	5.49	0.00	0.61	0.71	0.67	0.00	-0.09	0.10	0.00	0.00
95	0.01	0.01	0.05	-0.48	-0.64	5.48	0.00	0.60	0.71	0.68	0.00	-0.08	0.15	0.00	0.00
100	0.01	0.01	0.05	-0.51	-0.68	5.46	0.00	0.60	0.72	0.68	0.02	-0.09	0.13	0.00	0.00
105	0.01	0.01	0.05	-0.54	-0.72	5.46	0.00	0.61	0.72	0.68	0.01	-0.09	0.14	0.00	0.00
110	0.01	0.01	0.05	-0.58	-0.76	5.45	0.00	0.61	0.72	0.68	0.03	-0.09	0.12	0.00	0.00
115	0.01	0.01	0.05	-0.61	-0.79	5.39	0.00	0.60	0.72	0.68	0.02	-0.09	0.11	0.00	0.00
120	0.01	0.01	0.05	-0.64	-0.83	5.25	0.00	0.61	0.72	0.68	0.03	-0.09	0.00	0.00	0.00
125	0.01	0.01	0.05	-0.64	-0.83	5.25	0.00	0.60	0.71	0.68	0.02	-0.10	0.12	0.00	0.00
130	0.01	0.01	0.05	-0.70	-0.89	5.39	0.00	0.60	0.71	0.68	0.02	-0.10	0.12	0.00	0.00
135	0.01	0.01	0.05	-0.72	-0.91	5.40	0.00	0.61	0.72	0.68	0.04	-0.10	0.17	0.00	0.00
140	0.01	0.01	0.05	-0.75	-0.94	5.38	0.00	0.61	0.72	0.68	0.03	-0.10	0.11	0.00	0.00
145	0.01	0.01	0.05	-0.78	-0.97	5.39	0.00	0.60	0.71	0.68	0.04	-0.11	0.12	0.00	0.00
150	0.01	0.01	0.05	-0.81	-1.01	5.40	0.00	0.60	0.71	0.67	0.04	-0.11	0.12	0.00	0.00
155	0.01	0.01	0.05	-0.83	-1.03	5.37	0.00	0.61	0.72	0.67	0.04	-0.11	0.10	0.00	0.00
160	0.01	0.01	0.05	-0.86	-1.06	5.38	0.00	0.61	0.72	0.68	0.04	-0.12	0.18	0.00	0.00
165	0.00	0.01	0.05	-0.88	-1.10	5.29	0.00	0.61	0.72	0.68	0.05	-0.11	0.10	0.00	0.00
170	0.00	0.01	0.05	-0.90	-1.11	5.29	0.00	0.61	0.72	0.67	0.05	-0.12	0.10	0.00	0.00
175	0.01	0.01	0.05	-0.92	-1.14	5.29	0.00	0.61	0.71	0.67	0.06	-0.12	0.12	0.00	0.00
180	0.01	0.01	0.05	-0.94	-1.16	5.31	0.00	0.60	0.71	0.66	0.06	-0.12	0.15	0.00	0.00
185	0.01	0.01	0.05	-0.94	-1.16	5.31	0.00	0.60	0.71	0.66	0.06	-0.12	0.16	0.00	0.00
190	0.01	0.01	0.05	-0.97	-1.20	5.27	0.00	0.60	0.71	0.65	0.06	-0.13	0.10	0.00	0.00
195	0.01	0.01	0.05	-0.99	-1.19	5.08	0.00	0.60	0.71	0.66	0.07	-0.14	-0.01	0.00	0.00
200	0.01	0.01	0.05	-1.00	-1.21	5.27	0.00	0.60	0.71	0.64	0.07	-0.14	0.23	0.00	0.00
205	0.01	0.01	0.05	-1.02	-1.23	5.28	0.00	0.60	0.72	0.65	0.07	-0.14	0.19	0.00	0.00
210	0.01	0.01	0.05	-1.03	-1.25	5.28	0.00	0.60	0.71	0.64	0.09	-0.13	0.18	0.00	0.00
215	0.01	0.01	0.05	-1.05	-1.26	5.23	0.00	0.61	0.72	0.63	0.09	-0.14	0.11	0.00	0.00
220	0.01	0.01	0.05	-1.06	-1.29	5.25	0.00	0.60	0.71	0.63	0.09	-0.14	0.16	0.00	0.00
225	0.01	0.01	0.05	-1.08	-1.29	5.23	0.00	0.61	0.72	0.63	0.10	-0.15	0.17	0.00	0.00
230	0.00	0.01	0.05	-1.10	-1.33	5.25	0.00	0.60	0.72	0.62	0.09	-0.14	0.23	0.00	0.00
235	0.00	0.01	0.05	-1.12	-1.36	5.23	0.00	0.61	0.72	0.63	0.11	-0.14	0.18	0.00	0.00
240	0.00	0.01	0.05	-1.13	-1.38	5.23	0.00	0.61	0.72	0.62	0.11	-0.14	0.15	0.00	0.00
245	-0.01	0.01	0.05	-1.15	-1.38	4.84	0.00	0.61	0.72	0.63	0.13	-0.14	-0.13	0.00	0.00
250	0.00	0.01	0.05	-1.16	-1.39	5.17	0.00	0.61	0.72	0.61	0.13	-0.14	0.22	0.00	0.00
255	0.00	0.01	0.05	-1.16	-1.39	5.17	0.00	0.61	0.72	0.61	0.13	-0.15	0.23	0.00	0.00
260	-0.01	0.01	0.05	-1.18	-1.43	5.20	0.00	0.61	0.72	0.61	0.13	-0.15	0.24	0.00	0.00
265	-0.01	0.01	0.05	-1.18	-1.43	5.20	0.00	0.61	0.72	0.60	0.13	-0.14	-0.23	0.00	0.00
270	-0.01	0.01	0.05	-1.20	-1.45	5.16	0.00	0.60	0.72	0.60	0.14	-0.15	0.24	0.00	0.00
275	-0.02	0.01	0.05	-1.22	-1.47	5.16	0.00	0.61	0.72	0.59	0.14	-0.16	0.20	0.00	0.00
280	-0.02	0.01	0.05	-1.24	-1.49	5.17	0.00	0.60	0.72	0.59	0.14	-0.15	0.26	0.00	0.00
285	-0.02	0.01	0.05	-1.25	-1.49	5.16	0.00	0.60	0.71	0.59	0.15	-0.15	0.21	0.00	5.43
290	-0.02	0.01	0.05	-1.25	-1.51	5.17	0.00	0.60	0.71	0.59	0.15	-0.15	0.28	0.00	8.58
295	-0.02	0.01	0.05	-1.27	-1.53	5.18	0.00	0.61	0.72	0.58	0.15	-0.15	0.31	0.00	0.00
300	-0.03	0.01	0.05	-1.29	-1.54	5.14	0.00	0.60	0.71	0.57	0.16	-0.15	0.28	0.00	0.00
305	-0.03	0.01	0.05	-1.29	-1.55	5.14	0.00	0.60	0.71	0.57	0.16	-0.15	0.33	0.00	0.00
310	-0.03	0.01	0.05	-1.30	-1.56	5.15	0.00	0.60	0.71	0.56	0.17	-0.14	0.29	0.00	0.00
315	-0.04	0.00	0.05	-1.32	-1.59	5.11	0.00	0.60	0.71	0.56	0.17	-0.13	0.32	0.00	0.00
320	-0.04	0.00	0.05	-1.34	-1.61	5.12	0.00	0.61	0.71	0.56	0.18	-0.13	0.30	0.00	0.00
325	-0.04	0.00	0.05	-1.34	-1.61	5.12	0.00	0.61	0.71	0.56	0.18	-0.13	0.12	0.00	0.00
330	-0.05	-0.01	0.05	-1.37	-1.64	5.06	0.00	0.61	0.72	0.55	0.20	-0.12	0.35	0.00	0.00
335	-0.05	-0.01	0.05	-1.38	-1.66	5.09	0.00	0.61	0.72	0.55	0.20	-0.12	0.40	0.00	0.00
340	-0.05	-0.01	0.05	-1.38	-1.66	5.11	0.00	0.61	0.72	0.55	0.20	-0.12	0.43	0.00	0.00
345	-0.05	-0.01	0.05	-1.40	-1.67	5.10	0.00	0.61	0.72	0.54	0.21	-0.13	0.41	0.00	0.00
350	-0.06	-0.01	0.05	-1.41	-1.69	5.08	0.00	0.59	0.71	0.54	0.20	-0.13	0.41	0.00	0.00
355	-0.06	-0.01	0.05	-1.42	-1.70	5.06	0.00	0.60	0.71	0.53	0.21	-0.12	0.41	0.00	0.00
360	-0.07	-0.01	0.05	-1.44	-1.73	5.10	0.00	0.61	0.72	0.53	0.22	-0.11	0.46	0.00	0.00
365	-0.07	-0.01	0.05	-1.45	-1.73	5.07	0.00	0.61	0.72	0.53	0.23	-0.11	0.52	0.00	0.00
370	-0.07	-0.02	0.05	-1.45	-1.74	5.05	0.00	0.60	0.72	0.53	0.24	-0.11	0.49	0.00	0.00
375	-0.07	-0.02	0.05	-1.46	-1.75	5.03	0.00	0.60	0.72	0.52	0.24	-0.11	0.49	0.00	0.00
380	-0.07	-0.02	0.05	-1.47	-1.75	5.05	0.00	0.60	0.71	0.51	0.23	-0.12	0.53	0.00	0.00
385	-0.07	-0.02	0.05	-1.48	-1.76	5.05	0.00	0.60	0.71	0.51	0.24	-0.11	0.52	0.00	0.00
390	-0.07	-0.02	0.05	-1.48	-1.78	5.03	0.00	0.60	0.73	0.51	0.25	-0.10	0.54	0.00	7.66
395	-0.07	-0.02	0.05	-1.48	-1.78	5.03	0.00	0.60	0.72	0.50	0.25	-0.10	0.56	0.00	12.12
400	-0.08	-0.02	0.05	-1.51	-1.80	5.05	0.00	0.61	0.71	0.50	0.25	-0.10	0.59	0.00	0.00
405	-0.08	-0.01	0.05	-1.51	-1.80	5.04	0.00	0.61	0.72	0.49	0.26	-0.10	0.59	0.00	0.00

Data Log Ft Monmouth

Test Start: 4/17/98 11:19:45 GW Pump/VEGE/Air Sparge Test 2

elapsed time (sec)	MP-3(15ft) Press Resp (in WC)	MP-5(12ft) Press Resp (in WC)	MP-4 (9ft) Press Resp (in WC)	MP-2(6ft) Press Resp (in WC)	MP-1(3ft) Press Resp (in WC)	Casing Vacuum (inHg)	Pw+ (psi)	MP-3(15ft) GW DD (feet)	MP-5(12ft) GW DD (feet)	MP-4 (9ft) GW DD (feet)	MP-2(6ft) GW DD (feet)	MP-1 GW DD (feet)	RW-2 GW DD (feet)	IW Flow (scfm)	LoVac Air Flow (scfm)
410	-0.08	-0.01	0.05	-1.52	-1.83	5.03	0.00	0.61	0.71	0.49	0.26	-0.10	0.59	0.00	0.00
415	-0.08	-0.01	0.05	-1.52	-1.83	5.03	0.00	0.60	0.71	0.48	0.26	-0.10	0.60	0.00	0.00
420	-0.09	-0.01	0.05	-1.55	-1.85	4.79	0.00	0.60	0.71	0.48	0.26	-0.10	0.38	0.00	0.00
425	-0.09	-0.01	0.05	-1.56	-1.86	5.01	0.00	0.61	0.72	0.48	0.27	-0.09	0.65	0.00	0.00
430	-0.09	-0.01	0.05	-1.56	-1.86	5.01	0.00	0.61	0.72	0.49	0.28	-0.09	0.63	0.00	0.00
435	-0.09	-0.01	0.05	-1.57	-1.88	5.02	0.00	0.60	0.71	0.47	0.28	-0.10	0.65	0.00	0.00
440	-0.09	-0.01	0.05	-1.58	-1.88	5.00	0.00	0.59	0.72	0.47	0.28	-0.10	0.65	0.00	0.00
445	-0.10	-0.01	0.05	-1.59	-1.88	5.00	0.00	0.60	0.71	0.46	0.28	-0.10	0.66	0.00	0.00
450	-0.10	-0.01	0.05	-1.60	-1.92	5.02	0.00	0.60	0.71	0.47	0.28	-0.09	0.70	0.00	0.00
455	-0.11	-0.02	0.05	-1.62	-1.95	4.99	0.00	0.60	0.71	0.46	0.29	-0.09	0.69	0.00	0.00
460	-0.11	-0.02	0.05	-1.63	-1.94	4.98	0.00	0.59	0.72	0.45	0.30	-0.09	0.71	0.00	0.00
465	-0.11	-0.02	0.05	-1.62	-1.95	4.97	0.00	0.59	0.72	0.45	0.30	-0.08	0.71	0.00	0.00
470	-0.11	-0.02	0.05	-1.63	-1.95	5.00	0.00	0.58	0.71	0.44	0.30	-0.08	0.71	0.00	0.00
475	-0.12	-0.03	0.05	-1.65	-1.98	4.97	0.00	0.57	0.71	0.44	0.30	-0.09	0.74	0.00	0.00
480	-0.12	-0.03	0.05	-1.66	-1.99	4.99	0.00	0.57	0.72	0.44	0.30	-0.08	0.74	0.00	0.00
485	-0.12	-0.03	0.05	-1.66	-1.98	4.98	0.00	0.57	0.72	0.44	0.32	-0.07	0.80	0.00	0.00
490	-0.12	-0.03	0.05	-1.66	-1.98	4.98	0.00	0.55	0.71	0.43	0.31	-0.07	0.77	0.00	0.00
495	-0.13	-0.03	0.05	-1.68	-2.00	4.96	0.00	0.54	0.72	0.42	0.31	-0.07	0.81	0.00	0.00
500	-0.13	-0.03	0.04	-1.70	-2.04	4.95	0.00	0.54	0.71	0.42	0.32	-0.07	0.79	0.00	0.00
505	-0.14	-0.04	0.04	-1.58	-1.98	4.95	0.00	0.53	0.72	0.42	0.33	-0.06	0.81	0.00	0.00
510	-0.14	-0.03	0.05	-1.41	-1.92	4.96	0.00	0.53	0.71	0.41	0.33	-0.06	0.82	0.00	0.00
515	-0.14	-0.03	0.05	-1.33	-1.92	4.95	0.00	0.51	0.71	0.41	0.34	-0.06	0.84	0.00	0.00
520	-0.14	-0.04	0.04	-1.24	-1.90	4.84	0.00	0.51	0.71	0.40	0.36	-0.05	0.78	0.00	0.00
525	-0.14	-0.06	0.05	-1.20	-1.88	4.94	0.00	0.50	0.72	0.40	0.37	-0.06	0.87	0.00	0.00
530	-0.14	-0.06	0.05	-1.21	-1.92	4.95	0.00	0.50	0.71	0.39	0.37	-0.05	0.88	0.00	0.00
535	-0.14	-0.06	0.04	-1.15	-1.90	4.95	0.00	0.49	0.72	0.39	0.38	-0.03	0.89	0.00	0.00
540	-0.15	-0.06	0.04	-1.12	-1.89	4.94	0.00	0.48	0.72	0.39	0.38	-0.04	0.90	0.00	0.00
545	-0.15	-0.06	0.04	-1.12	-1.89	4.92	0.00	0.48	0.71	0.39	0.38	-0.04	0.90	0.00	0.00
550	-0.15	-0.05	0.04	-1.09	-1.89	4.94	0.00	0.47	0.72	0.39	0.39	-0.04	0.98	0.00	0.00
555	-0.15	-0.05	0.04	-1.06	-1.90	4.93	0.00	0.46	0.71	0.37	0.39	-0.04	1.02	0.00	0.00
560	-0.15	-0.05	0.04	-1.04	-1.88	4.44	0.00	0.46	0.72	0.38	0.41	-0.04	0.59	0.00	0.00
565	-0.15	-0.05	0.04	-1.03	-1.89	4.94	0.00	0.44	0.71	0.37	0.41	-0.03	1.04	0.00	0.00
570	-0.16	-0.05	0.03	-1.03	-1.90	4.77	0.00	0.44	0.72	0.37	0.41	-0.02	0.88	0.00	19.83
575	-0.16	-0.05	0.03	-1.02	-1.90	4.95	0.00	0.43	0.71	0.36	0.41	-0.03	1.05	0.00	0.00
580	-0.16	-0.05	0.03	-1.02	-1.90	4.92	0.00	0.43	0.72	0.36	0.42	-0.03	1.02	0.00	26.77
585	-0.16	-0.04	0.03	-1.01	-1.91	4.95	0.00	0.42	0.72	0.35	0.43	-0.02	1.01	0.00	27.32
590	-0.16	-0.04	0.03	-1.02	-1.93	4.94	0.00	0.41	0.71	0.35	0.42	-0.03	1.04	0.00	22.95
595	-0.17	-0.04	0.02	-1.03	-1.94	4.93	0.00	0.41	0.73	0.35	0.44	-0.01	1.07	0.00	20.24
600	-0.17	-0.04	0.03	-1.03	-1.94	4.93	0.00	0.40	0.71	0.34	0.44	-0.03	1.02	0.00	14.31
660	-0.18	-0.07	0.02	-1.11	-2.06	4.89	0.00	0.31	0.72	0.30	0.48	0.01	1.23	0.00	0.00
720	-0.18	-0.05	0.02	-1.07	-2.44	4.85	0.00	0.22	0.71	0.25	0.51	0.00	1.50	0.00	3.82
780	-0.19	-0.05	0.03	-1.16	-2.74	4.82	0.00	0.14	0.71	0.20	0.54	0.03	1.76	0.00	0.00
840	-0.19	-0.06	0.02	-1.25	-2.97	4.83	0.00	0.06	0.72	0.15	0.59	0.06	2.15	0.00	15.28
900	-0.21	-0.06	0.01	-1.72	-3.26	4.78	0.00	-0.03	0.72	0.11	0.59	0.07	2.66	0.00	6.61
960	-0.23	-0.07	0.01	-2.00	-3.59	4.80	0.00	-0.10	0.72	0.06	0.59	0.06	2.90	0.00	6.61
1020	-0.22	-0.06	0.03	-2.00	-3.82	4.76	0.00	-0.18	0.72	0.01	0.59	0.09	3.06	0.00	0.00
1080	-0.20	-0.05	0.05	-2.00	-4.10	4.75	0.00	-0.26	0.72	-0.02	0.59	0.11	3.05	0.00	12.65
1140	-0.17	-0.04	0.05	-2.00	-4.29	4.75	0.00	-0.34	0.67	-0.07	0.60	0.11	2.08	0.00	0.00
1200	-0.18	-0.05	0.05	-2.00	-4.43	4.73	0.00	-0.42	0.58	-0.12	0.61	0.12	2.13	0.00	0.00
1260	-0.22	-0.07	0.05	-2.00	-4.68	4.74	0.00	-0.48	0.48	-0.17	0.62	0.13	2.01	0.00	10.79
1320	-0.22	-0.07	0.05	-2.00	-4.80	4.70	0.00	-0.56	0.39	-0.23	0.63	0.14	2.84	0.00	0.00
1380	-0.26	-0.09	0.05	-0.02	-5.00	4.72	0.00	-0.62	0.31	-0.27	0.65	0.17	3.10	0.00	0.00
1440	-0.27	-0.02	0.05	-2.00	-5.14	4.71	0.00	-0.69	0.23	-0.32	0.66	0.19	3.10	0.00	0.00
1500	-0.28	-0.07	0.05	-4.55	-5.25	4.69	0.00	-0.75	0.12	-0.36	0.67	0.20	3.08	0.00	5.39
1560	-0.27	-0.07	0.05	-4.64	-5.34	4.70	0.00	-0.82	0.03	-0.40	0.68	0.23	2.85	0.00	17.88
1620	-0.28	-0.08	0.05	-4.77	-5.49	4.71	0.00	-0.88	-0.05	-0.45	0.70	0.25	3.12	0.00	0.00
1680	-0.31	-0.08	0.05	-4.89	-5.65	4.70	0.00	-0.94	-0.14	-0.50	0.70	0.26	2.56	0.00	0.00
1740	-0.32	-0.08	0.05	-5.02	-5.71	4.69	0.00	-1.00	-0.22	-0.53	0.71	0.28	3.10	0.00	0.00
1800	-0.32	-0.07	0.05	-5.04	-5.74	4.66	0.00	-1.07	-0.30	-0.58	0.73	0.29	3.09	0.00	0.00
1860	-0.31	-0.07	0.05	-5.06	-5.82	4.69	0.00	-1.12	-0.40	-0.61	0.74	0.31	3.07	0.00	5.39
1920	-0.32	-0.07	0.05	-5.20	-5.91	4.65	0.00	-1.17	-0.48	-0.66	0.75	0.33	2.76	0.00	0.00
1980	-0.34	-0.07	0.05	-5.23	-6.02	4.69	0.00	-1.24	-0.58	-0.70	0.75	0.35	3.07	0.00	9.33
2040	-0.34	-0.07	0.05	-5.30	-6.11	4.66	0.00	-1.29	-0.66	-0.74	0.76	0.35	2.59	0.00	0.00
2100	-0.35	-0.08	0.05	-5.37	-6.18	4.66	0.00	-1.34	-0.74	-0.77	0.78	0.38	3.08	0.00	0.00
2160	-0.36	-0.07	0.05	-5.36	-6.10	4.68	0.00	-1.39	-0.84	-0.81	0.78	0.39	3.09	0.00	0.00
2220	-0.36	-0.08	0.05	-5.33	-6.11	4.66	0.00	-1.44	-0.90	-0.85	0.80	0.41	3.00	0.00	0.00
2280	-0.38	-0.08	0.05	-5.38	-6.19	4.70	0.00	-1.49	-0.99	-0.88	0.81	0.42	2.56	0.00	0.00
2340	-0.38	-0.08	0.04	-5.45	-6.39	4.71	0.00	-1.54	-1.07	-0.92	0.82	0.43	2.36	0.00	17.88
2400	-0.39	-0.07	0.05	-5.52	-6.45	4.68	0.00	-1.59	-1.15	-0.96	0.82	0.44	2.84	0.00	0.00
2460	-0.39	-0.07	0.04	-5.66	-6.57	4.65	0.00	-1.63	-1.21	-0.99	0.82	0.44	3.08	0.00	0.00
2520	-0.39	-0.07	0.05	-5.73	-6.67	4.70	0.00	-1.69	-1.30	-1.03	0.83	0.46	2.74	0.00	0.00
2580	-0.39	-0.07	0.03	-5.81	-6.79	4.71	0.00	-1.72	-1.37	-1.06	0.84	0.46	2.42	0.00	17.05
2640	-0.40	-0.07	0.03	-5.90	-6.91	4.73	0.00	-1.77	-1.44	-1.10	0.83	0.47	2.09	0.00	20.18
2700	-0.39	-0.06	0.04	-6.01	-7.03	4.72	0.00	-1.81	-1.51	-1.13	0.83	0.47	1.95	0.00	0.00
2760	-0.40	-0.07	0.03	-6.07	-7.20	4.73	0.00	-1.86	-1.56	-1.17	0.84	0.47	1.85	0.00	0.00
2820	-0.41	-0.07	0.02	-6.15	-7.28	4.72	0.00	-1.90	-1.63	-1.20	0.84	0.48	1.77	0.00	0.00
2880	-0.42	-0.07	0.01	-6.25	-7.41	4.75	0.00	-1.92	-1.68	-1.22	0.85	0.49	1.70	0.00	0.00
2940	-0.44	-0.08	-0.01	-6.32	-7.56	4.74	0.00	-1.95	-1.75	-1.25	0.87	0.52	1.66	0.00	0.00
3000	-0.45	-0.08	-0.01	-6.42	-7.72	4.76	0.00	-2.00	-1.79	-1.29	0.86	0.52	1.61	0.00	0.00
3060	-0.47	-0.08	-0.02	-6.53	-7.82	4.74	0.00	-2.01	-1.83	-1.30	0.88	0.52	1.56	0.00	0.00
3120	-0.49	-0.09	-0.04	-6.66	-8.01	4.78	0.00	-2.06	-1.89	-1.34	0.87	0.53	1.51	0.00	0.00

Data Log Ft Monmouth

Test Start: 4/17/98 11:19:45 GW Pump/VEGE/Air Sparge Test 2

elapsed time (sec)	MP-3(15ft) Press Resp (in WC)	MP-5(12ft) Press Resp (in WC)	MP-4 (9ft) Press Resp (in WC)	MP-2(6ft) Press Resp (in WC)	MP-1(3ft) Press Resp (in WC)	Casing Vacuum (inHg)	Pw+ (psi)	MP-3(15ft) GW DD (feet)	MP-5(12ft) GW DD (feet)	MP-4 (9ft) GW DD (feet)	MP-2(6ft) GW DD (feet)	MP-1 GW DD (feet)	RW-2 GW DD (feet)	IW Flow (scfm)	LoVac Air Flow (scfm)
3180	-0.50	-0.09	-0.04	-6.19	-8.09	4.76	0.00	-2.07	-1.94	-1.37	0.90	0.55	1.46	0.00	0.00
3240	-0.50	-0.08	0.00	-6.07	-8.12	4.76	0.00	-2.11	-1.98	-1.41	0.91	0.55	1.52	0.00	0.00
3300	-0.50	-0.09	-0.03	-6.02	-8.26	4.74	0.00	-2.14	-2.02	-1.44	0.93	0.55	1.46	0.00	0.00
3360	-0.50	-0.09	-0.04	-6.03	-8.34	4.75	0.00	-2.17	-2.06	-1.47	0.94	0.55	1.49	0.00	0.00
3420	-0.50	-0.08	-0.03	-5.99	-8.42	4.77	0.00	-2.19	-2.11	-1.50	0.94	0.55	1.48	0.00	0.00
3480	-0.50	-0.07	-0.03	-6.00	-8.48	4.76	0.00	-2.22	-2.16	-1.53	0.94	0.55	1.50	0.00	0.00
3540	-0.50	-0.09	-0.05	-6.04	-8.60	4.77	0.00	-2.25	-2.17	-1.57	0.94	0.56	1.49	0.00	0.00
3600	-0.50	-0.08	-0.02	-6.02	-8.64	4.77	0.00	-2.26	-2.22	-1.59	0.96	0.56	1.46	0.00	0.00
3660	-0.50	-0.09	-0.06	-6.06	-8.69	4.76	0.00	-2.29	-2.25	-1.62	0.95	0.57	1.46	0.00	0.00
3720	-0.50	-0.07	-0.03	-6.06	-8.74	4.78	0.00	-2.31	-2.29	-1.65	0.95	0.54	1.46	0.00	0.00
3780	-0.50	-0.06	-0.03	-6.10	-8.79	4.77	0.00	-2.33	-2.32	-1.68	0.95	0.56	1.42	0.00	0.00
3840	-0.50	-0.07	-0.03	-6.07	-8.73	4.79	0.00	-2.36	-2.34	-1.70	0.96	0.56	1.48	0.00	0.00
3900	-0.50	-0.06	-0.03	-6.06	-8.70	4.76	0.00	-2.38	-2.38	-1.72	0.97	0.57	1.49	0.00	0.00
3960	-0.50	-0.04	0.00	-6.02	-8.72	4.79	0.00	-2.39	-2.40	-1.74	0.97	0.58	1.46	0.00	0.00
4020	-0.50	-0.05	-0.02	-6.04	-8.78	4.79	0.00	-2.41	-2.43	-1.77	0.98	0.57	1.45	0.00	3.82
4080	-0.50	-0.06	-0.02	-6.20	-8.82	4.80	0.00	-2.42	-2.46	-1.80	0.97	0.57	1.45	0.00	5.40
4140	-0.50	-0.04	0.00	-6.18	-8.82	4.79	0.00	-2.44	-2.47	-1.81	0.97	0.56	1.46	0.00	0.00
4200	-0.50	-0.05	-0.02	-6.23	-8.90	4.79	0.00	-2.46	-2.50	-1.84	0.97	0.57	1.45	0.00	0.00
4260	-0.50	-0.05	-0.03	-6.24	-8.98	4.79	0.00	-2.47	-2.51	-1.86	0.97	0.56	1.45	0.00	0.00
4320	-0.50	-0.04	-0.02	-6.25	-9.00	4.81	0.00	-2.49	-2.54	-1.88	0.98	0.57	1.46	0.00	0.00
4380	-0.50	-0.04	-0.02	-6.23	-8.98	4.81	0.00	-2.50	-2.55	-1.89	0.98	0.58	1.44	0.00	0.00
4440	-0.50	-0.02	-0.01	-6.16	-8.99	4.82	0.00	-2.51	-2.57	-1.90	0.98	0.57	1.44	0.00	0.00
4500	-0.50	-0.05	-0.02	-6.21	-9.05	4.80	0.00	-2.51	-2.59	-1.92	0.99	0.57	1.44	0.00	0.00
4560	-0.50	-0.04	-0.02	-6.24	-9.08	4.82	0.00	-2.53	-2.60	-1.93	0.98	0.58	1.44	0.00	0.00
4620	-0.50	-0.04	-0.02	-6.29	-9.15	4.81	0.00	-2.53	-2.62	-1.96	0.99	0.57	1.45	0.00	3.82
4680	-0.50	-0.04	-0.02	-6.27	-9.21	4.81	0.00	-2.54	-2.63	-1.98	0.99	0.57	1.47	0.00	0.00
4740	-0.50	-0.05	-0.02	-6.26	-9.26	4.83	0.00	-2.55	-2.63	-1.99	0.99	0.57	1.44	0.00	0.00
4800	-0.50	-0.05	-0.03	-6.18	-9.37	4.80	0.00	-2.55	-2.64	-2.00	1.02	0.58	1.44	0.00	0.00
4860	-0.50	-0.05	-0.03	-6.07	-9.46	4.82	0.00	-2.55	-2.65	-2.01	1.02	0.57	1.46	0.00	8.54
4920	-0.50	-0.06	-0.04	-6.20	-9.51	4.84	0.00	-2.57	-2.65	-2.04	1.02	0.57	1.43	0.00	0.00
4980	-0.50	-0.06	-0.03	-6.31	-9.55	4.81	0.00	-2.57	-2.66	-2.06	1.01	0.56	1.39	0.00	3.82
5040	-0.50	-0.05	-0.03	-4.51	-9.49	4.79	0.00	-2.57	-2.65	-2.07	1.11	0.58	1.38	0.00	0.00
5100	-0.50	-0.06	-0.04	-4.04	-9.47	4.81	0.00	-2.57	-2.66	-2.08	1.16	0.59	1.39	0.00	0.00
5160	-0.50	-0.06	-0.04	-4.01	-9.50	4.81	0.00	-2.57	-2.66	-2.10	1.17	0.59	1.38	0.00	0.00
5220	-0.50	-0.05	-0.03	-4.14	-9.51	4.81	0.00	-2.55	-2.67	-2.11	1.16	0.58	1.38	0.00	0.00
5280	-0.50	-0.05	-0.03	-4.22	-9.53	4.84	0.00	-2.58	-2.68	-2.12	1.15	0.59	1.37	0.00	0.00
5340	-0.50	-0.05	-0.03	-4.33	-9.54	4.82	0.00	-2.57	-2.68	-2.13	1.16	0.60	1.38	0.00	0.00
5400	-0.50	-0.04	-0.03	-4.45	-9.54	4.81	0.00	-2.58	-2.69	-2.14	1.15	0.59	1.37	0.00	0.00
5460	-0.50	-0.05	-0.04	-4.55	-9.62	4.83	0.00	-2.58	-2.69	-2.15	1.14	0.59	1.36	0.00	0.00
5520	-0.50	-0.03	-0.02	-4.55	-9.62	4.84	0.00	-2.58	-2.69	-2.17	1.15	0.58	1.38	0.00	0.00
5580	-0.50	-0.03	-0.02	-4.61	-9.58	4.83	0.00	-2.58	-2.70	-2.17	1.14	0.59	1.37	0.00	0.00
5640	-0.50	-0.03	-0.03	-4.69	-9.58	4.83	0.00	-2.58	-2.70	-2.17	1.15	0.62	1.37	0.00	0.00
5700	-0.50	-0.03	-0.03	-4.74	-9.62	4.80	0.00	-2.59	-2.70	-2.18	1.14	0.59	1.37	0.00	0.00
5760	-0.50	-0.02	-0.02	-4.81	-9.66	4.82	0.00	-2.58	-2.70	-2.19	1.15	0.60	1.36	0.00	0.00
5820	-0.50	-0.03	-0.03	-4.92	-9.70	4.84	0.00	-2.57	-2.70	-2.19	1.14	0.59	1.36	0.00	0.00
5880	-0.50	-0.03	-0.03	-4.95	-9.72	4.82	0.00	-2.57	-2.71	-2.19	1.14	0.60	1.36	0.00	0.00
5940	-0.50	-0.03	-0.03	-5.07	-9.78	4.84	0.00	-2.58	-2.70	-2.20	1.14	0.60	1.38	0.00	0.00
6000	-0.50	-0.03	-0.02	-5.11	-9.81	4.82	0.00	-2.58	-2.71	-2.20	1.13	0.60	1.35	0.00	0.00
6060	-0.50	-0.03	-0.02	-5.16	-9.85	4.83	0.00	-2.57	-2.70	-2.22	1.13	0.60	1.32	0.00	0.00
6120	-0.50	-0.03	-0.02	-5.21	-9.84	4.81	0.00	-2.58	-2.70	-2.22	1.12	0.60	1.35	0.00	0.00
6180	-0.50	-0.02	-0.02	-5.30	-9.89	4.83	0.00	-2.58	-2.70	-2.22	1.13	0.60	1.35	0.00	0.00
6240	-0.50	-0.03	-0.02	-5.34	-9.92	4.84	0.00	-2.57	-2.71	-2.22	1.13	0.60	1.37	0.00	9.36
6420	-2.22	-0.03	-0.03	-5.63	-9.93	4.81	0.00	-2.52	-2.70	-2.23	1.09	0.62	1.35	0.00	0.00
6480	-2.25	-0.03	-0.02	-5.71	-10.01	4.83	0.00	-2.53	-2.71	-2.24	1.10	0.60	1.34	0.00	0.00
6540	-1.67	-0.03	-0.02	-5.78	-10.01	4.83	0.00	-2.52	-2.71	-2.24	1.10	0.61	1.36	0.00	0.00
6600	-1.70	-0.03	-0.03	-5.84	-10.05	4.84	0.00	-2.51	-2.70	-2.24	1.08	0.60	1.36	0.00	0.00
6660	-1.71	-0.02	-0.02	-5.91	-10.09	4.82	0.00	-2.52	-2.70	-2.24	1.08	0.60	1.34	0.00	0.00
6720	-1.78	-0.02	-0.02	-5.98	-10.12	4.83	0.00	-2.51	-2.69	-2.25	1.08	0.61	1.37	0.00	0.00
6780	-1.83	-0.01	-0.01	-6.02	-10.13	4.84	0.00	-2.51	-2.70	-2.25	1.08	0.60	1.33	0.00	8.54
6840	-1.88	-0.02	-0.14	-6.12	-10.18	4.83	0.00	-2.51	-2.69	-2.25	1.07	0.60	1.34	0.00	0.00
6900	-1.92	-0.02	-0.04	-6.18	-10.21	4.83	0.00	-2.51	-2.69	-2.25	1.08	0.61	1.34	0.00	0.00
6960	-1.94	-0.02	-0.03	-6.19	-10.25	4.83	0.00	-2.49	-2.69	-2.26	1.07	0.60	1.32	0.00	0.00
7020	-1.99	-0.02	-0.02	-6.27	-10.29	4.84	0.00	-2.49	-2.67	-2.26	1.06	0.60	1.34	0.00	0.00
7080	-2.01	-0.02	-0.03	-6.38	-10.32	4.82	0.00	-2.49	-2.69	-2.25	1.07	0.61	1.35	0.00	0.00
7140	-1.99	-0.02	-0.03	-6.41	-10.36	4.84	0.00	-2.49	-2.69	-2.25	1.06	0.60	1.36	0.00	0.00
7200	-2.02	-0.02	-0.02	-6.42	-10.38	4.82	0.00	-2.49	-2.68	-2.26	1.07	0.60	1.32	0.00	0.00
7260	-2.01	-0.02	-0.02	-6.45	-10.42	4.84	0.00	-2.49	-2.68	-2.26	1.06	0.60	1.35	0.00	0.00
7320	-2.00	-0.01	-0.02	-6.53	-10.44	4.85	0.00	-2.49	-2.69	-2.26	1.06	0.60	1.33	0.00	9.36
7380	-2.02	-0.02	-0.02	-6.55	-10.46	4.84	0.00	-2.48	-2.69	-2.25	1.06	0.62	1.38	0.00	0.00
7440	-1.72	-0.02	-0.02	-6.55	-10.51	4.83	0.00	-2.48	-2.68	-2.26	1.06	0.60	1.36	0.00	0.00
7500	-1.73	-0.02	-0.03	-6.62	-10.54	4.85	0.00	-2.48	-2.68	-2.26	1.06	0.60	1.34	0.00	0.00
7560	-1.75	-0.01	-0.02	-6.62	-10.57	4.84	0.00	-2.47	-2.69	-2.26	1.06	0.59	1.35	0.00	7.64
7620	-1.77	-0.01	-0.03	-6.56	-10.62	4.84	0.00	-2.46	-2.69	-2.25	1.07	0.60	1.34	0.00	0.00
7680	-1.18	-0.01	-0.02	-6.51	-10.61	4.87	0.00	-2.47	-2.68	-2.25	1.07	0.60	1.38	0.00	3.82
7740	-1.24	-0.01	-0.02	-6.58	-10.65	4.84	0.00	-2.46	-2.68	-2.25	1.06	0.59	1.35	0.00	0.00
7800	-1.28	0.00	-0.01	-6.59	-10.67	4.84	0.00	-2.45	-2.67	-2.25	1.06	0.59	1.38	0.00	0.00
7860	-1.35	-0.01	-0.02	-6.64	-10.70	4.84	0.00	-2.45	-2.65	-2.24	1.07	0.61	1.36	0.00	0.00
7920	-1.38	-0.01	-0.02	-6.68	-10.72	4.84	0.00	-2.46	-2.66	-2.25	1.07	0.60	1.36	0.00	0.00
7980	-1.43	-0.01	-0.02	-6.71	-10.74	4.85	0.00	-2.46	-2.67	-2.24	1.06	0.60	1.37	0.00	0.00
8040	-1.47	-0.02	-0.03	-6.74	-10.80	4.84	0.00	-2.45	-2.66	-2.24	1.07	0.60	1.36	0.00	0.00
8100	-1.16	-0.02	-0.03	-6.76	-10.80	4.83	0.00	-2.44	-2.66	-2.23	1.07	0.60	1.37	0.00	0.00

Data Log Ft Monmouth

Test Start: 4/17/98 11:19:45 GW Pump/VEGE/Air Sparge Test 2

elapsed time (sec)	MP-3(15ft) Press Resp (in WC)	MP-5(12ft) Press Resp (in WC)	MP-4 (9ft) Press Resp (in WC)	MP-2(6ft) Press Resp (in WC)	MP-1(3ft) Press Resp (in WC)	Casing Vacuum (inHg)	Pw+ (psi)	MP-3(15ft) GW DD (feet)	MP-5(12ft) GW DD (feet)	MP-4 (9ft) GW DD (feet)	MP-2(6ft) GW DD (feet)	MP-1 GW DD (feet)	RW-2 GW DD (feet)	IW Flow (scfm)	LoVac Air Flow (scfm)
8160	-0.64	-0.01	-0.02	-6.81	-10.82	4.73	0.00	-2.44	-2.66	-2.24	1.06	0.60	1.35	0.00	0.00
8220	-0.54	-0.03	-0.01	-6.81	-10.83	4.74	0.00	-2.44	-2.65	-2.24	1.07	0.60	1.36	0.00	0.00
8280	-0.46	0.00	-0.02	-6.83	-10.87	4.73	0.00	-2.43	-2.64	-2.23	1.07	0.60	1.38	0.00	0.00
8340	-0.44	0.00	-0.02	-6.85	-10.85	4.92	0.00	-2.43	-2.65	-2.23	1.07	0.60	1.45	0.00	26.22
8400	-0.43	0.00	-0.02	-6.86	-10.85	4.84	0.00	-2.43	-2.65	-2.22	1.06	0.61	1.37	0.00	0.00
8460	-0.48	-0.02	-0.05	-6.94	-10.93	4.86	0.00	-2.43	-2.64	-2.22	1.07	0.60	1.37	0.00	6.62
8520	-0.46	-0.01	-0.03	-6.97	-10.97	4.85	0.00	-2.41	-2.64	-2.22	1.06	0.60	1.41	0.00	0.00
8580	-0.43	-0.02	-0.02	-7.01	-10.96	4.84	0.00	-2.42	-2.64	-2.22	1.07	0.61	1.37	0.00	0.00
8640	-0.45	-0.02	-0.02	-7.04	-11.00	4.84	0.00	-2.41	-2.64	-2.22	1.06	0.60	1.37	0.00	0.00
8700	-0.46	0.01	0.05	-6.70	-10.59	4.84	2.50	-2.41	-2.64	-2.23	0.94	0.60	1.38	17.40	0.00
8760	-0.44	0.01	0.05	-5.60	-8.19	4.85	3.07	-2.42	-2.62	-2.25	0.95	0.68	1.38	5.83	0.00
8820	-0.39	0.01	0.00	-4.13	-5.93	4.84	2.93	-2.42	-2.59	-2.25	0.99	0.77	1.41	1.21	0.00
8880	-0.33	0.01	0.05	-1.30	-2.05	4.84	4.92	-2.42	-2.58	-2.26	0.80	0.83	1.39	0.00	0.00
8940	-0.21	0.01	0.05	0.19	0.50	4.88	4.77	-2.42	-2.53	-2.29	0.69	1.01	1.39	0.00	0.00
9000	-0.09	0.01	0.05	0.19	0.50	4.72	4.71	-2.44	-2.58	-2.33	0.64	1.14	1.41	0.00	0.00
9060	-0.02	0.01	0.05	0.19	0.51	4.81	4.62	-2.46	-2.63	-2.38	0.65	1.20	1.35	0.00	27.80
9120	0.09	0.01	0.05	0.19	0.51	4.88	4.59	-2.47	-2.68	-2.41	0.69	1.25	1.39	0.00	0.00
9180	0.18	0.01	0.29	0.19	0.51	4.91	4.52	-2.51	-2.75	-2.44	0.74	1.28	1.38	0.00	0.00
9240	0.22	0.01	0.24	9.78	12.01	4.87	4.48	-2.53	-2.87	-2.49	0.76	1.28	1.38	0.00	0.00
9300	0.23	0.28	0.20	10.00	12.63	4.77	4.47	-2.55	-2.94	-2.54	0.83	1.29	1.36	0.78	0.00
9360	0.45	0.38	0.17	10.00	13.05	4.92	4.42	-2.57	-2.99	-2.58	0.88	1.28	1.36	0.00	31.54
9420	0.49	0.32	0.13	10.00	13.38	4.91	4.43	-2.59	-3.01	-2.61	0.92	1.26	1.33	0.00	0.00
9480	0.53	0.27	0.11	10.00	13.76	4.92	4.39	-2.64	-3.09	-2.65	0.97	1.26	1.33	0.00	0.00
9540	0.54	0.23	0.09	10.00	14.10	4.88	4.36	-2.66	-3.23	-2.68	1.03	1.25	1.30	0.00	0.00
9600	0.55	0.20	0.07	10.00	14.44	4.80	4.35	-2.69	-3.27	-2.72	1.10	1.24	1.34	0.94	0.00
9660	0.53	0.18	0.09	10.00	14.80	4.91	4.31	-2.72	-3.33	-2.75	1.16	1.24	1.30	0.00	15.77
9720	0.51	0.16	0.09	0.03	1.02	4.91	4.30	-2.75	-3.21	-2.76	1.25	1.24	1.27	0.00	0.00
9780	0.49	0.16	0.13	10.00	15.24	4.90	4.29	-2.78	-3.40	-2.79	1.26	1.22	1.27	0.00	0.00
9840	0.53	0.15	0.15	10.00	15.65	4.89	4.28	-2.81	-3.44	-2.83	1.32	1.23	1.27	0.00	0.00
9900	0.56	0.17	0.19	10.00	15.59	4.82	4.41	-2.84	-3.49	-2.87	1.31	1.21	1.26	0.72	13.23
9960	0.53	0.17	0.14	10.00	15.57	4.93	4.43	-2.86	-3.51	-2.88	1.35	1.20	1.25	0.00	3.83
10020	0.55	0.19	0.18	10.00	15.68	4.91	4.41	-2.90	-3.54	-2.91	1.35	1.19	1.25	0.00	0.00
10080	0.56	0.17	0.22	10.00	15.73	4.95	4.37	-2.93	-3.60	-2.93	1.34	1.17	1.20	0.00	0.00
10140	0.62	0.16	0.21	10.00	15.90	4.79	4.37	-2.95	-3.61	-2.96	1.36	1.17	1.22	0.68	0.00
10200	0.57	0.14	0.15	10.00	16.00	4.90	4.35	-2.98	-3.64	-2.99	1.37	1.17	1.14	0.30	36.07
10260	0.60	0.16	0.20	10.00	16.16	4.96	4.32	-3.00	-3.67	-3.01	1.38	1.16	1.18	0.00	0.00
10320	0.66	0.16	0.90	10.00	16.23	4.94	4.33	-3.03	-3.69	-3.02	1.40	1.16	1.15	0.00	0.00
10380	0.60	0.18	0.26	10.00	16.29	4.95	4.31	-3.04	-3.74	-3.04	1.41	1.14	1.15	0.00	0.00
10440	0.56	0.18	0.33	10.00	16.37	4.81	4.29	-3.07	-3.79	-3.04	1.41	1.14	1.15	0.86	0.00
10500	0.54	0.11	0.40	10.00	16.37	4.95	4.28	-3.08	-3.69	-3.04	1.42	1.14	1.16	0.00	31.33
10560	0.53	0.07	0.52	10.00	16.42	4.94	4.28	-3.12	-3.82	-3.09	1.41	1.14	1.13	0.00	0.00
10620	0.51	0.10	0.45	10.00	16.50	4.94	4.25	-3.12	-3.87	-3.10	1.42	1.13	1.11	0.00	0.00
10680	0.53	0.07	0.38	10.00	16.54	4.92	4.24	-3.15	-3.84	-3.13	1.43	1.14	1.08	0.00	0.00
10740	0.53	0.09	0.48	10.00	16.58	4.82	4.24	-3.16	-3.90	-3.16	1.43	1.11	1.06	0.80	0.00
10800	0.54	0.05	0.39	10.00	16.58	4.95	4.24	-3.18	-3.88	-3.17	1.44	1.13	1.08	0.00	13.80
10860	0.63	0.08	0.54	10.00	16.65	4.92	4.22	-3.19	-3.91	-3.19	1.45	1.13	1.06	0.00	0.00
10920	0.59	0.10	0.40	10.00	16.66	4.91	4.21	-3.20	-3.97	-3.20	1.45	1.13	1.03	0.00	0.00
10980	0.66	0.11	0.43	10.00	16.64	4.95	4.21	-3.22	-3.94	-3.20	1.47	1.13	1.07	0.00	7.65
11040	0.49	0.01	0.62	10.00	16.60	4.85	4.20	-3.23	-3.99	-3.20	1.47	1.12	1.03	0.77	0.00
11100	0.53	-0.01	0.61	10.00	16.64	4.94	4.18	-3.24	-4.01	-3.22	1.47	1.12	1.03	0.00	0.00
11160	0.62	0.02	0.45	10.00	16.64	4.94	4.17	-3.25	-4.03	-3.24	1.48	1.12	1.00	0.00	0.00
11220	0.60	-0.01	0.65	10.00	16.64	4.95	4.16	-3.26	-4.03	-3.25	1.49	1.14	1.02	0.00	7.65
11280	0.65	0.02	0.60	10.00	16.65	4.94	4.16	-3.27	-4.06	-3.27	1.49	1.14	1.00	0.00	0.00
11340	0.65	0.02	0.56	10.00	16.61	4.85	4.18	-3.28	-4.03	-3.28	1.49	1.14	0.98	0.91	0.00
11400	0.62	0.40	0.60	10.00	16.58	4.95	4.16	-3.28	-4.03	-3.28	1.50	1.15	0.98	0.00	0.00
11460	0.66	0.49	0.80	10.00	16.57	4.99	4.17	-3.29	-4.08	-3.29	1.50	1.16	1.00	0.00	10.13
11520	0.63	0.49	0.81	10.00	16.51	4.95	4.15	-3.30	-4.09	-3.29	1.48	1.16	0.97	0.00	0.00
11580	0.69	0.47	0.75	10.00	16.45	4.89	4.14	-3.31	-4.10	-3.29	1.50	1.17	1.01	0.77	0.00
11640	0.72	0.49	0.85	10.00	16.53	4.99	4.11	-3.31	-4.05	-3.29	1.52	1.18	0.98	0.64	49.48
11700	0.63	0.47	0.83	10.00	16.46	4.95	4.11	-3.31	-4.06	-3.31	1.53	1.19	0.94	0.21	0.00
11760	0.71	0.50	0.87	10.00	16.44	4.95	4.12	-3.32	-4.10	-3.32	1.53	1.19	0.93	0.21	0.00
11820	0.77	0.50	0.81	10.00	16.40	4.98	4.08	-3.31	-4.12	-3.31	1.54	1.20	0.93	0.21	0.00
11880	0.69	0.45	0.77	10.00	16.28	4.85	4.08	-3.31	-4.09	-3.31	1.54	1.21	0.93	0.96	3.82
11940	0.83	0.48	0.85	10.00	16.36	4.98	4.09	-3.31	-4.10	-3.31	1.55	1.22	0.94	0.52	31.33
12000	0.83	0.49	0.88	10.00	16.29	4.95	4.07	-3.32	-4.13	-3.32	1.54	1.22	0.88	0.30	0.00
12060	0.82	0.50	0.88	10.00	16.28	4.95	4.08	-3.32	-4.10	-3.32	1.56	1.22	0.88	0.48	0.00
12120	0.82	0.50	0.88	10.00	16.23	4.96	4.05	-3.31	-4.13	-3.31	1.57	1.23	0.91	0.30	0.00
12180	0.80	0.50	0.89	10.00	16.17	4.87	4.05	-3.32	-4.10	-3.29	1.57	1.25	0.90	0.88	0.00
12240	0.74	0.48	0.86	10.00	16.14	4.96	4.05	-3.32	-4.10	-3.31	1.58	1.24	0.88	0.37	11.48
12300	0.75	0.50	0.89	10.00	16.07	4.97	4.04	-3.30	-4.12	-3.30	1.58	1.24	0.89	0.21	8.56
12360	0.76	0.49	0.89	10.00	16.01	4.96	4.01	-3.30	-4.10	-3.29	1.59	1.26	0.87	0.37	0.00

Data Log

Ft Monmouth

Test Start: 4/17/98 10:51:05 SVE Test 1

elapsed time (sec)	MP-3 Vac Resp (in WC)	MP-5 Vac Resp (in WC)	MP-4 Vac Resp (in WC)	MP-2 Vac Resp (in WC)	MP-1 Vac Resp (in WC)	Casing Vacuum (inHg)	MP-3 GW DD (feet)	MP-5 GW DD (feet)	MP-4 GW DD (feet)	MP-2 GW DD (feet)	MP-1 GW DD (feet)	VP-1 GW DD (feet)	LoVac Air Flow (scfm)
5	-0.01	-0.01	-0.05	-0.02	-0.06	0.02	0.60	0.70	0.67	0.00	-0.06	-0.31	104.21
10	-0.01	-0.01	-0.05	-0.02	-0.05	0.00	0.60	0.71	0.67	0.00	-0.07	-0.30	104.48
15	-0.01	-0.01	-0.05	-0.02	0.89	4.80	0.59	0.71	0.67	0.01	-0.08	1.65	200.83
20	-0.01	-0.01	-0.05	0.04	3.00	4.78	0.59	0.70	0.67	-0.01	-0.15	1.29	218.47
25	-0.01	-0.01	-0.05	0.14	4.27	4.73	0.58	0.71	0.67	-0.01	-0.24	0.76	218.32
30	-0.01	-0.01	-0.05	0.28	5.15	5.16	0.57	0.70	0.67	0.00	-0.32	0.75	196.28
35	-0.01	-0.01	-0.05	0.40	5.83	5.16	0.57	0.71	0.68	-0.01	-0.38	0.62	175.67
40	-0.01	-0.01	-0.05	0.52	6.38	5.68	0.57	0.71	0.68	-0.02	-0.42	0.69	161.36
45	-0.01	-0.01	-0.05	0.63	6.77	5.60	0.57	0.70	0.67	-0.03	-0.46	0.53	140.42
50	-0.01	-0.01	-0.05	0.73	7.12	5.63	0.57	0.70	0.67	-0.05	-0.51	0.46	118.39
55	-0.01	-0.01	-0.05	0.82	7.27	5.62	0.57	0.70	0.67	-0.05	-0.52	0.38	99.62
60	-0.01	-0.01	-0.05	0.88	7.42	5.59	0.57	0.71	0.67	-0.05	-0.54	0.39	80.81
65	-0.01	-0.01	-0.05	0.94	7.64	5.62	0.57	0.71	0.68	-0.05	-0.55	0.25	63.94
70	-0.01	-0.01	-0.05	1.00	7.78	5.60	0.58	0.71	0.68	-0.05	-0.57	0.28	54.62
75	-0.01	-0.01	-0.05	1.05	7.93	5.60	0.57	0.71	0.68	-0.06	-0.57	0.39	42.46
80	-0.01	-0.01	-0.05	1.08	8.01	5.44	0.57	0.71	0.68	-0.06	-0.58	0.52	28.83
85	-0.01	-0.01	-0.05	1.11	8.08	5.57	0.57	0.71	0.68	-0.06	-0.59	0.70	25.31
90	-0.01	-0.01	-0.05	1.14	8.16	5.43	0.57	0.70	0.67	-0.06	-0.60	0.73	0.00
95	-0.01	-0.01	-0.05	1.16	8.19	5.54	0.58	0.72	0.68	-0.06	-0.62	0.80	0.00
100	-0.01	-0.01	-0.05	1.18	8.25	5.48	0.58	0.71	0.68	-0.07	-0.61	0.81	0.00
105	-0.01	-0.01	-0.05	1.20	8.27	5.48	0.57	0.70	0.67	-0.06	-0.62	0.86	0.00
110	-0.01	-0.01	-0.05	1.22	8.29	5.48	0.57	0.71	0.67	-0.06	-0.63	0.88	0.00
115	-0.01	-0.01	-0.05	1.25	8.83	5.43	0.56	0.70	0.67	-0.08	-0.62	0.89	0.00
120	0.00	-0.01	-0.05	1.29	9.45	5.49	0.60	0.70	0.68	-0.07	-0.67	0.88	0.00
125	0.00	-0.01	-0.05	1.34	9.46	5.41	0.56	0.71	0.67	-0.07	-0.70	0.89	0.00
130	0.00	-0.01	-0.05	1.36	9.46	5.44	0.56	0.70	0.67	-0.07	-0.71	0.90	0.00
135	0.01	-0.01	-0.05	1.39	9.38	5.48	0.55	0.70	0.67	-0.07	-0.70	0.91	0.00
140	0.02	-0.01	-0.05	1.41	9.37	5.44	0.56	0.70	0.66	-0.08	-0.71	0.85	0.00
145	0.02	-0.01	-0.05	1.43	9.42	5.41	0.60	0.70	0.67	-0.08	-0.71	0.84	0.00
150	0.03	-0.01	-0.05	1.44	9.58	5.38	0.57	0.70	0.67	-0.07	-0.71	0.89	0.00
155	0.04	-0.01	-0.05	1.46	9.73	5.38	0.56	0.71	0.67	-0.07	-0.74	0.86	0.00
160	0.04	-0.01	-0.05	1.48	9.69	5.38	0.55	0.70	0.67	-0.07	-0.74	0.88	0.00
165	0.05	-0.01	-0.05	1.50	9.69	5.32	0.60	0.70	0.67	-0.07	-0.73	0.81	0.00
170	0.05	-0.01	-0.05	1.50	9.69	5.32	0.57	0.71	0.68	-0.07	-0.74	0.92	0.00
175	0.05	-0.01	-0.05	1.51	9.63	5.38	0.59	0.71	0.67	-0.07	-0.74	0.88	0.00
180	0.05	-0.01	-0.05	1.52	9.59	5.40	0.56	0.70	0.67	-0.07	-0.74	0.90	0.00
185	0.06	-0.01	-0.05	1.52	9.50	5.42	0.56	0.70	0.68	-0.06	-0.73	0.90	0.00
190	0.06	-0.01	-0.05	1.52	9.50	5.42	0.56	0.71	0.67	-0.07	-0.73	0.87	0.00
195	0.07	-0.01	-0.05	1.53	9.44	5.46	0.57	0.70	0.67	-0.06	-0.74	0.90	0.00
200	0.07	-0.01	-0.05	1.53	9.44	5.46	0.57	0.70	0.67	-0.07	-0.74	0.87	0.00
205	0.07	-0.01	-0.05	1.51	9.38	5.32	0.56	0.70	0.67	-0.07	-0.74	0.89	0.00
210	0.08	-0.01	-0.05	1.49	9.32	5.40	0.56	0.70	0.66	-0.07	-0.74	0.87	0.00
215	0.09	-0.01	-0.05	1.49	9.28	5.37	0.55	0.70	0.67	-0.07	-0.74	0.86	0.00
220	0.10	-0.01	-0.05	1.49	9.23	5.36	0.57	0.70	0.68	-0.06	-0.74	0.86	0.00
225	0.10	-0.01	-0.05	1.49	9.16	5.40	0.57	0.71	0.67	-0.06	-0.74	0.87	0.00
230	0.11	-0.01	-0.05	1.49	9.15	5.34	0.57	0.71	0.67	-0.06	-0.73	0.88	0.00
235	0.12	-0.01	-0.05	1.49	9.05	5.31	0.56	0.70	0.67	-0.07	-0.74	0.82	0.00
240	0.13	-0.01	-0.05	1.48	8.86	5.38	0.57	0.70	0.67	-0.06	-0.73	0.83	0.00
245	0.14	-0.01	-0.05	1.47	8.89	5.35	0.56	0.70	0.67	-0.06	-0.73	0.77	0.00
250	0.15	-0.01	-0.05	1.47	8.85	5.27	0.57	0.70	0.67	-0.06	-0.73	0.71	0.00
255	0.18	-0.01	-0.05	1.48	8.92	5.22	0.57	0.70	0.67	-0.05	-0.72	0.67	0.00
260	0.22	-0.01	-0.05	1.48	8.99	5.38	0.57	0.71	0.68	-0.05	-0.73	0.74	0.00
265	0.28	-0.01	-0.05	1.48	8.86	5.27	0.57	0.71	0.67	-0.05	-0.73	0.67	0.00
270	0.33	-0.01	-0.05	1.48	8.71	5.28	0.57	0.70	0.67	-0.05	-0.74	0.64	0.00
275	0.37	-0.01	-0.05	1.48	8.66	5.27	0.57	0.70	0.67	-0.05	-0.73	0.59	0.00
280	0.39	-0.01	-0.05	1.47	8.64	5.24	0.57	0.71	0.67	-0.06	-0.73	0.57	0.00
285	0.40	-0.01	-0.05	1.48	8.59	5.30	0.57	0.71	0.68	-0.05	-0.73	0.58	0.00
290	0.40	-0.01	-0.05	1.47	8.56	5.26	0.56	0.70	0.67	-0.05	-0.71	0.53	0.00
295	0.40	-0.01	-0.05	1.47	8.56	5.26	0.56	0.70	0.66	-0.05	-0.72	0.52	0.00
300	0.40	-0.01	-0.05	1.47	8.51	5.27	0.57	0.71	0.67	-0.05	-0.72	0.50	0.00
305	0.40	-0.01	-0.05	1.47	8.51	5.27	0.57	0.71	0.67	-0.05	-0.72	0.46	0.00
310	0.40	-0.01	-0.05	1.46	8.46	5.22	0.57	0.71	0.68	-0.05	-0.71	0.42	0.00
315	0.40	-0.01	-0.05	1.47	8.46	5.23	0.56	0.71	0.67	-0.05	-0.72	0.38	0.00
320	0.40	-0.01	-0.05	1.47	8.56	5.26	0.56	0.70	0.67	-0.06	-0.71	0.41	0.00
325	0.40	-0.01	-0.05	1.47	8.58	5.20	0.57	0.70	0.67	-0.04	-0.73	0.38	0.00
330	0.40	-0.01	-0.05	1.48	8.59	5.27	0.57	0.72	0.68	-0.03	-0.73	0.36	0.00
335	0.40	-0.01	-0.05	1.48	8.65	5.23	0.57	0.70	0.67	-0.03	-0.74	0.33	0.00
340	0.40	-0.01	-0.05	1.48	8.59	5.18	0.56	0.70	0.67	-0.04	-0.74	0.31	0.00
345	0.39	-0.01	-0.05	1.48	8.55	5.22	0.57	0.71	0.68	-0.04	-0.73	0.31	0.00

Data Log

Ft Monmouth

Test Start: 4/17/98 10:51:05 SVE Test 1

elapsed time (sec)	MP-3 Vac Resp (in WC)	MP-5 Vac Resp (in WC)	MP-4 Vac Resp (in WC)	MP-2 Vac Resp (in WC)	MP-1 Vac Resp (in WC)	Casing Vacuum (inHg)	MP-3 GW DD (feet)	MP-5 GW DD (feet)	MP-4 GW DD (feet)	MP-2 GW DD (feet)	MP-1 GW DD (feet)	VP-1 GW DD (feet)	LoVac Air Flow (scfm)
350	0.39	-0.01	-0.05	1.48	8.52	5.23	0.57	0.70	0.67	-0.05	-0.74	0.27	0.00
355	0.39	-0.01	-0.05	1.48	8.54	5.21	0.57	0.71	0.67	-0.05	-0.74	0.25	0.00
360	0.39	-0.01	-0.05	1.48	8.54	5.20	0.58	0.71	0.67	-0.03	-0.74	0.23	0.00
365	0.39	-0.01	-0.05	1.48	8.52	5.23	0.57	0.70	0.67	-0.04	-0.75	0.22	0.00
370	0.39	-0.01	-0.05	1.48	8.53	5.24	0.57	0.71	0.67	-0.03	-0.74	0.19	0.00
375	0.39	-0.01	-0.05	1.48	8.53	5.18	0.57	0.71	0.68	-0.03	-0.74	0.16	0.00
380	0.39	-0.01	-0.05	1.49	8.58	5.18	0.57	0.71	0.67	-0.05	-0.75	0.16	0.00
385	0.39	-0.01	-0.05	1.49	8.63	5.20	0.56	0.70	0.67	-0.03	-0.75	0.12	0.00
390	0.39	-0.01	-0.05	1.49	8.64	5.22	0.57	0.71	0.67	-0.03	-0.75	0.11	7.68
395	0.39	-0.01	-0.05	1.49	8.66	5.18	0.56	0.71	0.67	-0.04	-0.76	0.05	0.00
400	0.39	-0.01	-0.05	1.49	8.68	5.18	0.56	0.70	0.67	-0.03	-0.76	0.06	0.00
405	0.39	-0.01	-0.05	1.50	8.76	5.18	0.57	0.71	0.67	-0.03	-0.76	0.02	0.00
410	0.39	-0.01	-0.05	1.50	8.74	4.67	0.56	0.70	0.67	-0.03	-0.76	-0.24	0.00
415	0.39	-0.01	-0.05	1.50	8.72	5.21	0.57	0.71	0.68	-0.03	-0.76	-0.02	0.00
420	0.39	-0.01	-0.05	1.50	8.71	5.16	0.57	0.71	0.67	-0.03	-0.77	-0.04	0.00
425	0.39	-0.01	-0.05	1.50	8.71	5.22	0.56	0.71	0.67	-0.03	-0.78	-0.01	0.00
430	0.39	-0.01	-0.04	1.51	8.71	5.19	0.57	0.71	0.68	-0.02	-0.79	-0.08	0.00
435	0.39	-0.01	-0.04	1.51	8.71	5.14	0.55	0.70	0.67	-0.03	-0.79	0.04	0.00
440	0.39	-0.01	-0.05	1.50	8.71	5.20	0.57	0.71	0.67	-0.03	-0.76	0.06	0.00
445	0.38	-0.01	-0.05	1.49	8.68	5.10	0.56	0.70	0.67	-0.03	-0.76	-0.08	0.00
450	0.38	-0.01	-0.05	1.49	8.69	5.07	0.57	0.70	0.67	-0.02	-0.77	-0.09	19.17
455	0.38	-0.01	-0.05	1.49	7.75	0.08	0.57	0.71	0.68	-0.02	-0.77	-2.33	0.00

APPENDIX VIII

LOPRO DESIGN UTILITY REPORT

Contaminant	Influent	Required Effluent	Calculated Effluent	Excess Level	Removal Efficiency
BENZENE	13169	7	72.58	65.58	0.9945
TOLUENE	19177	19.2	85.38	66.18	0.9956
ETHYLBENZENE	1996	2	11.07	9.07	0.9944
XYLENE	10987	11	44.49	33.49	0.996
MTBE	623	70	170.56	100.56	0.7262

Date: 4/30/99
Time: 2:35:54 PM
Name: Paul Clark
Project Name:
Ft. Monmouth Bldg 699
Project Number:
Model Run #1
Program Mode: Automatic

Classification: Class 1, Div 2
Blower Type: 5 HP TEFC Rotron
Voltage: 208 - 230 Volts, 3 Ph, 60 Hz
Temperature: 50.00 Degrees F
Start at: 233 Cubic Feet/Minute
Clean trays at: 223 Cubic Feet/Minute
Number Trays: 8
Tray height: 10 Inches
Flow rate: 15 Gallons/Minute
Air/Water ratio: 111.19

NOTE: all influent/effluent values are in ppb.

LOPRO DESIGN UTILITY REPORT

Contaminant	Influent	Required Effluent	Calculated Effluent	Excess Level	Removal Efficiency
BENZENE	13169	7	6.82	0.0	0.9995
TOLUENE	19177	19.2	7.98	0.0	0.9996
ETHYLBENZENE	1996	2	1.04	0.0	0.9995
XYLENE	10987	11	4.15	0.0	0.9996
MTBE	623	70	28.88	0.0	0.9536

Date: 4/30/99
Time: 2:36:09 PM
Name: Paul Clark
Project Name:
Ft. Monmouth Bldg 699
Project Number:
Model Run #2
Program Mode: Automatic

Classification: Class 1, Div 2
Blower Type: 10 HP Spencer
Voltage: 220 - 240 Volts, 3 Ph, 60 Hz
Temperature: 50.00 Degrees F
Start at: 1112 Cubic Feet/Minute
Clean trays at: 732 Cubic Feet/Minute
Number Trays: 3
Tray height: 13 Inches
Flow rate: 15 Gallons/Minute
Air/Water ratio: 365.

NOTE: all influent/effluent values are in ppb.

ShallowTray™
low profile air strippers

System Performance Estimate

Client and Proposal Information:

Ft. Monmouth
Bldg 699
Model Run 3

Model Chosen:	1300
Water Flow Rate:	15.0 gpm
Air Flow Rate:	150 cfm
Water Temp:	50.0 F
Air Temp:	50.0 F
A/W Ratio:	74.8
Safety Factor:	10%

Contaminant	Untreated Influent Effluent Target	Model 1311 Effluent Water Air(lbs/hr) % removal	Model 1321 Effluent Water Air(lbs/hr) % removal	Model 1331 Effluent Water Air(lbs/hr) % removal	Model 1341 Effluent Water Air(lbs/hr) % removal
Benzene	**13169 ppb** 7 ppb	**2638 ppb** 0.079017 79.9714%	**529 ppb** 0.094842 95.9886%	**106 ppb** 0.098016 99.1966%	**22 ppb** 0.098646 99.8391%
Toluene	**19177 ppb** 19 ppb	**4218 ppb** 0.112242 78.0085%	**928 ppb** 0.136928 95.1637%	**204 ppb** 0.142360 98.9364%	**45 ppb** 0.143553 99.7661%
Ethyl Benzene	**1996 ppb** 2 ppb	**370 ppb** 0.012200 81.4811%	**69 ppb** 0.014459 96.5705%	**13 ppb** 0.014879 99.3649%	**3 ppb** 0.014954 99.8824%
p-Xylene	**10987 ppb** 11 ppb	**2156 ppb** 0.066262 80.3839%	**423 ppb** 0.079265 96.1521%	**83 ppb** 0.081816 99.2452%	**17 ppb** 0.082311 99.8519%
MTBE	**623 ppb** 70 ppb	**499 ppb** 0.000930 19.9999%	**399 ppb** 0.001681 35.9998%	**319 ppb** 0.002281 48.7998%	**256 ppb** 0.002754 59.0398%

This report has been generated by ShallowTray Modeler software version 2.1W. This software is designed to assist a skilled operator in predicting the performance of a ShallowTray air stripping system. North East Environmental Products, Inc. is not responsible for incidental or consequential damages resulting from the improper operation of either the software or the air stripping equipment.
Report generated: 4/30/1999

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ShallowTray™
low profile air strippers

System Performance Estimate

Client and Proposal Information:

Ft. Monmouth

Model Chosen:	2300
Water Flow Rate:	15.0 gpm
Air Flow Rate:	300 cfm
Water Temp:	50.0 F
Air Temp:	50.0 F
A/W Ratio:	149.6
Safety Factor:	10%

Contaminant	Untreated Influent Effluent Target	Model 2311 Effluent Water Air(lbs/hr) % removal	Model 2321 Effluent Water Air(lbs/hr) % removal	Model 2331 Effluent Water Air(lbs/hr) % removal	Model 2341 Effluent Water Air(lbs/hr) % removal
Benzene	**13169 ppb** 7 ppb	**924 ppb** 0.091878 92.9903%	**65 ppb** 0.098323 99.5086%	**5 ppb** 0.098773 99.9656%	**1 ppb** 0.098804 99.9976%
Toluene	**19177 ppb** 19 ppb	**1564 ppb** 0.132156 91.8467%	**128 ppb** 0.142930 99.3352%	**11 ppb** 0.143808 99.9458%	**1 ppb** 0.143883 99.9956%
Ethyl Benzene	**1996 ppb** 2 ppb	**124 ppb** 0.014046 93.8243%	**8 ppb** 0.014917 99.6186%	**1 ppb** 0.014969 99.9764%	**<1 ppb** 0.014976 99.9985%
p-Xylene	**10987 ppb** 11 ppb	**745 ppb** 0.076849 93.2221%	**51 ppb** 0.082056 99.5406%	**4 ppb** 0.082409 99.9689%	**<1 ppb** 0.082437 99.9979%
MTBE	**623 ppb** 70 ppb	**313 ppb** 0.002326 49.8908%	**157 ppb** 0.003497 74.8906%	**79 ppb** 0.004082 87.4179%	**40 ppb** 0.004374 93.6952%

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Report generated: 4/30/1999

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GROUNDWATER TREATMENT SYSTEM
INFLUENT CONCENTRATION CALCULATIONS

Department of the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

Well	Sample Date	Benzene	Toluene	Ethylbenzene	Xylene	MTBE
MW-1	7/29/99	22228	35849	3025	19011	12
MW-11	7/29/99	4110	2504	967	2962	1233
		13169	**19177**	**1996**	**10987**	**623**

GROUNDWATER TREATMENT SYSTEM DESIGN CALCULATIONS

Department of the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

I. Influent Concentrations (Design)[1]

Benzene =	13,169 ppb[2]
Toluene =	19,177 ppb[2]
Ethylbenzene =	1,996 ppb[2]
Xylene =	10,987 ppb[2]
MTBE =	623 ppb[2]

1 - Groundwater will be recovered via electric, submersible pumps from one (1) existing recovery well and two (2) proposed recovery wells in order to enhance vapor extraction.
2 - In order to estimate the influent concentrations of the BTEX compounds, groundwater samples from MW-1 and MW-11 and influent groundwater system samples from MW-11 were utilized. MW-1 is close to the proposed location of RW-3 and MW-11 is the existing recovery well.

II. Effluent Concentrations (Permit Limitation)

	Monthly Average	Daily Maximum
Total Suspended Solids (mg/L)[3]	---	40
Petroleum Hydrocarbons (mg/L)[3]	10	15
Total Organic Carbon (mg/L)[3]	---	20
pH Range (S.U.)[3]	6.0 Min. - 9.0 Max.	
Benzene (ug/L)[3]		7
MTBE (ug/L)[3]	85% Removal or 70 ppb	
Naphthalene (ug/L)[3]	22	59

3 - Based on typical New Jersey Pollutant Discharge Elimination System / Discharge to Surface Water (NJPDES / DSW) permit limitations.

III. Treatment System Flowrate

A maximum of 3 wells shall be utilized for groundwater recovery.

Estimated Flowrate =	5.00 gpm/well[4] * 3 wells	≅	15.0	gpm (System Total)
Peak Flowrate (Design) =	15.0 gpm			

4 - Based on the groundwater recovery rates measured under vacuum enhanced groundwater extraction during the pilot test conducted on pril 17, 1998. Historical pumping data from the existing groundwater system indicates that a much lower flowrate might be expected erhaps 3 to 6 gpm total). It is expected that soil vapor extraction (SVE) will enhance groundwater extraction as it did in the pilot test.

IV. Granular Activated Carbon Design Calculations When Air Stripping Is Not Included In The Treatment System

1) Size Carbon Units

Determine Minimum Diameter Of Carbon Units

Design Flowrate (Peak Flow) =	15.0	gpm			
Maximum Acceptable Hydraulic Loading[5] =	4	gpm/sq. ft.			
Minimum Cross-Sectional Area Of Carbon Units =	15 / 4	gpm / gpm/sq. ft.	=	3.75	sq. ft.
Minimum Diameter Of Carbon Units =	26	inches			

5 - Empirical value supplied by Cetco, Arlington Heights, IL and Norit Americas, Inc., Atlanta, GA.

Determine Contact Time

For 99.9% Removal Of BTEX Compounds[6]:

Contact Time = 15-20 minutes

For 99.99% Removal Of BTEX Compounds[6]:

Contact Time = 20-25 minutes

For 99.9% Removal Of BTEX Compounds and MTBE[6]:

Contact Time = 20-25 minutes

For 99.99% Removal Of BTEX Compounds and MTBE[6]:

Contact Time = 25-30 minutes

- Empirical value supplied by Cetco, Arlington Heights, IL

Calculate Bed Volume

A 30-minute contact time is chosen for design purposes. Based on the information provided above, this should correspond to a removal efficiency of approximately 99.99% for BTEX and MTBE.

15 gpm x 30 min = 450 gal = 60 cu. ft.

Recommended Granular Activated Carbon Units

Number Of Carbon Units In Series =	3	units
Diameter Of Carbon Units =	42	inches
42 inches >	26	inches
Weight Of Carbon Per Unit =	750	lbs
Volume Of Carbon Per Unit =	27	cu. ft.
Total Volume of Carbon =	81	cu. ft.
81 cu. ft. >	60	cu. ft.

Since granular activated carbon (GAC) would be the primary treatment technology, the first two GAC vessels (the primary unit) are sized to provide the required contact time for 99.99% removal of BTEX and MTBE. The third vessel is provided for safety.

2) Estimate Carbon Usage

Calculate Pounds Of Total Adsorbable Organics (TAO) Per Day

Estimated organic loading (Section I)

Benzene =	13,169 ppb
Toluene =	19,177 ppb
Ethyl Benzene =	1,996 ppb
Xylene =	10,987 ppb
MTBE =	623 ppb
TAO =	51,058 ppb[7]

7 - Assumes BTEX and MTBE account for 90% of the total adsorbable organics (TAO).

$$\text{TAO (lb/day)} = 51.06 \text{ ppm} \times 15 \text{ gpm} \times 0.012 \frac{\text{lb/day}}{\text{gpm - ppm}} = 9.19 \text{ lb/day}$$

Calculate Pounds Of MTBE Per Day

$$\text{MTBE (lb/day)} = \frac{623 \text{ ppb}}{51{,}058 \text{ ppb}} \times 9.19 \text{ lb/day} = 0.11 \text{ lb/day}$$

Calculate Granular Activated Carbon Usage For MTBE

MTBE = 623 ppb

Adsorption Capacity From MTBE Isotherm[8] = 0.42 %

$$\frac{0.11 \text{ lb/day}}{0.42 \%} = 26.71 \text{ lb/day}$$ Granular Activated Carbon Required For MTBE Adsorption

8 - Freundlich coefficients deduced from Freundlich isotherm supplied by Norit Americas, Inc., Atlanta, GA, (k = .308, 1/n = .406) The isotherm provided is valid for a residual concentration range of 10 to 10,000 ug/L. As a conservative estimate of the adsorption capacity for concentrations above this range, the value for a concentration of 10,000 ug/L is used as opposed to extrapolating the isotherm to the specific value.

Calculate Granular Activated Carbon Usage For Remainder of TAO

Assume that the benzene isotherm is adequate for characterizing the remaining TAO

Remaining TAO = TAO - MTBE

Remaining TAO (lb/day) = 9.19 lb/day - 0.11 lb/day = 9.08 lb/day

Remaining TAO (ppb) = 51,058 ppb - 623 ppb = 50,435 ppb

Remaining TAO (ppb) = 50,435 ppb

Adsorption Capacity From Benzene Isotherm[9] = 21.27 %

$$\frac{9.08 \text{ lb/day}}{21.27 \%} = 42.68 \text{ lb/day}$$ Granular Activated Carbon Required For Remaining TAO Adsorption

9 - Based on Freundlich isotherm supplied by Norit Americas, Inc., Atlanta, GA, (k = 2.021, 1/n = 0.43). The isotherm provided is valid for a residual concentration range of 0.1 to 100,000 ug/L. As a conservative estimate of the adsorption capacity for concentrations above this range, the value for a concentration of 100,000 ug/L is used as opposed to extrapolating the isotherm to the specific value.

Total Granular Activated Carbon Usage

Total Carbon Usage = Carbon Usage For Remaining TAO + Carbon Usage For MTBE

Total Carbon Usage = 42.68 lb/day + 26.71 lb/day = 69.39 lbs

Increase carbon usage by an additional 5% due to adsorption interference from background organics. This assumes naturally occurring background organics are at a concentration of 1 - 2 ppm in the groundwater. (Based on information provided by Cetco, Arlington Heights, IL.)

1.05 x 69.39 lb/day = 73 lb/day Total Granular Activated Carbon Usage

3) Estimate Breakthrough Time Per 1,500 Pounds Of Carbon

1,500 lbs / 73 lb/day = 20.6 Days Until Breakthrough For 1,500 lbs of Carbon

4) Estimate Carbon Costs

Assume a carbon rebed cost of $1.76/lb (Price based on Carbon Service & Equipment Company, 1999 GES pricing.)

Carbon Costs = $1.76 /lb x 73 lb/day = $128 /day = $3,975 /month

V. Air Stripper Design Calculations

The air stripper was sized using the Lopro Design Utility software version 3.13, provided by ORS Environmental Systems, Denver, CO, and the ShallowTray Modeler software version 2.1W, provided by North East Environmental Products, Inc., West Lebanon, NH (NEEP). The Lopro Design Utility was run for the Lopro II and Lopro III series air strippers. The ShallowTray Modeler was run in the automatic mode with a 10% safety factor. Four different model air runs were performed to determine the most cost-effective solution. The model runs are summarized below and the corresponding reports generated by the software are provided at the end of this section.

The models were run for the influent concentrations described below. The effluent limitation for benzene input into the models corresponds to the required effluent concentration for a typical New Jersey Pollutant Discharge Elimination System / Discharge to Surface Water (NJPDES / DSW) permit. This provides a safety factor in the event the carbon adsorption units break through. Since it is unlikely that benzene will be desorbed from a spent carbon bed, the effluent concentration should be less than the influent concentration to the carbon units. Therefore the treatment process is designed in order to meet these requirements. The effluent limitations input for toluene, ethylbenzene and xylene correspond to 99.99% removal, though the removal is typically higher due to the stringent benzene requirement. Since MTBE is not readily removed by the air stripping process, even the low influent concentration anticipated for this site would significantly increase the size of the air stripper if the monthly average NJPDES / DSW permit limitation was used for design of the air stripper. However, carbon adsorption is very effective in removing MTBE, therefore there will be no difficulty in meeting the effluent limitation. Therefore, the granular activated carbon will be used to reduce the remaining MTBE in the air stripper effluent to below the permit limitation.

Since it is desirable to operate the air stripping system without off-gas treatment, the maximum emissions of toxic compounds (TOX) must be limited to 0.1 lb/hr and the maximum emissions of non-methane volatile organic compounds (VOC) must be limited to 0.5 lb/hr as per the New Jersey Department of Environmental Protection Bureau of New Source Review (BNSR). The following equation is utilized to convert the influent TOX and VOC concentrations to pounds per hour. It is then assumed, as is required by the BNSR, that 100% of the liquid phase influent TOX and VOC are exchanged to the vapor phase.

Process Rate (lb/hr) = Flow Rate (gpm) x Concentration (ug/L) x Conversion Factor

Conversion Factor = (60 mins/hr) x (2.2×10^{-9} lb/ug) x (3.788 L/gal) = 5.0×10^{-7} min-lb-L/hr-ug-gal

Concentration (ug/L) = Process Rate (lb/hr) / [Flowrate (gpm) x 5.0×10^{-7}]

Maximum Concentration = 0.1 lb/hr / (15.0 gpm x 5E-07)

Maximum Concentration = 13,169 ug/L Benzene (TOX)

Maximum Concentration = 0.5 lb/hr / (15.0 gpm x 5E-07)

Maximum Concentration = 66,667 ug/L Total Non-Methane VOC

Estimated organic loading to the air stripper based on maximum air emissions of 0.1 and 0.5 lb/hr TOX and non-methane VOC, respectively:

Since the concentrations determined above are greater than the influent design concentrations indicated in Section I, the total system flowrate will not need to be adjusted in order to reduce the total mass flow of benzene and total VOC to less than 0.1 lb/hr and 0.5 lb/hr, respectively.

Benzene =	13,169 ppb
Toluene =	19,177 ppb
Ethyl Benzene =	1,996 ppb
Xylene =	10,987 ppb
MTBE =	623 ppb
TAO =	51,058 ppb[10]

10 - Assumes BTEX and MTBE account for 90% of the total adsorbable organics (TAO).

Model Run Summaries:

All model runs utilize a design water flowrate of 15 gpm, the influent concentrations, and effluent limitations detailed above. Based on model runs 1 and 3, neither the Lopro II or the Series 1300 Shallowtray air strippers are able to achieve the effluent limits. As indicated in model run 2, the Lopro III is able to achieve the desired effluent limitation for benzene by a mere 0.18 ppb. The Lopro III is able the achieve all the desired effluent limitations for the other compounds including MTBE. Model Run 4 indicates that the ShallowTray 2341 air stripper is capable of achieving the desired effluent limitations for all the compounds.

Based on the above information, the air stripper model selected is the NEEP ShallowTray 2341-P. The granular activated carbon system described in Section VI of the report will be utilized to provide secondary treatment and polishing of the groundwater treatment system discharge. The "P" suffix on the model number indicates a polyethylene unit, as opposed to the standard stainless steel unit, will be utilized; VOC removal efficiencies for the two units are identical, while the capital cost of the polyethylene unit is significantly less than the stainless steel unit.

RUN 1

Flowrate: 15 gpm
Influent Concentrations: Design Concentrations Provided Above
Effluent Concentrations: Permit Limitations For Volatile Organic Compounds (VOC) Provided in Section II
Software Model: Automatic - Air Stripper Limited to Lopro II Series
Air Stripper Model Selected: Lopro II (Eight 10-inch Trays) Unable to achieve effluent limitations on VOCs and MTBE

RUN 2

Flowrate: 15 gpm
Influent Concentrations: Design Concentrations Provided Above
Effluent Concentrations: Permit Limitations For Volatile Organic Compounds (VOC) Provided in Section II
Software Model: Automatic - Air Stripper Size Limited to Lopro III Series
Air Stripper Model Selected: Lopro III (Three 13-inch Trays) Able to achieve effluent limitations

RUN 3

Flowrate: 15 gpm
Influent Concentrations: Design Concentrations Provided Above
Effluent Concentrations: Permit Limitations For Volatile Organic Compounds (VOC) Provided in Section II
Software Model: Automatic - Air Stripper Limited to 1300 Series
Air Stripper Model Selected: 1341 (Four 10-inch Trays) Unable to achieve effluent limitations on VOCs and MTBE

RUN 4

Flowrate: 15 gpm
Influent Concentrations: Design Concentrations Provided Above
Effluent Concentrations: Permit Limitations For Volatile Organic Compounds (VOC) Provided in Section II
Software Model: Automatic - Air Stripper Limited to 2300 Series
Air Stripper Model Selected: 2341 (Four 9-inch Trays) Able to achieve effluent limitations

VI. Granular Activated Carbon Design Calculations When Air Stripping Is Included In The Treatment System

1) Size Carbon Units

Minimum Diameter of Carbon Units

Based on a design flowrate of 15 gpm, as indicated in section III above, the minimum diameter of the carbon units is 26 inches.

Contact Time and Bed Volume

When air stripping is utilized the contact time will be reduced to 20 minutes in order to achieve 99.9% reduction of BTEX and MTBE.

15 gpm x 20 min = 300 gal = 40 cu. ft.

Recommended Granular Activated Carbon Units

Number Of Carbon Units In Series =	3	units
Diameter Of Carbon Units =	30	inches
30 inches >	26	inches
Weight Of Carbon Per Unit =	500	lbs
Volume Of Carbon Per Unit =	18	cu. ft.
Total Volume of Carbon =	54	cu. ft.
54 cu. ft. >	40	cu. ft.

Since granular activated carbon (GAC) provides secondary treatment, the first two GAC vessels combined are sized to provide the required contact time for 99.9% removal of BTEX and MTBE. The third vessel is provided for safety.

2) Estimate Carbon Usage

Calculate Pounds Of Total Adsorbable Organics (TAO) Per Day

Estimated organic loading following air stripping with the North East Environmental Products, Inc., Model 2341-P Air Stripper (Model Run 4).

Benzene =	1 ppb
Toluene =	1 ppb
Ethyl Benzene =	1 ppb
Xylene =	1 ppb
MTBE =	40 ppb
TAO =	49 ppb[11]

11 - Assumes BTEX and MTBE account for 90% of the total adsorbable organics (TAO).

$$\text{TAO (lb/day)} = 0.05\ \text{ppm} \times 15\ \text{gpm} \times \frac{0.012\ \text{lb/day}}{\text{gpm - ppm}} = 0.009\ \text{lb/day}$$

Calculate Pounds Of MTBE Per Day

$$\text{MTBE (lb/day)} = \frac{40\ \text{ppb}}{49\ \text{ppb}} \times 0.0088\ \text{lb/day} = 0.0072\ \text{lb/day}$$

Calculate Granular Activated Carbon Usage For MTBE

MTBE = 40 ppb

Adsorption Capacity From MTBE Isotherm[12] = 0.14 %

$$\frac{0.007 \text{ lb/day}}{0.14\ \%} = 5.23 \text{ lb/day}$$ Granular Activated Carbon Required For MTBE Adsorption

12 - Freundlich coefficients deduced from Freundlich isotherm supplied by Norit Americas, Inc., Atlanta, GA, (k = .308, 1/n = .406) The isotherm provided is valid for a residual concentration range of 10 to 10,000 ug/L. As a conservative estimate of the adsorption capacity for concentrations above this range, the value for a concentration of 10,000 ug/L is used as opposed to extrapolating the isotherm to the specific value.

Calculate Granular Activated Carbon Usage For Remainder of TAO

Assume that the benzene isotherm is adequate for characterizing the remaining TAO

Remaining TAO = TAO - MTBE

Remaining TAO (lb/day) = 0.0088 lb/day - 0.0072 lb/day = 0.0016 lb/day

Remaining TAO (ppb) = 49 ppb - 40 ppb = 9 ppb

Remaining TAO (ppb) = 9 ppb

Adsorption Capacity From Benzene Isotherm[13] = 0.52 %

$$\frac{0.002 \text{ lb/day}}{0.52\ \%} = 0.31 \text{ lb/day}$$ Granular Activated Carbon Required For Remaining TAO Adsorption

13 - Based on Freundlich isotherm supplied by Norit Americas, Inc., Atlanta, GA, (k = 2.021, 1/n = 0.43). The isotherm provided is valid for a residual concentration range of 0.1 to 100,000 ug/L. As a conservative estimate of the adsorption capacity for concentrations above this range, the value for a concentration of 100,000 ug/L is used as opposed to extrapolating the isotherm to the specific value.

Total Granular Activated Carbon Usage

Total Carbon Usage = Carbon Usage For Remaining TAO + Carbon Usage For MTBE

Total Carbon Usage = 0.31 lb/day + 5.23 lb/day = 5.54 lbs

Increase carbon usage by an additional 40% due to adsorption interference from background organics. This assumes naturally occurring background organics are at a concentration of 1 - 2 ppm in the groundwater. (Based on information provided by Cetco, Arlington Heights, IL.)

1.4 x 5.54 lb/day = 7.8 lb/day Total Granular Activated Carbon Usage

3) Estimate Breakthrough Time Per 1,000 Pounds Of Carbon

1,000 lbs / 7.8 lb/day = 129.0 Days Until Breakthrough For 1,000 lbs of Carbon

4) Estimate Carbon Costs

Assume a carbon rebed cost of $1.76/lb (Price based on Carbon Service & Equipment Company, 1999 GES pricing.)

Carbon Costs = $1.76 /lb x 7.8 lb/day = $13.64 /day = $423 /month

VII. Solids Removal and Sediment Filtration

Assuming the total solids are made up exclusively of iron (dissolved and suspended), influent solids loading is based on the results of March 9-10, 1999 groundwater sampling for MW-1 and MW-11.

Daily Loading (lbs/day) = Concentration (mg/l) x Flow (MGD) x 8.34 (lbs/gal)

Daily Loading = 50 mg/l x 0.0216 MGD x 8.34 lbs/gal

Daily Loading = 9.01 lbs/day

Weekly Loading = 63.05 lbs/week

VIII. Recommended Treatment System

Based on the design calculations provided above the recommended treatment system will utilize the air stripping process and granular activated carbon adsorption for the removal volatile organic compounds. A clarifier/filter unit and multiple bag filters will be utilized for the removal of suspended solids, including any dissolved iron precipitates from solution due to the oxidation process occurring in the air stripper. The operational cost to provide granular activated carbon with air stripping is $3,552 less per month than without the air stripper. Based on the estimated cost of the specified air stripper, the additional capital costs will be offset within a period of 4 months by the projected savings in carbon costs.

SOIL VAPOR EXTRACTION SYSTEM DESIGN CALCULATIONS

Department of The Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

CALCULATION OF SOIL PERMEABILITY AND THEORETICAL RADIUS OF INFLUENCE

Extraction Test 1:
Test Condition 1:

Test Date: April 17, 1998
Extraction Point: RW-2
Observation Point: MP-3
Screened Interval At Extraction Point: 2' - 12'
Depth To Water At Extraction Point: 4.18 (2.68 static)

Low-vacuum soil vapor extraction (SVE) with a jet pump and drop tube utilized for groundwater extraction from RW-2.

Determination of soil permeability (k) in darcys:

The governing equation[1] is:

$$k = \frac{Q * u * \ln(Rw/Ro)}{H * pi * Pw[1-(Po/Pw)^2]} \qquad (1)$$

Where:
- Q = air flow at the extraction well[2] (cm^3/sec)
- u = viscosity of air in centipoise
- Rw = radius of extraction well (cm)
- Ro = distance to observation well (cm)
- H = height of screen affected by applied vacuum (cm)
- Pw = pressure at the extraction well (atm)
- Po = pressure at the observation well (atm)

1 - As described by P. C. Johnson et al, Groundwater, Vol. 28, No. 3, May-June 1990
2 - Johnson's equation requires air flow in actual, not standard conditions. Field measurements are reported in standard cubic feet per minute (scfm). Thus for the calculation of k, the soil permeability, it is necessary to convert to actual cubic feet per minute (acfm):

$$Q\,(acfm) = Q\,(scfm) * \frac{391.95\ "H_2O}{391.95\ "H_2O - \text{Applied Vacuum}\ ("H_2O)} \qquad (2)$$

Test Data Representative of Steady-State Conditions:

Q =	8.9	scfm			
Q =	10.769852	acfm	=	5082.804	cm^3/sec
u =	0.018	Centipoise	=	0.018	centipoise
Rw =	0.083	feet	=	2.540	cm
Ro =	15	feet	=	457.200	cm
H =	2.18	feet	=	66.446	cm
Vacuum at RW-2 =	68.1	inches-H_2O	=	0.8328	atm
Vacuum at MP-3 =	0.5	inches-H_2O	=	0.9988	atm

Given the above conditions, the permeability of the formation is:

k = 6.24 Darcy

Determination of the distance, Ri, to a vacuum of 0.1 inches H_2O:

The governing equation[3] is:

$$Po = Pw[1+(1-(Pi/Pw)^2)*\ln(Ro/Rw)/\ln(Rw/Ri)]^{1/2} \quad (3)$$

Where: Ri = radial extent of vacuum influence (ft)
Pi = pressure at the radial extent of vacuum influence (inches H_2O)

3 - As described by P. C. Johnson et al, Groundwater, Vol. 28, No. 3, May-June 1990

Rearranging Equation (3) and solving for Ri results in the following:

$$Ri= Rw(Ro/Rw) \wedge -[(1-(Pi/Pw)^2)/((Po/Pw)^2-1)] \quad (4)$$

Solving Equation (4) for the conditions summarized above results in the following value of Ri:

Ri= 15.5 ft.

RECOVERY SYSTEM DESIGN (All Proposed Laterals)

Flowrate Per Unit Length Of Exposed Screen, Q/H

Extraction Test 1: Q/H = 4.08 scfm/ft

Total Vapor Phase (Design) Flow From Extraction Wells

Table 1
Extraction Well Screen Detail

Extraction Lateral	Length of Lateral[4] (ft)	Operational DTW[5] (ft)	Available Screen (ft)	Anticipated Flow (scfm) (Q/H * Avail. Screen)
MW-11[6]	-	6	3	12.2
RW-3[6]	-	6	3	12.2
RW-4[6]	-	6	3	12.2
VL-1	5	4	5	20.4
VL-2	5	4	5	20.4
VL-3	5	4	5	20.4
VL-4	5	4	5	20.4
VL-5	5	4	5	20.4
VL-6	5	4	5	20.4
VL-7	5	4	5	20.4
VL-8	5	4	5	20.4
VL-9	5	4	5	20.4
Total			54	220.2

4 - All laterals are proposed, the construction of which is anticipated to be as shown.
5 - Approximate water elevations based on static water levels observed in nearby monitoring wells 1991 to present and an estimated 2-foot drawdown in each of the recovery wells.
6 - The groundwater recovery wells will be outfitted for soil vapor extraction and are estimated to have 3 feet of casing.

Total Length of Available Screen = 54.0 ft

Total Design Flow = Q/H * Total Available Screen = 220.2 scfm

Flowrate Required To Extract The Equivalent Of Four Pore Volumes Per Day

Areal Extent of Vacuum Influence[7] = 12,053 sq. ft
Average Vertical Extent of Vacuum Influence[8] = 4.0 ft
Assumed Soil Porosity = 0.30

7 - Based on the theoretical calculations provided above, and the actual extent of vacuum influence observed during the pilot study, a vacuum radius of influence (design) of 20 ft is assumed when a vacuum of 68.1 inches H_2O is applied at the wells.

8 - The Johnson equation assumes radial flow; however, as a factor of safety, the vertical extent of vacuum influence is assumed to extend from ground surface to the average operational water level.

Estimated Pore Volume Influenced = Porosity * Areal Extent of Influence* Vertical Extent of Vacuum Influence

Estimated Pore Volume Influenced = 14,464 cu. ft.

Required Daily Volumetric Flow = 4 * Pore Volume Influenced = 57,854 cu. ft./day

Approximate Required Vapor Flowrate = 40 scfm

Total system vapor flowrate = 4.08 scfm/ft x 54 ft of avail. screen = 220

220 scfm > 40 scfm

RECOVERY SYSTEM DESIGN (Without Optional Laterals)

Flowrate Per Unit Length Of Exposed Screen, Q/H

Extraction Test 1: Q/H = 4.08 scfm/ft

Total Vapor Phase (Design) Flow From Extraction Wells

Table 1
Extraction Well Screen Detail

Extraction Lateral	Length of Lateral[4] (ft)	Operational DTW[5] (ft)	Available Screen (ft)	Anticipated Flow (scfm) (Q/H * Avail. Screen)
MW-11[6]	-	6	3	12.2
RW-3[6]	-	6	3	12.2
RW-4[6]	-	6	3	12.2
VL-1	5	4	5	20.4
VL-2	5	4	5	20.4
VL-3	5	4	5	20.4
VL-4	5	4	5	20.4
VL-5	5	4	5	20.4
VL-6	5	4	5	20.4
Total			39	159.2

Total Length of Available Screen = 39.0 ft

Total Design Flow = Q/H * Total Available Screen = 159.2 scfm

Flowrate Required To Extract The Equivalent Of Four Pore Volumes Per Day

Areal Extent of Vacuum Influence[7] =	7,928	sq. ft
Average Vertical Extent of Vacuum Influence[8] =	4.0	ft
Assumed Soil Porosity =	0.30	

Estimated Pore Volume Influenced = Porosity * Areal Extent of Influence* Vertical Extent of Vacuum Influence

Estimated Pore Volume Influenced = 9,514 cu. ft.

Required Daily Volumetric Flow = 4 * Pore Volume Influenced = 38,054 cu. ft./day

Approximate Required Vapor Flowrate = 26 scfm

Total system vapor flowrate = 4.08 scfm/ft x 39 ft of avail. screen = 159

159 scfm > 26 scfm

The system (with or without the optional laterals) is therefore capable of extracting greater than 4 pore volumes per day. A summary of the data from the feasibility test is presented in the table on the following page.

SOIL VAPOR EXTRACTION BLOWER DESIGN CALCULATIONS

Department of the Army
Fort Monmouth
Main Post Gas Station
Building 699
Eatontown, New Jersey

I. Determination Of The Maximum Frictional Loss In 2-Inch Pipe (Vacuum Side)

In order to determine the maximum frictional losses associated with the individual extraction wells, similar calculations were performed for each well. Based on the anticipated flowrate as calculated in the *Soil Vapor Extraction System Design Calculations* section of this report and the length and diameter of the individual extraction lines, VL-3 will generate the greatest frictional losses and is therefore utilized in the subsequent blower design calculations.

SVE System Design Flow[1] =	220	scfm
Maximum Number of Extraction Laterals/Wells =	12	laterals/wells
Approximate Flowrate from VL-3 =	20.4	scfm
Diameter of Vapor Extraction Pipe to Individual Laterals =	2	inch
Frictional Loss per Unit Length of Pipe[2] =	0.01	inches H_2O/ft (@ 20.4 scfm)
Distance to VL-3 =	440	ft

Frictional Loss = 440 ft x 0.01 inches H_2O/ft = 4.4 inches H_2O

II. Determination Of The Frictional Loss In 2-Inch Pipe Fittings (Vacuum Side)

Number of 45 Degree Elbows =	0	
Equivalent Length of Pipe[3] =	0	ft
Number of 90 Degree Elbows =	6	
Equivalent Length of Pipe[3] =	30	ft
Total Equivalent Length of Pipe =	30	ft

Frictional Loss = 30.0 ft x 0.01 inches H_2O/ft = 0.3 inches H_2O

III. Frictional Loss at Moisture Separator[4]

Total Design System Flow =	220 scfm
Maximum System Flow Including Dilution Air =	300 scfm
MS350BS Moisture Separator Operating at 300 scfm =	1.8 inches H_2O

IV. Frictional Loss Due to Manifold & Valving[5]

1.0 inch H_2O

V. Total Losses on Vacuum Side of the Blower

Maximum Frictional Losses in 2-inch Pipe =	4.4 inches H_2O
Frictional Losses in 2-inch Pipe Fittings =	0.3 inches H_2O
Frictional Loss Across Moisture Separator =	1.8 inches H_2O
Frictional Losses in Manifold & Valving =	1.0 inch H_2O
Total Vacuum Losses =	7.5 inches H_2O

VI. Determination Of The Frictional Loss In Process Pipe (Pressure Side)

Frictional Loss per Unit Length of Pipe[2] = 0.21 inches H_2O/ft (3" Pipe @ 300 scfm)
Total Length of Pipe (Assumed) = 10 ft

Frictional Loss = 10 ft x 0.21 inches H_2O/ft = 2.1 inches H_2O

Frictional Loss per Unit Length of Pipe[2] = 0.01 inches H_2O/ft (6" Pipe @ 300 scfm)
Total Length of Pipe[6] = 20 ft

Frictional Loss = 20 ft x 0.01 inches H_2O/ft = 0.2 inches H_2O

Total Frictional Loss in Process Pipe = 2.3 inches H_2O

VII. Determination Of The Frictional Loss In 3-Inch Pipe Fittings (Pressure Side)

Number of 90 Degree Elbows = 2
Equivalent Length of Pipe[3] = 14.0 ft

Frictional Loss = 14.0 ft x 0.21 inches H_2O/ft = 2.9 inches H_2O

VIII. Frictional Loss at Catalytic Oxidizer[7] 31.0 inches H_2O

The frictional losses due to GAC treatment of the SVE offgas are expected to be less than the frictional losses due to the catalytic oxidizer. So, when the offgas treatment technology changes the SVE blower will not have to be resized.

IX. Total Losses on Pressure Side of Blower

Total Frictional Losses in Process Pipe =	2.3 inches H_2O
Frictional Losses in 3-inch Pipe Fittings =	2.9 inches H_2O
Frictional Loss at Catalytic Oxidizer =	31.0 inches H_2O
Total Pressure Side Losses =	36.2 inches H_2O

X. Vacuum Required (Design) at Extraction Well[1] 68.1 inches H_2O

XI. Summary of SVE Blower Performance Requirements

Vacuum Requirements = Vacuum at Extraction Well + Losses on Vacuum Side of Blower
68.1 inches H_2O + 7.5 inches H_2O = 75.6 inches H_2O

Pressure Requirements = Losses on Pressure Side of Blower
36.2 inches H_2O = 36.2 inches H_2O

Total Vacuum and Pressure Requirements = 111.8 inches H_2O

Since the vacuum requirements for the blower are greater than the pressure requirements, the blower was sized using the vacuum performance curve[3].

Design Requirements: 300 scfm @ 112 inches H_2O

XII. SVE Blower Selection

Blower selected:

Model:	MD Competitor 4005[8]	300 scfm @ 125 inches H_2O
Manufacturer:	TUTHILL Corporation	230V/3PH/15HP
	M-D Pneumatics Division	
	Springfield, Missouri	

The MD Competitor 4005 shall have the capability to operate the entire system at the required flow and vacuum. To operate within safe influent concentrations for the Falco 300, it may become necessary to introduce dilution air into the system. Therefore, it may become necessary to pulse vent the SVE system, especially during the initial phase of operation when concentrations are elevated. Experience with similar remedial systems has shown the trend that concentrations usually decrease rapidly from the initial levels. After the drop in concentrations, it should then be possible to operate additional extraction points simultaneously.

1 - Based on information provided in the *Soil Vapor Extraction System Design Calculations* section of this report.

2 - Based on nomagraph provided by EG&G Rotron, Saugerties, NY

3 - Based on information provided by EG&G Rotron, Saugerties, NY

4 - Based on equipment specifications provided by EG&G Rotron, Saugerties, NY

5 - Assumed frictional losses through the vapor extraction manifold and valves.

6 - Accounts for catalytic oxidizer discharge stack.

7 - Based on equipment specifications provided by Falmouth Products, Inc., Falmouth, MA.

APPENDIX IX

VAPOR PHASE TREATMENT OPERATIONAL COST ANALYSIS
FALCO 300 CATALYTIC OXIDIZER

PARAMETERS	
FUEL:	ELECTRIC
COST[1] ($/kW-h):	$0.0943
FLOW (scfm):	300
INFLUENT TEMP:	100 'F
OPERATING TEMP:	
Without Heat Exchanger	600 'F
With Heat Exchanger	600 'F
POWER REQUIREMENT[3] (kW):	
With Heat Exchanger	20.3

ASSUMPTIONS / NOTES

1 - It is assumed that the extracted soil vapor is composed primarily of benzene, toluene, ethylbenzene and xylenes (BTEX).
2 - The molecular weight of weathered gasoline is 108 g/mole, P. C. Johnson et al, Groundwater, Vol. 28, No. 3, May-June 1990.
3 - The fuel value of the extracted soil vapor is assumed to be 20,260 BTU/lb (Lowest value for gasoline).
4 - Based on information provided by PSE&G.
5 - Based on information supplied by Falmouth Products, Falmouth, MA, for the Falco 300.
6 - 100 percent of the lower explosive limit (LEL) of gasoline is equivalent to 13000 ppm_v.
7 - Mass flow (lbs/hr) = (scfm x ppm_v x 108 g/mole) x [(1.55 x 10^{-7}) (mole/ft3)(min/hr)(lb/g)(ppm^{-1})].
8 - Power available in extracted soil vapor (kW) = BTU/lb * lbs/hr * 2.93 x 10^{-4} kW-hr/BTU.
9 - Due to the significant fluctuation in the influent BTEX concentrations over time in the extracted soil vapor, only general trends can be established. It is therefore difficult to predict a finite duration of system operation to remove a given quantity of hydrocarbons. Consequently, the costs are presented on a unit mass/volume basis.
10 - Supplemental Power Requirement = Power Requirement of Unit (kW) - Power Available in Soil Vapor (kW).
11 - At or above an influent soil vapor non-methane volatile organic compound (VOC) concentration of approximately 780 ppm_v, the heat recovered from the effluent heat exchanger is great enough to heat the influent air stream to the minimum required destruction temperature, therefore no supplemental power requirements are indicated, since the pre-heater does not have to operate. Slight power usage will be required upon starting/restarting the unit in the event of a shut down as the unit must be warmed up slowly. In addition, the pre-heater will activate during normal operation in this concentration range in order to compensate for variations in the influent soil vapor concentrations. In addition, the maximum allowable influent VOC concentration to the Falmouth catalytic oxidizer is 2400 ppm_v. Operation of the unit when influent VOC concentrations are higher than this value will require the introduction of dilution air to reduce the combined influent to the oxidizer to less than 2400 ppm_v.
12 - Granular activated carbon consumption supplied by Cetco, Arlington Heights, IL.
13 - Assumes $0.98/lb for granular activated carbon, including vac/rebed charges.

CATALYTIC OXIDATION W/ HEAT EXCHANGER

EXTRACTED SOIL VAPOR				Days of Operation/ 1000 gal BTEX[9]	POWER REQUIREMENT (kW)[5]	SUPPLEMENTAL POWER (kW)[10]	*Catalytic Oxidizer*			*Granular Activated Carbon*			
% LEL	(ppm_v)[6]	(lbs/hr)[7]	(kW)[8]				$/Month[11]	$/lb BTEX	$/gal BTEX	lb/Month[12]	$/Month[13]	$/lb BTEX	$/gal BTEX
0%	0	0.00	0.0	-	20.3	20.3	$1,397.44	-	-	-	-	-	-
1%	130	0.65	3.9	399.21	20.3	16.4	$1,130.65	$2.37	$14.84	3976	$3,896.40	$8.17	$51.08
2%	260	1.31	7.8	199.60	20.3	12.5	$863.86	$0.91	$5.67	6865	$6,727.60	$7.05	$44.10
3%	390	1.96	11.6	133.07	20.3	8.7	$597.08	$0.42	$2.61	9704	$9,509.86	$6.64	$41.56
4%	520	2.61	15.5	99.80	20.3	4.8	$330.29	$0.17	$1.08	12079	$11,837.16	$6.20	$38.80
5%	650	3.26	19.4	79.84	20.3	0.9	$63.51	$0.03	$0.17	14680	$14,386.70	$6.03	$37.72
6%	780	3.92	23.3	66.53	20.3	0.0	$0.00	-	-	17455	$17,106.14	$5.98	$37.38
7%	910	4.57	27.1	57.03	20.3	0.0	$0.00	-	-	19646	$19,252.80	$5.76	$36.06
8%	1,040	5.22	31.0	49.90	20.3	0.0	$0.00	-	-	22127	$21,684.31	$5.68	$35.54
10%	1,300	6.53	38.8	39.92	20.3	0.0	$0.00	-	-	27263	$26,718.16	$5.60	$35.03
15%	1,950	9.79	58.1	26.61	20.3	0.0	$0.00	-	-	39322	$38,535.81	$5.38	$33.68
18%	2,340	11.75	69.8	22.18	20.3	0.0	$0.00	-	-	45439	$44,530.27	$5.19	$32.43
20%	2,600	13.06	77.5	19.96	20.3	0.0	$0.00	-	-	50222	$49,217.67	$5.16	$32.26
25%	3,250	16.32	96.9	15.97	20.3	0.0	$0.00	-	-	61168	$59,944.60	$5.03	$31.44
30%	3,900	19.59	116.3	13.31	20.3	0.0	$0.00	-	-	71567	$70,135.18	$4.90	$30.65
35%	4,550	22.85	135.6	11.41	20.3	0.0	$0.00	-	-	80671	$79,057.37	$4.73	$29.61
40%	5,200	26.11	155.0	9.98	20.3	0.0	$0.00	-	-	90878	$89,060.55	$4.67	$29.19