

FINAL

**REMEDIAL INVESTIGATION / FEASIBILITY STUDY
REPORT FOR SITE FTMM-04**

**FORT MONMOUTH, OCEANPORT,
MONMOUTH COUNTY, NEW JERSEY**

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**FINAL
REMEDIAL INVESTIGATION / FEASIBILITY STUDY REPORT
SITE FTMM-04**

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Fort Monmouth, Oceanport, Monmouth County, New Jersey

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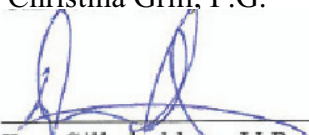


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LIST OF ACRONYMS

ACRONYM	DEFINITION
µg/L	micrograms per liter
API	American Petroleum Institute
ARARs	Applicable or Relevant and Appropriate Requirements
BEE	Baseline Ecological Evaluation
bgs	below ground surface
BRAC	Base Realignment and Closure
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSM	Conceptual Site Model
CWA	Charles Wood Area
DDs	Decision Documents
DER	Declaration of Environmental Restriction
DoD	Department of Defense
EA	Evans Area
ECP	exposure point concentration
ESC	ecological screening criteria
FMERPA	Fort Monmouth Economic Redevelopment Planning Authority
FMETL	Fort Monmouth Environmental Testing Laboratory
FS	feasibility study
ft ²	square feet
ft/day	feet per day
ft/ft	foot per foot
ft/yr	feet per year
FTMM	Fort Monmouth
GES	Groundwater & Environmental Services, Inc.
gpd/ft ²	gallons per day per square foot
gpm	gallons per minute
GWQS	Groundwater Quality Standards
HHRA	Human Health Risk Assessment
HSDB	Hazardous Substances Data Bank
HTRW	hazardous, toxic, and radiological waste
ICs	Institutional Controls
IGW	Impact to Ground Water
IRP	Installation Restoration Program
LUCs	Land Use Controls

ACRONYM	DEFINITION
MBC	Maximum background level
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MP	Main Post
NCP	National Contingency Plan
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NRDCSRS	Non-residential direct contact soil remediation standard
NRWQC	National Recommended Water Quality Criteria
PAHs	Polynuclear Aromatic Hydrocarbons
Parsons	Parsons Government Services Inc.
PCB	polychlorinated biphenyl
PCE	Tetrachloroethene
ppt	parts per thousand
RAGS	Risk Assessment Guidance for Superfund
R&D	research and development
RDCSCC	Residential Direct Contact Soil Cleanup Criteria
RDCSRS	Residential direct contact soil remediation standard
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RSL	regional screening level
SE	saline
SI	site investigation
SVOCs	semi volatile organic compounds
SWQS	Surface Water Quality Standards
TAL	target analyte list
TCE	trichloroethene
TO	task order
THQ	target hazard quotient
TPV	total present value
TR	target risk
TRSR	Technical Requirements for Site Remediation
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
WERS	Worldwide Environmental Restoration Services
WRA	Well Restriction Area

EXECUTIVE SUMMARY

E.1 SITE DESCRIPTION

Site FTMM-04 is located on Fort Monmouth's (FTMM's) Main Post (MP) and is bounded by the Avenue of Memories to the South, North Drive to the North, and Wilson Avenue to the east. Mill Creek bisects the west-central portion of the landfill. The 1.42 acre FTMM-04 was used in 1955 and 1956 as a landfill for building demolition debris, and has been inactive since 1956. Since that time a stable vegetative cover has developed on the surface of the landfill. The anticipated future use of FTMM-04 is passive open space.

E.2 GEOLOGY AND HYDROGEOLOGY

Soil to a depth of at least 36 inches below ground surface (bgs) at FTMM-04 is comprised of brown, fine to coarse sand with fine gravel and root fragments and green/gray/black sandy silt and clay. Cement debris has been encountered at depths of up to 36 inches, and exploratory trench logs indicate waste depths ranging from 4 to 8 feet bgs. The depth to groundwater typically ranges from approximately 5 to 10 feet bgs. Groundwater east of Mill Creek migrates toward the west (i.e., toward Mill Creek); the calculated average advective groundwater seepage velocity is 0.48 foot per day (175 feet per year).

E.3 SOIL SAMPLING RESULTS

A total of 66 near-surface soil samples were collected from 63 borings at FTMM-04 in March 1998. No volatile organic compounds (VOCs) in soil samples exceeded current residential or non-residential direct contact comparison criteria. Concentrations of seven semivolatile organic compounds (SVOCs), nine metals, and two pesticides exceeded their current New Jersey Department of Environmental Protection (NJDEP) residential direct contact soil remediation standard (RDCSRS) and/or U.S. Environmental Protection Agency (USEPA) residential regional screening level (RSL) in at least one soil sample. Concentrations of five SVOCs and three metals exceeded their current NJDEP non-residential direct contact soil remediation standard (NRDCSRS) and/or USEPA industrial RSL in at least one soil sample. Concentrations of three VOCs, 16 SVOCs, three pesticides, and 18 metals exceeded the current NJDEP Impact to Ground Water (IGW) soil screening level and/or USEPA Groundwater Protection soil screening level in at least one soil sample.

In most cases, compliance averages calculated by Versar (2004b) were either below the applicable NJDEP regulatory criteria or were considered marginal (e.g., within 1 to 2 milligrams per kilogram of the then-current RDCSRS. Evaluation of the analytical results did not define a source area or level of contamination that necessitated the identification and evaluation of potential targeted remedial actions (Versar, 2004b). The maximum-detected concentrations of 20 of the 23 metals targeted for analysis exceed the maximum background concentrations for the MP presented in Weston Site Investigation (SI) Report (1995). Therefore, not all of the metals can be assumed to be representative of natural background conditions at every one of the 63 soil boring locations.

Based on comparison to USEPA residential RSLs and (in the case of metals) maximum background concentrations presented in Weston SI Report (1995), contaminants of potential concern (COPCs) in soil that are evaluated in the risk assessment include the SVOCs acenaphthylene, phenanthrene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene,

benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenz[a,h]anthracene, benzo[g,h,i]perylene; the pesticides 4,4'-DDE and 4,4'-DDD; and the metals aluminum, antimony, arsenic, beryllium, cobalt, selenium, thallium, and vanadium.

E.4 GROUNDWATER SAMPLING RESULTS

Groundwater sampling was initially performed at the site in 1995, and quarterly groundwater sampling was performed from May 1997 to July 2011 utilizing a network of up to six monitoring wells.. An additional sampling event was performed in August 2013 to reestablish baseline conditions after a 2-year interruption in the sampling program. Three monitoring wells were installed in 1995, one in 1999, and two in 2010. From 1997 through 2004, samples were analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), and TAL metals. Upon approval of the NJDEP, analysis for VOCs, SVOCs, pesticides, and PCBs was discontinued beginning in 2005.

Previous Remedial Investigation (RI) reports for FTMM-04 have identified up to 12 metals (aluminum, antimony, arsenic, beryllium, cadmium, iron, lead, manganese, nickel, silver, selenium, and thallium) as the primary constituents exceeding NJDEP Ground Water Quality Standards (GWQS) in site groundwater (Versar 2005; U.S. Army, 2012). Versar (2005) observed that the metals that exceeded NJDEP cleanup criteria are routinely observed in groundwater samples because they are common constituents of Monmouth County and the MP soils. Versar (2005) also concluded that concentrations of metals in groundwater were due to a combination of a natural, dissolved component along with input from sample turbidity. Similarly, the U.S. Army (2012) concluded that metals detected at concentrations exceeding NJDEP GWQS are not considered to be site-related as they are naturally occurring within the soils of Fort Monmouth, and no source areas are apparent.

The sampling data from the most recent eight quarters (November 2009 to August 2011) and August 2013 supports the conclusion that detected concentrations of metals are representative of background conditions despite exceedances of NJDEP and/or USEPA comparison criteria for 15 of the metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, mercury, selenium, sodium, and vanadium). There are no site-related COPCs in groundwater at FTMM-04.

E.5 SURFACE WATER SAMPLING RESULTS

Previous RI reports for FTMM-04 have identified three VOCs (tetrachloroethene [PCE], trichloroethene [TCE], and methylene chloride) and three metals (antimony, arsenic, and mercury) as the primary constituents exceeding NJDEP surface water quality standards (SWQS) in surface water samples collected from locations related to FTMM-04 (Versar 2005; U.S. Army, 2012). During the most recent eight quarters of surface water sampling (March 2007 to September 2010), PCE was the only VOC that exceeded SWQS. However, since PCE concentrations exceeding the SWQS were detected at surface water sampling point SS-15 (located upstream, at FTMM's MP boundary), the PCE concentrations detected in Mill Creek surface water near FTMM-04 originate from upstream, and is considered an offsite source. Metals that exceeded the NJDEP SWQS were detected in the upstream sampling location SS-15 and are not associated with FTMM-04. There are no site-related COPCs in surface water associated with FTMM-04.

E.6 SEDIMENT SAMPLING RESULTS

Sediment sampling was conducted in April 2000 in Mill Creek to evaluate PCB-related impacts to stream sediments associated with FTMM-04. PCBs were detected in one of six samples collected at a concentration below the NJDEP RDCSRS; therefore, there were no screening criteria exceedances in sediment. There are no human health sediment screening values available, therefore soil screening values are used as comparison criteria. The use of soil screening values conservatively overestimates the exposure to sediment, because the residential soil screening values assume that a person would be exposed to soil 350 days per year, and exposure to sediment would be considerably less, on the order of 35 to 50 days per year.

E.7 CONTAMINANT FATE AND TRANSPORT

Detected constituents of interest in terms of contaminant fate and transport at FTMM-04 include metals and SVOCs in vadose zone soil. The migration route of interest includes dissolution of soluble residual concentrations in the vadose zone into infiltrating precipitation that percolates through vadose zone soil to the water table. Metals and SVOCs in vadose zone soil at FTMM-04 are expected to be relatively persistent and immobile, limiting their impact on groundwater quality. This observation is supported by the fact that 1) SVOCs were removed from the groundwater monitoring program after NJDEP approval in 2004 (November 16, 2004 email) due to a lack of GWQS exceedances, and 2) metal concentrations detected in groundwater from November 2009 to August 2013 are representative of background conditions.

E.8 RISK ASSESSMENT

According to the Baseline Ecological Evaluation (BEE), exceedances of ecological screening criteria have been sufficiently evaluated and addressed for ecological consideration, and no additional ecological evaluation is necessary. Therefore, ecological risk evaluation was not performed at FTMM-04.

The specific objective of the baseline human health risk assessment (HHRA) is to provide a quantitative evaluation of the risk associated with exposure to soil, surface water, sediment and groundwater at FTMM-04. The HHRA used a risk ratio approach to quantify potential cancer risk and non-cancer hazard for each COPC in each contaminated medium. The maximum detected concentration or the 95% upper confidence limit (UCL) of each COPC was used as the exposure point concentrations (EPC) to evaluate risk. In order to be consistent with USEPA Risk Assessment Guidance for Superfund (RAGS), and to properly estimate the risk, it is important that risk-based criteria are used to calculate the risk ratio. Therefore, USEPA human health screening values were used for the risk ratio analysis. Risk ratio analyses provide a conservative quantification of risk to human health due to exposure to site contamination. The EPC was divided by the appropriate screening level for the environmental medium to determine a ratio of the site concentration to a health protective concentration, for each receptor (outdoor worker and recreational user). After calculating the risk ratios for individual chemicals, the ratios for the individual chemicals were then summed to determine the cumulative risk for outdoor workers and recreational users. Cumulative non-carcinogenic risk ratios greater than one indicate a potential unacceptable non-carcinogenic risk. Cumulative carcinogenic risk ratios greater than USEPA's acceptable risk range of 10^{-4} to 10^{-6} indicate a potential unacceptable carcinogenic risk. An evaluation of the potential risk resulting from human exposure to soil, surface water, sediment, and groundwater was conducted as part of this RI. Unacceptable risks for outdoor

workers and recreational users were calculated for the non-carcinogenic chemicals detected in soil at FTMM-04, and the calculated risk ratio was 25 (outdoor workers) and 4 (recreational users), which consisted entirely of the hazard associated with exposure to thallium in soil. However, thallium, for both outdoor workers and recreational user, drives the noncarcinogenic risk, but was detected in one soil sample (B-34) out of 66 samples. Thallium is believed to be a false positive result. Further, thallium was detected at low concentrations in less than 1 percent of the samples. The risk ratios associated with other non-carcinogens in soil were 1 (outdoor worker) and 0.1 (recreational user) if thallium was not included in the cumulative risk, and these hazards are appropriately representative of expected site conditions. For carcinogens, the calculated cumulative risk ratio was within the acceptable range of 1×10^{-4} to 1×10^{-6} for analytes (4×10^{-5} , outdoor worker and 8×10^{-6} , recreational user). Based on a qualitative evaluation of the thallium data for soil, thallium was excluded as a contaminant of concern (COC) and no COCs were identified for soil at FTMM-04.

No COPCs were identified in groundwater, surface water, or sediment. Therefore, further evaluation of groundwater, surface water, or sediment in the baseline risk assessment was not conducted and no unacceptable risks are expected from human exposure to groundwater, surface water, or sediment.

E.9 FEASIBILITY STUDY

A feasibility study (FS) was not performed for FTMM-04. Because the RI concluded that risks to human health and the environment are within acceptable ranges for the current and future intended land use, no COCs were identified for FTMM-04 and a feasibility study (FS) is not required. No further action is required at FTMM-04 under CERCLA.

A vegetated soil cover will be placed over the landfill area to provide safety protection for future non-residential use. The soil cap will be placed consistent with the NJDEP Solid Waste regulations (New Jersey Administrative Code [N.J.A.C.] 7:26-2A). Additional soil will be added to the existing soil cover to provide a minimum of two feet of soil between the ground surface and landfilled debris. The use of a vegetated native soil cover will prevent future exposure to solid waste at the landfill and control surface water runoff and erosion.

Institutional Controls (ICs) to maintain the soil cover and prevent residential land use will also be implemented at FTMM-04. The Army will prepare a land use control implementation plan during the remedy design phase to document the location of the engineering control and detail the landfill cover inspection, reporting and long-term management requirements. The U.S. Army will be responsible for documenting and implementing the ICs through the filing of a deed notice, and will also be responsible to conduct biennial reviews to ensure that the ICs remain protective of human health and the environment. However, the Army will not be responsible for obtaining a remedial action permit under New Jersey Technical Requirements for Site Remediation (TRSR). When the property is transferred to private ownership, the ICs will be incorporated into the title and the new owner will be responsible for complying with the ICs. Although the Army may later transfer its procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Army shall retain ultimate responsibility for remedy integrity. The estimated total present value (TPV) of the soil cover and ICs is approximately \$520,000.

SECTION 1 INTRODUCTION

1.1 PROJECT AUTHORIZATION

Parsons Government Services Inc. (Parsons) is serving as the prime contractor to the U.S. Army Engineering and Support Center, Huntsville (USAESCH) for preparation of Remedial Investigation/Feasibility Study (RI/FS) reports to achieve acceptance of Decision Documents (DDs) at the FTMM site in Oceanport, Monmouth County, New Jersey. This project is being performed under task order (TO) 0012 issued under the Worldwide Environmental Restoration Services (WERS) contract number W912DY-09-D-0062.

This TO was issued to address a number of environmental sites at FTMM that are in various stages of hazardous, toxic, and radiological waste (HTRW) investigation and remediation. Specific activities that will be performed under this TO include 1) performance of RIs and FSs and preparation of RI/FS reports to achieve acceptance of DDs in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300 and to the extent possible to meet the substantive remedial requirements of N.J.A.C. 7:26E TRSR, and 2) supporting the closure of environmental sites to facilitate the efficient transfer of real property to other parties.

1.2 PURPOSE AND SCOPE

Parsons has prepared this RI/FS report for landfill site FTMM-04 based on historical site characterization activities performed from 1993 to 2011. The RI/FS report provides relevant site background information, characterizes the nature and extent of site-related contamination, compiles information to fill data gaps, evaluates the potential risk to human health and the environment, and identifies the actions that will be taken to meet CERCLA and NJDEP requirements. The overall goal of this process is to obtain stakeholder concurrence on a final RI/FS report for each site, and if appropriate, provide sufficient data to facilitate future remedial action or administrative closure.

1.3 SITE BACKGROUND INFORMATION

The following sections describe the site background. Included is a description of the site location, site history, background investigations, and previous technical reports.

1.3.1 Site Location and Description

FTMM is located in the central-eastern portion of New Jersey in Monmouth County, approximately 45 miles south of New York City, New York, 70 miles northeast of Philadelphia, Pennsylvania, and 40 miles east of Trenton, New Jersey. The Atlantic Ocean is approximately 3 miles to the east. FTMM was comprised of three areas: the MP, the Charles Wood Area (CWA) and the Evans Area (EA) (**Figure 1.1**). The areas of the MP and CWA are 637 acres and 489 acres, respectively. The EA (not shown on **Figure 1.1**) was located approximately eight miles to the south of the MP and CWA and was formerly used for administrative, research and development (R&D), and some training. The EA was closed under Base Realignment and Closure (BRAC) 1998 and has been transferred from FTMM. FTMM falls within the Boroughs

of Eatontown, Oceanport, and Tinton Falls. The MP is in the Eatontown and Oceanport Boroughs. The CWA is in the Eatontown and Tinton Falls Boroughs.

Figure 1.2 shows the location of FTMM-04, a landfill site on the MP. The landfill is bounded by North Drive to the north, Avenue of Memories to the south, and Wilson Avenue to the east. Mill Creek bisects the west-central portion of the landfill. The approximate area of FTMM-04 is 61,800 square feet (ft²). The site layout is depicted on **Figure 1.3**. FTMM-04 has also been referred to as Landfill 4 and Landfill M-4 in historical documents. As shown on **Figure 1.3**, storm sewers discharge to Mill Creek at the southern and northern ends of FTMM-04.

1.3.2 Site History

Historically, FTMM-04 was used as a landfill for disposal of demolition debris in 1955 and 1956. A chronological summary of events related to the environmental characterization and remediation of FTMM-04 is provided in **Table 1.1** and described in this subsection.

Suspected hazardous waste sites were initially identified at FTMM in a report prepared in May 1980 by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The purpose of the report was to assess the environmental quality of FTMM with regard to the use, storage, treatment, and disposal of toxic and hazardous materials. Thirty-seven sites at the MP, CWA, and EA were identified as having known or suspected waste material. The report recommended that FTMM perform surface water and groundwater sampling at the installation's landfills and report the results to USATHAMA.

A study was conducted in 1980 at locations that were considered to be major landfill areas. FTMM-04 was not included; however, the adjacent area to the north of the landfill was included. Groundwater and surface water samples were collected and analyzed for compliance with National Interim Primary Drinking Water Standards and National Secondary Drinking Water Regulations. The study concluded that the targeted parameters were not found at sufficiently elevated concentrations to cause degradation to groundwater or surface water, but it was recommended that FTMM submit a landfill registration statement to the NJDEP (USATHAMA, 1988).

A follow-up evaluation was completed by USATHAMA (1988) to determine if environmental/hazardous waste disposal conditions at FTMM (including the landfills) had changed since the assessment in the USATHAMA (1980) report. Based on an assessment of available data, it was recommended that USATHAMA not conduct an SI, but surface water and groundwater sampling at the MP landfill areas should be continued (USATHAMA, 1988).

SI field activities were performed at 13 sites at the MP and 8 sites at the CWA between November 1994 and March 1995 (Weston, 1995). Field activities performed at FTMM-04 included installation and sampling of three shallow groundwater monitoring wells.

Groundwater sampling was performed at the FTMM-04 site from 1995 to 2011 using a network of three to five monitoring wells. The results of groundwater sampling have been documented in an SI Report (Weston, 1995), an RI report (Versar, 2005), and an RI report addendum (U.S. Army, 2012).

Surface water sampling was performed at three locations (SS-5, SS-15, and SS-16) along Mill Creek at and upstream of FTMM-04 from October 1996 to September 2010, and sediment

sampling was performed in April 2000. Surface water and sediment sampling results were documented in RI reports prepared by Versar (2004a [sediment] and 2005 [surface water]).

In 1998 near-surface soils were characterized by analyzing soil samples collected on a grid pattern within the boundaries of FTMM-04. The results of soil sampling were documented in a RI Report (Versar, 2004b).

In October 2008, the Army conducted a landfill boundary delineation study to refine the dimensions of FTMM-04. The landfill boundary delineation study involved advancement of test pits and soil borings. Exploratory trenches were advanced within and around the known perimeter of the M-4 Landfill boundary. Trench logs show waste depths of 4 to 8 feet. The landfill boundary delineation activities resulted in some revisions to the landfill boundary based on observations of the presence or absence of waste material in test pits and soil borings. The locations of the waste delineation trenches are shown on Figure 3-1 of the U.S. Army (2012) Remedial Investigation Report Addendum provided in **Appendix A**, and on **Figure 2.1** of this report. The original and revised FTMM-04 landfill boundaries are shown on **Figure 1.3**.

A draft Groundwater Classification Exception Area (CEA) report for FTMM-04 was prepared by Brinkerhoff Environmental Services, Inc (Brinkerhoff, 2011b) due to detections of lead concentrations that exceeded the NJDEP GWQS for lead. The horizontal extent of the CEA for lead was defined by the site monitoring well network, and the vertical extent includes the shallow part of the aquifer beneath the site from the water table to approximately 22 feet bgs. The CEA also constituted a Well Restriction Area (WRA) that coincided with the boundaries of the CEA. The purpose of the WRA was to restrict extraction of groundwater for potable use within the CEA. FTMM subsequently withdrew the CEA application, further review of the CEA by NJDEP was ceased, and it was never approved.

Environmental investigations performed at FTMM-04 are summarized in greater detail in Section 2, and the nature and extent of contamination detected during the environmental investigations is summarized in Section 4.

1.4 REPORT ORGANIZATION

This RI/FS report is organized to be compliant with relevant portions of the outline presented in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

- Introduction: Section 1 details the overall scope and objective of the project, presents the organization of the report, and presents an overview of the site and its history, including previous investigations;
- Previous Investigations and Interim Remedial Actions: Section 2 details the site characterization field activities and interim remedial actions that have been performed;
- Physical Characteristics of the Site: Section 3 describes the physical setting of the site, including surface features, surface water hydrology, geology and hydrogeology, land use, and ecological setting;
- Nature and Extent of Contamination: Section 4 summarizes the degree to which sampled media (i.e., soil and groundwater) have been impacted by site-related contamination, and identifies those constituents that were detected above applicable

cleanup criteria but are believed to be representative of natural background concentrations;

- Contaminant Fate and Transport: Section 5 describes the migration and fate of contaminants present in the subsurface based upon site-specific data, the geologic and hydrogeologic characteristics of the site, and the physicochemical properties of the constituents;
- Baseline Risk Assessment: Section 6 provides a quantitative assessment of the risk posed by site-related COPCs to potential human receptors;
- Remedial Investigation Summary and Conclusions: Section 7 summarizes the main findings of the RI and provides recommendations regarding the adequacy of the data and the need for additional site characterization;
- Feasibility Study: Section 8 addresses why a FS was not performed, describes the planned installation of a vegetated soil cover, and implementation of institutional controls and biannual reviews; and
- References: Section 9 includes a list of references used in the preparation of this report.

Additional information is attached to this report as appendices:

- **Appendix A** – Key Historical Reports and Background Information;
- **Appendix B** – Recreational User Screening Level Calculations, Exposure Assumptions, and ProUCL Output; and
- **Appendix C** – Cost Estimate.

SECTION 2 PREVIOUS INVESTIGATIONS AND INTERIM REMEDIAL ACTIONS

2.1 GEOLOGIC/HYDROGEOLOGIC INVESTIGATIONS

The geologic and hydrogeologic characteristics of FTMM have been investigated during numerous historical installation-wide and site-specific environmental studies. The primary methods of geologic/hydrogeologic investigation at FTMM-04 have consisted of describing soils encountered during monitoring well drilling, measuring water levels in site monitoring wells, and constructing potentiometric surface (i.e., groundwater surface elevation contour) maps indicating the direction and magnitude of the horizontal hydraulic gradient.

2.2 SOIL AND VADOSE ZONE INVESTIGATIONS

To demonstrate compliance with the Solid Waste Disposal Act of 1965, the existing soil cover at FTMM-04 was characterized. In March 1998, a total of 66 soil samples were collected from 63 borings (B01-B63) as shown on **Figure 2.1** (Versar, 2004b). The borings were located in a grid like pattern within the original FTMM-04 boundary as depicted in the Weston (1995) SI Report. Samples were analyzed at Fort Monmouth Environmental Testing Laboratory (FMETL) for VOCs, SVOCs, pesticides, PCBs, and target analyte list (TAL) metals. The samples were collected between 6 and 12 inches bgs except for the VOC samples, which were collected at approximately 24 inches bgs.

2.3 GROUNDWATER INVESTIGATIONS

In 1994, three monitoring wells (M4MW07 through M4MW09) were installed as part of the Weston (1995) SI. Two rounds of groundwater sampling were conducted to evaluate groundwater quality. The wells were sampled for VOCs, SVOCs, pesticides, PCBs, TAL metals, and cyanide. The three wells were screened across the water table to total depths of 16, 18, and 22 feet bgs. Based on the findings of the SI, the Army implemented a long-term groundwater monitoring program.

The three monitoring wells (M4MW07 through M4MW09) were each sampled 31 times from May 1997 to October 2004. An additional well (M4MW10) was installed in 1999 and was sampled 20 times during the same time period. Samples were collected and analyzed at FMETL for VOCs, SVOCs, pesticides, PCBs, and TAL metals. In 2000, two additional low-flow sampling rounds were collected in August and October and analyzed for TAL metals. Locations of monitoring wells are shown on **Figure 2.1** and well construction details are provided in **Table 2.1**. The wells depths range from 15.5-22 feet bgs. Two additional low-flow sampling rounds were conducted and samples were analyzed for pesticides, PCBs, and TAL metals (Versar, 2005).

In November 2004, the U.S. Army submitted a letter requesting changes to the groundwater monitoring program at FTMM-04. In their November 16, 2004 response letter, the NJDEP (2004) approved discontinuing analysis for VOCs, SVOCs, pesticides, and PCBs; however, the request to eliminate analysis for TAL metals was not approved.

The four monitoring wells (M4MW07, M4MW08, M4MW09, and M4MW10) were each sampled 23 times from January 2005 to January 2010 as summarized in **Table 2.2**. Low-flow

sampling was performed from April 2010 until July 2011. Samples collected were analyzed at FMETL for TAL metals.

Additional wells M4MW05 and M4MW06 were installed in 2010. One sample was collected from M4MW05 in August 2010 and analyzed at FMETL for VOCs and TAL metals. Low-flow sampling of six wells was conducted from October 2010 to July 2011 and the samples were analyzed for TAL metals.

2.4 SURFACE WATER INVESTIGATIONS

In order to determine whether site-related contamination had impacted nearby surface waters, quarterly surface water sampling was performed at the site from October 1996 to September 2010. Locations of the three surface water sampling points are shown on **Figure 2.2**. A total of 159 samples were collected from October 1996 through September 2010. The sample dates, analyses, and locations for the surface water samples are summarized in **Table 2.3**. VOCs were analyzed at SS-5, SS-15, and SS-16 for 61 sampling events, except VOC analyses at SS-16 stopped in November 2004. Pesticides were sampled at SS-5, SS-15 from June 2000 until December 2008 and at SS-16 from June 2000 until August 2004. TAL metals were sampled only at SS-15 from November 2004 until September 2010. Sampling of SS-16 was discontinued in November 2004. Surface water samples were also collected from Mill Creek adjacent to FTMM-04 during the 2010 BEE (Shaw, 2012). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals.

2.5 SEDIMENT INVESTIGATIONS

The FTMM-04 landfill was included in a sediment sampling program to evaluate potential impacts to stream sediments in Mill Creek. Thirteen sediment samples were collected from six borings in April 2000 to evaluate potential PCB-related impacts to stream sediments associated with the FTMM-04 landfill (Versar, 2004a). The sediment sampling locations are shown on **Figure 2.2**. The samples were collected at depths ranging from surface (0-6 inches) to near surface (6-12 inches) along the 360-foot section of Mill Creek that runs through FTMM-04. Samples were analyzed at FMETL for PCBs.

Sediment samples were also collected from Mill Creek adjacent to FTMM-04 during the 2010 BEE (Shaw, 2012). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals.

2.6 ECOLOGICAL INVESTIGATIONS

A Baseline Ecological Evaluation (BEE; Shaw, 2012) was performed at the MP and CWA to fulfill requirements set forth in NJDEP's TRSR (N.J.A.C. 7:26E-5.3). The BEE is Tier I of the ecological evaluation and ecological risk assessment process as developed by the Site Remediation Program, and is defined in the TRSR and Site Remediation News (NJDEP, 1997). The objective of the BEE at FTMM was to examine each of 23 identified sites (8 Environmental Condition of Property [ECP] parcels and 15 Installation Restoration Program [IRP] sites). Such, the results of a BEE are used to determine whether potential ecological impacts are negligible or whether more site-specific ecological evaluation is warranted.

The BEE (Shaw, 2012) concluded that constituents at FTMM, including FTMM-04, are unlikely to have a deleterious effect on sensitive ecological receptors or habitats, and additional ecological assessments at FTMM are not warranted or recommended in an August 27, 2012

letter. The NJDEP has accepted the recommendations and conclusions of the BEE (Shaw, 2012) and concurs that no further evaluation of ecological risk is required. Therefore, based on the recommendation of the BEE (Shaw, 2012), no further ecological risk assessment was conducted for FTMM-04. Additional ecological information pertinent to this site was obtained from the BEE report and is summarized in Section 3.5.

2.7 PREVIOUS INVESTIGATIONS OF BACKGROUND SOIL AND GROUNDWATER QUALITY

2.7.1 Weston (1995) Background Investigation

Weston (1995) collected 10 s oil and groundwater samples on the MP and 10 s oil and groundwater samples on the CWA to determine concentrations of constituents that occur naturally or as a result of activities unrelated to FTMM. Background sampling locations were selected as specified in the document *Investigations of Suspected Hazardous Waste Sites at Fort Monmouth, New Jersey* (Weston, 1993), which was conditionally approved by NJDEP pending incorporation of NJDEP's comments provided in a letter dated April 20, 1994. FTMM provided responses to these comments in a letter dated June 3, 1994 and stated that the Work Plan would be updated per the responses provided in the letter. The resulting background data set was found to be neither normally or log-normally distributed; therefore, the tolerance interval method for determining representative background concentrations described in the then-current version of the USEPA document *Statistical Analysis of Groundwater Monitoring Activities at RCRA Facilities* was not used. Weston (1995) states that nonparametric methods that are similar to the tolerance interval method involve selecting the data value that was at the 95th percentile of the data set. Because there were 10 data points, the equivalent method for the FTMM background data set was to use the maximum value. An outlier screening was conducted to identify background concentrations that were inconsistent with the rest of the data set. Based on the screening, outliers were identified for beryllium, chromium, cobalt, lead, vanadium, and zinc in MP groundwater, and manganese in CWA soil. These outliers were eliminated from the data set.

In addition, Weston (1995) identified maximum background values for Monmouth County based on published data. The Monmouth County background concentrations for soils were based on analyses of samples from the vicinity of Fort Monmouth.

2.7.2 Brinkerhoff (2011a) Background Evaluation

Brinkerhoff (2011a) performed an evaluation to achieve the following objectives:

- Document the presence of naturally occurring metals in groundwater;
- Identify various conditions which are likely to have resulted in exceedances of NJDEP GWQS by concentrations of various metals detected in groundwater at FTMM; and
- Develop a strategy for determining which sites contain metal concentrations in groundwater that represent site-related contamination.

The results of the analysis performed for metals in FTMM-04 groundwater are summarized in Section 4.2.3 of this report.

2.7.3 Base-wide Glauconitic Soil Sampling Report

Previous studies have documented the presence of elevated naturally-occurring metal concentrations (e.g., arsenic, beryllium, lead) in glauconitic soils such as those present within the New Jersey Coastal Plain physiographic province (Dooley, 2001; USGS, 1984). In an effort to confirm and document that select metals detected in groundwater on the MP are naturally associated with glauconitic soils, the FTMM Directorate of Public Works (FTMM, 2011) conducted a soil and groundwater sampling investigation to determine whether naturally occurring metals in soil are causing metal concentrations in groundwater to exceed the NJDEP GWQS. According to Jablonski (1968) the Red Bank and Tinton Sands that outcrop at the MP contain glauconite. Minard (1969) states that glauconite may comprise 60 to 80 percent of the sand fraction in the upper portion of the Tinton Sand.

Six co-located soil and groundwater samples were collected at three sites and analyzed for TAL metals. The study concluded that arsenic and lead co-exist as naturally occurring metals that are unrelated to any documented source at any of the sampled sites. The study also concluded that arsenic in groundwater, which was detected at concentrations exceeding the NJDEP GWQS of 3 micrograms per liter ($\mu\text{g/L}$) in three of the six samples, was due to natural conditions rather than man-made/anthropogenic sources (FTMM, 2011).

SECTION 3 PHYSICAL CHARACTERISTICS OF THE SITE

3.1 SURFACE FEATURES

FTMM-04 is located in the floodplain of Mill Creek. The ground surface topography is flat, with ground surface elevations of less than 20 feet above mean sea level. The site is bounded by baseball fields to the west, Avenue of Memories to the south, North Drive to the north, and Wilson Avenue/Building 589 to the east (**Figures 1.2 and 1.3**).

3.2 SURFACE-WATER HYDROLOGY

The nearest surface water body to FTMM-04 is Mill Creek, which bisects the landfill. Mill Creek originates off-post and flows along the southern boundary of the MP and turns north just past the Avenue of Memories (**Figure 1.2**).

3.3 GEOLOGY AND HYDROGEOLOGY

3.3.1 Regional Geology and Hydrogeology

The MP and CWA are situated on coastal plain deposits that thicken to the southeast. The regional geologic and hydrogeologic framework for the New Jersey coastal plain is described by Zapecza (1989), who identified 15 regional hydrogeologic units, including nine aquifers and six confining units. An early regional geologic cross-section for the FTMM vicinity based on the work of Zapecza (1989), and presented in Versar (2005b), is provided in **Appendix A**. This cross-section indicates that the depth to crystalline bedrock at FTMM is approximately 1,000 feet. In 2010, the understanding of the unconsolidated bedrock geology in the area around FTMM was refined by Sanford and Sugarman of the New Jersey Geological Survey. They describe the bedrock in the coastal plain as consisting of unconsolidated sand, silt, clay, and glauconitic clay laid down in coastal, nearshore-marine, and continental shelf settings between 95 and 10 million years ago. The sediments are grouped into 19 formations and members.

The Bedrock Geology of the Long Branch Quadrangle (Stanford and Sugarman, 2010) indicates that the Hornerstown, Vincentown, and Tinton formations are the unconsolidated bedrock units that outcrop or occur close to the ground surface in the area of FTMM. There is a relatively thin veneer of surficial deposits that covers most of the unconsolidated bedrock, according to the Surficial Geology of the Long Branch Quadrangle (Stanford, 2000). The 2010 bedrock geologic map provides a geologic cross-section (A-A') through FTMM that is more refined than the one developed by Zapecza (1989); this refined cross section is also included in **Appendix A**. 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, Navesink, and Hornerstown Formations). The individual thicknesses for these units varies greatly from several tens of feet to several hundred feet.

The Hornerstown Formation, which underlies much of the MP and the northern portion of the CWA, consists of glauconitic (>50%) clay and silty clay. This unstratified formation is olive, dark green and black where unweathered and olive-brown with brown to reddish-brown mottles where weathered (Stanford and Sugarman, 2010). The Hornerstown Formation is 25 to 30 feet thick. The Vincentown Formation, which unconformably overlies the Hornerstown Formation,

consists of glauconitic (5-20%), silty, medium-to-coarse, quartz sand; some fine-to-medium sand; and some very coarse sand to very fine pebbles. This formation is yellow, reddish-yellow, olive yellow, or olive-brown in color and has a total thickness of 180 feet.

The Tinton (Sand) Formation unconformably underlies the Hornerstown Formation and conformably overlies the Red Bank Sand and consists of glauconitic (5-30%), silty, medium-to-coarse and fine-to-medium, quartz sand. The color is reddish-brown, reddish-yellow, yellowish-brown where weathered, and grayish-brown, brown, and olive-brown where unweathered. It is commonly iron-cemented into beds and masses as much as 15 feet thick. The uppermost 4 to 6 feet, just below the contact with the Hornerstown Formation, is a brown to olive-gray, glauconitic, clayey silt to sandy or silty clay (Stanford and Sugarman, 2010).

The water table aquifer in the MP and CWA areas is identified as part of the “Navesink-Hornerstown Confining Units,” or minor aquifers. The minor aquifers include the Navesink Formation, Red Bank Sand, Tinton Sand, Hornerstown Sand, Vincentown Formation, Manasquan Formation, Shark River Formation, Piney Point Formation, and the basal clay of the Kirkwood Formation. These geologic formations comprise a “Composite Confining Bed” for the underlying Wenonah Mount Laurel Aquifer (Zapeczka, 1989 as reported by Versar, 2005b) (see regional geologic cross-section in **Appendix A**). The Composite Confining Bed is estimated to be approximately 125 feet thick at FTMM (Versar, 2005b). Wells installed in the Red Bank and Tinton Sands produce 2 to 25 gallons per minute (gpm) (Jablonski, 1968). The shallow water table conditions in the Tinton and Red Bank Sands, and the similar composition of these sands within the Kirkwood Formation, suggest that the Tinton-Red Bank-Kirkwood sequence forms a single, laterally continuous aquifer. Regionally, groundwater in this water table aquifer flows east towards the Atlantic Ocean. However, local topography tends to deflect the flow toward local depressions (Versar, 2005b).

A pumping test performed at FTMM in 1992 yielded a hydraulic conductivity of 32 gallons per day per square foot (gpd/ft²) (4.3 feet per day [ft/day]) (Groundwater & Environmental Services, Inc. [GES], 1999). The location of the pumping test and the geologic unit tested are not known. Additional hydraulic conductivity information for the MP area is provided in Appendix IV of the *MODFLOW Groundwater Modeling Report* prepared by Brinkerhoff (2010). Twenty-one hydraulic conductivity values derived from slug tests performed in monitoring wells installed at various building areas ranged from 0.3 ft/day to 31.7 ft/day with a geometric mean value of 3.2 ft/day.

A preliminary tidal evaluation of select monitoring wells throughout the MP was conducted in 2010, which included M4MW05, M4MW07, and M4MW10 at FTMM-04. The evaluation found that M4MW10, which is adjacent to Mill Creek, did exhibit a rhythmic cycle of groundwater fluctuation indicative of tidal influence while M4MW07 did not indicate tidal influence (Brinkerhoff, 2010). The M4 landfill site is not considered to be within the primary zone of potential tidal influence; however, it is susceptible to groundwater elevation changes due to surface water permeation (Brinkerhoff, 2010).

3.3.2 Site-Specific Geology and Hydrogeology

Monitoring wells M4MW06, M4MW07, M4MW08, M4MW09, and M4MW10 were installed at depths ranging from 15.5 to 22 feet bgs. Soil borings at the site were advanced to a maximum depth of 36 feet bgs. The well construction logs presented in Appendix D of the

Remedial Investigation Report Addendum for the M-4 Landfill Site (U.S. Army, 2012) indicate that the soil column to 24 feet bgs is comprised of brown, fine to coarse sand with fine gravel and root fragments and green/gray/black sandy silt and clay. Cement debris was encountered at depths of up to 36 inches. A geologic cross-section was constructed by Versar (2005) that depicts inferred lithologic conditions across the southern portion of FTMM-04, between wells M4MW07 and M4MW10. This cross-section is provided in **Appendix A** of this report. FTMM-04 overlies the unconsolidated bedrock of the Hornerstown Formation, according to the Bedrock Geologic Map of the Long Branch Quadrangle (Stanford and Sugarman, 2010). Naturally deposited surficial soils also exist above the unconsolidated bedrock (Stanford, 2000).

The depth to groundwater in the MP is typically encountered at 2 to 9 feet bgs. At the FTMM-04 landfill site the groundwater depth typically ranges from approximately 5 to 10 feet bgs based on groundwater depth measurements from monitoring wells M4MW07 through M4MW10 collected between January 2000 and January 2001 (Versar, 2005). East of Mill Creek, groundwater migrates towards the west (i.e., toward Mill Creek, **Figures 1.2 and 1.3**) with a horizontal hydraulic gradient of approximately 0.030 foot per foot (ft/ft) based on potentiometric surface maps presented by Versar (2005). Groundwater west of Mill Creek is presumed to migrate east toward the creek. This presumption is supported by groundwater elevation data for wells M4MW06 (5.73 feet above mean sea level) and M4MW05 (5.14 feet above mean sea level) obtained during the August 2013 sampling event. These data indicate a hydraulic gradient towards the creek. An average advective groundwater seepage velocity for FTMM-04 was calculated using the following equation:

$$V = Ki/n_e$$

Where:

V = seepage velocity

K = hydraulic conductivity = 3.2 ft/day (the geometric mean value determined from slug tests at FTMM)

i = hydraulic gradient = 0.030 ft/ft (measured from site-specific potentiometric surface maps for January, August, and October 2000 prepared by Versar (2005) [see **Appendix A** of this report])

n_e = effective porosity = 0.20 or 20% (estimated value for a fine to coarse sand with minor silt and clay)

The calculated average advective groundwater seepage velocity is 0.48 ft/day (175 ft/yr).

3.4 LAND USE

FTMM-04 has been an inactive landfill since 1956. Since 1956, there has been growth and stabilization of vegetation (grass, trees, and bushes) along the surface and boundaries of the landfill. The anticipated future land use at FTMM-04 is passive open space (Edaw Inc., 2008).

3.5 ECOLOGY

Major vegetation zones at FTMM consist of landscaped areas, estuarine and fresh water wetlands, riparian areas, upland forests, and old field habitats. Much of the upland areas of the MP and CWA consist of extensive areas of regularly mowed lawns and landscaped areas (Shaw, 2012). FTMM-04 consists of an open, vegetated field that is maintained through landscaping.

1 The BEE report (Shaw, 2012) indicates that no significant habitats exist in the vicinity of
2 FTMM-04 according to the GIS digital data provided by NJDEP.

3 Except for occasional transient species, no federally-listed or proposed threatened or
4 endangered flora or fauna are known to exist at FTMM. There was one observance in 1992 of a
5 New Jersey-listed endangered species, the clustered sedge. No federal- or state-listed species
6 were observed during the BEE site visit conducted on the MP and CWA in September 2009.

SECTION 4 NATURE AND EXTENT OF CONTAMINATION

Environmental sampling results for soil, groundwater, surface water, and sediment at FTMM-04 are described in this section.

4.1 SOIL QUALITY

Soil quality results obtained during the near-surface soil characterization (Versar, 2004b) are summarized in the following subsections. Sixty-six samples were collected (i.e., 63 primary and 3 field duplicates) from 63 soil borings. Sample locations are shown on **Figure 2.1**. The soil boring locations are east of Mill Creek. The FTMM-04 boundary did not extend west of Mill Creek during the 1998 soil sampling event. **Figure 2.1** shows the revised boundary following the 2008 landfill delineation study. **Tables 4.1** and **4.2** show the sampling results for detected analytes and also show selected NJDEP comparison criteria and background criteria (**Table 4.1**) and USEPA comparison criteria (**Table 4.2**), including:

- NJDEP RDCSRS, Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS), and IGW soil screening levels; and
- USEPA RSLs (target risk [TR] = 1×10^{-6} and target hazard quotient [THQ] = 0.1) for residential and industrial soil and protection of groundwater (the latter being analogous to the NJDEP IGW soil screening levels).

Table 4.3 summarizes the number of times detected analyte concentrations were greater than one or more NJDEP or USEPA comparison criteria, and the number of times that detected metal concentrations were greater than maximum background concentrations presented by Weston (1995).

4.1.1 Summary of Comparison Criteria Exceedances in Soil

Concentrations of VOCs, SVOCs, pesticides/PCBs and metals were detected that exceed NJDEP and/or USEPA comparison criteria. Versar (2004b) reported that analysis of the soil sampling results did not define a source area or level of contamination that necessitated the identification and evaluation of potential targeted remedial actions. For many of the analytical results that exceeded the then-current Residential Direct Contact Soil Cleanup Criteria (RDCSCC), the “compliance averaging” approach was used by Versar (2004b) to determine compliance with NJDEP technical requirements. Compliance averaging uses the average contaminant concentration in an area of concern rather than the concentration in individual samples for comparison to applicable soil cleanup criteria. In most cases, either the calculated compliance average was below the respective RDCSCC or the exceedance was considered marginal (Versar, 2004b). For the analytes that were not eliminated based on compliance averaging, Versar (2004b) recommended that a document equivalent to a Declaration of Environmental Restriction be incorporated into the FTMM Master Plan for soils containing these exceedances, and recommended no further action for near-surface soil at FTMM-04. A Declaration of Environmental Restriction is equivalent to the current “Deed Notice” in the NJDEP regulations.

4.1.1.1 Summary of Exceedances of Residential Direct Contact Comparison Criteria

Concentrations of the following constituents exceeded the current NJDEP RDCSRS and/or USEPA residential RSL in at least 1 of the 66 soil samples analyzed for VOCs, SVOCs, pesticides/PCBs, and metals (**Tables 4.1 through 4.3**).

- The SVOCs benzo(a)anthracene, bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene (classified as PAHs except for bis(2-Ethylhexyl)phthalate);
- The pesticides 4,4'-DDE and 4,4'-DDD; and
- The metals aluminum, antimony, arsenic, beryllium, cobalt, iron, selenium, thallium, and vanadium.

Detected concentrations of bis(2-Ethylhexyl)phthalate that exceeded a residential direct contact comparison criterion were flagged with a “B” qualifier indicating that they were also detected in an associated blank sample and are therefore associated with non-site-related contamination (i.e., contamination introduced at the laboratory or during field sampling). The chromium concentrations were not speciated into hexavalent and trivalent forms of this metal. Since there is no historical evidence of the presence of the reactive hexavalent form, the total chromium concentrations were compared to the USEPA residential RSL for trivalent chromium.

4.1.1.2 Summary of Exceedances of Non-Residential Direct Contact Comparison Criteria

Concentrations of the following constituents exceeded the current NJDEP NRDCSRS and/or USEPA industrial RSL in at least 1 of the 66 soil samples analyzed for VOCs, SVOCs, pesticides/PCBs, and metals (**Tables 4.1 through 4.3**).

- The SVOCs benzo(a)anthracene, bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz[a,h]anthracene (classified as PAHs except for bis(2-Ethylhexyl)phthalate); and
- The metals arsenic, cobalt, and thallium.

Detected concentrations of bis(2-Ethylhexyl)phthalate that exceeded a non-residential direct contact comparison criterion were flagged with a “B” qualifier indicating that they were also detected in an associated blank sample and are therefore associated with non-site-related contamination (i.e., contamination introduced at the laboratory or during field sampling). As described in Section 4.1.1.1, the total chromium concentrations were compared to the USEPA industrial RSL for trivalent chromium.

4.1.1.3 Summary of Exceedances of Impact to Ground Water Comparison Criteria

Concentrations of the following constituents exceeded the current NJDEP impact to groundwater standard and/or USEPA protection of groundwater RSL in at least 1 of the 66 soil samples analyzed for VOCs, SVOCs, pesticides/PCBs and metals (**Tables 4.1 through 4.3**).

- The VOCs acetone, methylene chloride, and ethylbenzene;
- The SVOCs 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, di-n-butylphthalate, pyrene, benzo(a)anthracene, chrysene,

bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene;

- The pesticides 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT; and
- The metals aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

Acetone and methylene chloride are common laboratory contaminants, and detected concentrations of these analytes may be representative of laboratory-derived contamination. Detected concentrations of bis(2-Ethylhexyl)phthalate that exceeded an impact to groundwater comparison criterion were flagged with a "B" qualifier, indicating that they were also detected in an associated blank sample and are therefore associated with non-site-related contamination (i.e., contamination introduced at the laboratory or during field sampling).

4.1.1.4 Identification of Background Constituents

Metal concentrations were compared to maximum background concentrations for the MP presented by Weston (1995) (Tables 4.1 through 4.3). The maximum-detected concentrations of aluminum, arsenic, barium, beryllium, cobalt, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc were greater than one or more NJDEP and/or USEPA comparison criteria and greater than the maximum background concentration. The metals antimony, cadmium, iron, magnesium, mercury, potassium, and thallium were detected in site soil samples, but were not detected at concentrations greater than maximum background concentrations presented by Weston (1995).

4.1.2 COPCs in Soil

Following USEPA (1989) guidance, data with J, E or ER, and D qualifiers were treated as detects and usable for COPC identification purposes. U and UJ qualified data were considered to be nondetects but usable for COPC identification. B and BJ qualified data were treated as nondetects because the analyte was detected in the associated blank and the estimated chemical concentration in the sample was not five or ten times greater than the concentration in the associated blank (USEPA, 1989). Detections flagged with B and BJ are not usable for COPC identification purposes as the detections may be associated with laboratory contamination.

COPCs in soil were identified by comparing the maximum detected concentration of each analyte to the USEPA residential RSL ($TR = 1 \times 10^{-6}$ and $THQ = 0.1$). If organic chemicals were detected at concentrations greater than USEPA residential RSLs in at least one sample, they were considered COPCs. Metals detected at concentrations exceeding the residential RSL were then compared to the maximum background concentration (Weston, 1995). If the maximum concentration of a metal was greater than both the USEPA residential RSL and the maximum background concentration in at least one sample, that metal was considered to be a COPC. If the maximum concentration was greater than the USEPA residential RSL but less than the maximum background concentration, it was not considered a COPC. However, metals that are considered to be essential human nutrients (calcium, iron, magnesium, potassium, and sodium) were not considered to be COPCs. This decision logic is presented on Figure 4.1.

COPCs in soil (Table 4.3) include acenaphthylene, phenanthrene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene,

dibenz[a,h]anthracene, benzo[g,h,i]perylene, 4,4'-DDE, 4,4'-DDD, aluminum, antimony, arsenic, beryllium, cobalt, selenium, thallium, and vanadium.

4.2 GROUNDWATER QUALITY

The scope of the groundwater monitoring program implemented from May 1997 to July 2011 is summarized in **Table 2.2**. Monitoring well locations are shown on **Figure 2.1**.

Quarterly sampling of site monitoring wells was conducted from 1997 into 2011. Groundwater sampling results obtained from 2008 to 2011 are presented in **Table 4.4**. Groundwater sampling results obtained during the baseline sampling event in August 2013 are presented in **Table 4.5**. More comprehensive summary tables that provide groundwater quality data from May 1997 through July 2011 are provided in **Appendix A**. **Tables 4.4** and **4.5** also show the NJDEP GWQS and USEPA Tapwater RSLs, and maximum background concentrations presented by Weston (1995).

4.2.1 Summary of Groundwater Sampling Results From 1997 to 2011

Two VOCs (acetone and 2-butanone) were detected at least once at concentrations below their respective GWQS in groundwater samples collected from May 1997 through November 2004, after which VOCs were removed from the groundwater analytical program.

Four SVOCs (naphthalene, di-n-butylphthalate, bis(2-ethyl)phthalate, di-n-butylphthalate) were detected at least once at concentrations below their respective GWQS in groundwater samples collected from May 1997 through November 2004, after which SVOCs were removed from the groundwater analytical program.

The pesticide 4,4'-DDE was detected in one sample collected in July 1998 at a concentration below the NJDEP GWQS. Pesticides/PCBs were removed from the monitoring program after the October 2004 sampling event.

Removal of VOCs, SVOCs, and pesticide/PCB analyses from the FTMM-04 groundwater sampling program was approved by the NJDEP in a November 16, 2004 email.

TAL metals were detected in FTMM-04 groundwater samples collected during the 54 groundwater sampling events from May 1997 through July 2011, including six rounds of low-flow sampling. Twelve metals (aluminum, antimony, arsenic, beryllium, cadmium, iron, lead, manganese, nickel, silver, selenium, and thallium) were detected at concentrations that exceeded their respective GWQS. However, concentrations for five of the metals (aluminum, iron, manganese, nickel, and sodium) that exceeded the GWQS did not exceed the maximum background concentrations for groundwater at the MP established in the Weston SI Report (1995). In addition, the U.S. Army (2012) noted that antimony, beryllium, cadmium, nickel, and selenium are common in soils at FTMM, as documented through site-specific analysis, and have low GWQS. Versar (2005) stated that there were two "non-native" metals (lead and silver) that were detected in groundwater at concentrations exceeding their respective NJDEP GWQS. Native metals were defined as being indigenous to the soil types present at FTMM. However, Versar (2005) eliminated lead and silver as constituents of concern in groundwater following comparison of low-flow sampling results to GWQS.

Metals in groundwater at FTMM-04 were evaluated in the Background Metals Evaluation prepared by Brinkerhoff (2011a). A 90th Percentile Analysis was performed on data collected from January 2005 to August 2010 to remove data outliers and obtain a more representative data

set. The analysis determined that 90th percentile values for barium, beryllium, chromium, copper, and nickel were below their respective NJDEP GWQS. The mean value for cadmium was also below its GWQS. Due to possible laboratory inaccuracies affecting selenium and thallium, the 90th percentile analysis was not used to determine compliance for these metals.

4.2.2 Summary of Results from Most Recent Eight Quarterly Sampling Events and August 2013 Baseline Sampling Event

The most recent eight quarters of groundwater monitoring data (November 2009 through July 2011) and the baseline data collected in August 2013 are evaluated in greater detail in this subsection as being representative of recent conditions. During these most recent nine sampling events, detected concentrations of selected VOCs and metals exceeded NJDEP GWQS and/or USEPA Tapwater RSLs.

Table 4.6 summarizes the number of times concentrations of a detected analyte were greater than the NJDEP GWQS and/or USEPA Tapwater RSLs during the most recent eight quarterly sampling events and the August 2013 baseline sampling event, and the number of times detected metal concentrations exceeded the maximum background concentration presented by Weston (1995).

4.2.2.1 Summary of Exceedances of NJDEP and USEPA Comparison Criteria

Concentrations of the following constituents exceeded their current NJDEP GWQS and/or USEPA Tapwater RSL in at least 1 of the 58 samples collected during the most recent eight quarters of groundwater monitoring or the 2013 baseline sampling:

- The VOC naphthalene; and
- The metals aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, mercury, selenium, sodium, and vanadium.

The naphthalene concentration in groundwater from well M4MW10 (0.28 BJ µg/L) exceeded the USEPA tapwater RSL (0.14 µg/L) in one sample collected during the August 2013 baseline sampling event. The naphthalene detection was flagged with a “B” qualifier indicating that it was also detected in a blank sample, and is therefore associated with non-site-related contamination (i.e., contamination introduced at the laboratory or during field sampling).

4.2.2.2 Identification of Background Constituents

The metals detected at concentrations exceeding their NJDEP GWQS and/or USEPA Tapwater RSL, and also the maximum background concentration for the MP established by Weston (1995) included barium, lead, manganese, mercury, selenium, and sodium. Exceedances of background levels for these metals are evaluated below:

- The maximum background concentration for barium (699 µg/L) reported by Weston (1995) was exceeded one time during the most recent eight sampling events (883 µg/L in M4MW08 in November 2009). This was not a low-flow sampling event and therefore the sample may have been relatively turbid, resulting in biased high metal concentrations. The maximum barium concentration detected in this well during the subsequent seven events was 42.3 µg/L, and barium was not detected in the last 4 of these 7 events. Given the isolated nature of the maximum background exceedance, barium is considered to be representative of background conditions;

- The maximum background concentration for lead (22.7 µg/L; Weston, 1995) was exceeded only once during the most recent eight sampling events (31.10 µg/L from M4MW09 in November 2009) and was not detected in the last 7 of 7 events. Given the isolated, low-magnitude nature of the exceedance, lead is considered to be representative of background conditions;
- The maximum background concentration for manganese (331 µg/L; Weston, 1995) was exceeded twice during the most recent eight sampling events (938 µg/L from M4MW08 in November 2009 and 336 µg/L from M4MW08 in October 2010). Given the isolated, low-magnitude nature of the two exceedances, manganese is considered to be representative of background conditions;
- The maximum background concentration for mercury (0.26 µg/L; Weston, 1995) was exceeded only twice during the most recent eight sampling events dating back to January 2008 (0.47 µg/L in the duplicate sample from M4MW09 in July 2010 [primary sample concentration < maximum background level], and 0.4 µg/L in M4MW10 in July 2010). Mercury was not detected in the subsequent 3 out of 4 samples following the exceedances at both M4MW09 and M4MW10. Given the isolated, low-magnitude nature of the two exceedances, mercury is considered to be representative of background conditions; and
- The maximum background concentration for selenium (29.6 µg/L; Weston, 1995) was exceeded five times during the most recent eight sampling events dating back to November 2009. The five exceedances occurred in July 2010 in samples from M4MW07, M4MW08, M4MW09 (both the primary and duplicate sample), and M4MW10. Concentrations ranged from 59.8-83.4 µg/L. Given the isolated, low-magnitude nature of the five exceedances, selenium is considered to be representative of background conditions.

The only metal concentrations detected in the August 2013 baseline sampling event that exceeded their maximum background concentration were calcium and sodium. Both calcium and sodium exceeded the background concentration 25 times during the last 8 sampling events, from November 2009 to August 2013. Both are essential human nutrients and are not expected to pose a risk to human health.

4.2.3 COPCs in Groundwater

As shown on **Figure 4.1**, COPCs in groundwater were identified by comparing the maximum detected concentration during the eight most recent quarterly sampling events (November 2009 to July 2011) and August 2013 to the USEPA tapwater RSL ($TR = 1 \times 10^{-6}$ and $THQ = 0.1$). Organic chemicals that were detected at concentrations greater than USEPA tapwater RSLs were considered COPCs. Metals that were detected at concentrations exceeding the tapwater RSL were then compared to the maximum detected background concentration (Weston, 1995). Detected metals that also exceeded the maximum background concentration (Weston, 1995) were then assessed more holistically to determine whether background exceedances were representative of site-related contamination or were due to other factors such as turbidity or upgradient sources. Metals exceeding background were exempted from being identified as COPCs as a result of this holistic assessment if any of the following conditions were met:

- There were only a small number of background exceedances during the most recent eight quarterly sampling events and the August 2013 baseline sampling event such that the exceedances were anomalous outliers and not representative of the vast majority of the data;
- The background exceedances occurred early in the time period encompassed by the most recent eight quarterly sampling events, and concentrations in subsequent samples were below the maximum background concentration; and/or
- The background exceedances only occurred in an upgradient monitoring well.

In each of the three scenarios listed above, the metals were deemed to be representative of background conditions. In addition, metals that are considered to be essential human nutrients (calcium, iron, magnesium, potassium, and sodium) were not evaluated as COPCs in the risk assessment.

SVOCs, pesticides and PCBs were ruled out as COPCs based on samples collected from May 1997 to October 2004 (see Section 2.3). Metals were ruled out as COPCs based on the analysis provided in Section 4.2.2.2. NJDEP approved discontinuing analysis for VOCs, SVOCs, pesticides, and PCBs in a November 16, 2004 letter.

There are no site-related COPCs in groundwater at FTMM-04 (**Table 4.6**). The VOC naphthalene exceeded the USEPA RSL; however, the exceedance was “B” flagged indicating it may be associated with laboratory contamination. Four metals (barium, lead, manganese, and mercury) exceeded both the USEPA RSL and the maximum background value. However, further analysis determined them to be anomalous and not representative; therefore, no metals were identified as COPCs.

4.3 SURFACE WATER QUALITY

The scope of the surface water monitoring program implemented from October 1996 to September 2010 is summarized in **Table 2.3**, and sampling locations historically associated with FTMM-04 are shown on **Figure 2.2**. SS-15 is located upstream of FTMM-04 where Mill Creek first enters the MP, and is indicative of water quality entering the MP. SS-16 is located at the upstream end of FTMM-04 and is indicative of water quality entering the site. SS-5 is located approximately 120 feet north (downstream) of FTMM-04 at the confluence of Mill and Lafetra Creeks. As shown in **Table 2.3**, SS-16 has not been sampled since 2004.

4.3.1 Summary of Surface Water Sampling Results From 1996 to 2010

Surface water samples were collected from two upstream sampling points (SS-15 and SS-16) and one downstream sampling point (SS-5) from the 3rd Quarter 1996 to the 3rd Quarter 2004. Three VOCs (PCE, TCE, and methylene chloride) were detected at least once at concentrations above their respective SWQS at these three stream sampling points. The VOCs detected at concentrations exceeding the criteria were suspected to be from a source upstream and outside the boundary of FTMM due to detections of these VOCs in upstream samples (SS-15 and SS-16) and the fact that PCE and TCE are not groundwater contaminants at FTMM-04 (Versar, 2005; U.S. Army, 2012).

Three metals (antimony, arsenic, and mercury) were detected in FTMM-04 surface water samples during 24 surface water sampling events from 2004 to 2010. However, metals were not considered to be constituents of concern at FTMM as their widespread occurrence in soil,

groundwater, and surface water and the lack of discernible trends suggest they are of background origin (U.S. Army, 2012).

Surface water samples were also collected from Mill Creek adjacent to FTMM-04 during the 2010 BEE (Shaw, 2012). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Sampling results were compared to ecological screening concentrations (ESC) that are intentionally conservative. The results of the comparisons were used to identify contaminants of potential ecological concern (COPECs). There were no COPECs identified in surface water.

4.3.2 Summary of Results from Most Recent Eight Quarterly Sampling Events

Table 4.7 presents surface water sampling results obtained from March 2007 to September 2010. This table shows NJDEP saline (SE) SWQS and USEPA National Recommended Water Quality Criteria (NRWQC) for protection of human health (organism only) for detected VOCs, metals, and selected wet chemistry constituents for comparison purposes. NJDEP saline SWQS are used as comparison criteria because the high tide salinities at upstream sampling location on Mill Creek for SS-15 ranged from 4 to 7 parts per thousand (ppt), respectively (Shaw, 2012, Figure 2-1).

The most recent eight quarters of surface water monitoring data (December 2008 through September 2010, total of 16 samples) are evaluated in greater detail as being representative of recent conditions. **Table 4.8** summarizes the number of times a detected analyte was greater than NJDEP saline SWQS and/or the USEPA NRWQC. During the most recent eight quarterly sampling events, only one VOC (PCE) was detected at concentrations exceeding the NJDEP SWQS (1.6 µg/L). None of the detected PCE concentrations exceeded the USEPA NRWQC (**Table 4.8**). Most of the SWQS exceedances occurred at upstream location SS-15. PCE concentrations detected downstream of FTMM-04 at SS-5 were similar to or lower than concentrations detected upstream of the site at SS-15. These data show that FTMM-04 is not impacting VOC concentrations in the reach of Mill Creek that borders the site.

Arsenic was detected upstream of FTMM-04 at SS-15 at concentrations that exceeded both the NJDEP SWQS and USEPA NRWQC. Mercury was detected at SS-15 at a concentration that exceeded the NJDEP SWQS (**Table 4.8**). Metals that exceeded the NJDEP SWQS and USEPA NRWQC were detected at the upstream sampling location SS-15 and are not associated with FTMM-04. Surface water samples collected at downstream location SS-5 were not analyzed for metals.

4.3.3 COPCs in Surface Water

COPCs were identified in surface water by comparing the maximum detected concentration to the USEPA NRWQC for protection of human health (organism only). Detected analytes that exceeded the USEPA NRWQC in surface water samples were considered COPCs unless the analyte was also detected upstream of the site at a similar or greater concentration.

There are no site-related COPCs in surface water adjacent to FTMM-04 (**Table 4.8**). The only analyte that exceeded the USEPA NRWQC for protection of human health (organism only) was arsenic. However, arsenic was detected at the upstream sampling location SS-15 and is not considered a COPC at FTMM-04.

4.4 SEDIMENT

Sediment sampling was conducted in Mill Creek in April 2000 to evaluate PCB-related impacts to stream sediments associated with the FTMM-04 landfill (Versar, 2004a). PCBs were detected in one of six samples collected (B-5) at a concentration of 0.051 mg/kg. This concentration is less than the NJDEP RDCSRS of 0.2 mg/kg and the USEPA RSL for Residential soil of 0.11 mg/kg for total PCBs (Table 4.9). Therefore, there were no screening criteria exceedances in sediment.

Sediment samples were also collected from Mill Creek adjacent to FTMM-04 during the 2010 BEE (Shaw, 2012). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Sampling results were compared to ESC that are intentionally conservative. The results of the comparisons were used to identify COPECs. COPECs identified in sediment included SVOCs (classified as PAHs), pesticides, PCBs, and metals. The potential for ecological effects from COPECs in sediment was judged to be minimal for the following reasons (Shaw, 2012):

- Polynuclear Aromatic Hydrocarbons (PAHs) have many anthropogenic sources and are ubiquitous in environmental media. The few detected concentrations of PAHs identified as COPECs were detected at low concentrations similar to those in background samples;
- PCBs were not detected in near surface soils at FTMM-04 and may not be related to the landfill. PCBs at low concentrations are ubiquitous due to varied anthropogenic sources, and detected concentrations were similar to those in background samples;
- Pesticides were infrequently detected and detected concentrations were low with respect to ESC; and
- Concentrations of metals in sediment were similar to those found in background samples.

For the above-listed reasons, the BEE (Shaw, 2012) concluded that constituents in sediment at FTMM-04 were unlikely to have a deleterious effect on sensitive ecological receptors or habitats, and additional ecological assessments were not warranted or recommended.

SECTION 5 CONTAMINANT FATE AND TRANSPORT

This section addresses the fate and transport of metals and SVOCs detected in vadose zone soil at FTMM-04 at concentrations exceeding one or more NJDEP or USEPA comparison criteria and (in the case of metals) maximum background concentrations reported in the SI Report (Weston, 1995) (see Section 4.1.5). The fate and transport of detected constituents in the other sampled media (groundwater, surface water, and sediment) are not addressed for the following reasons:

- SVOCs were removed from the groundwater monitoring program after 2004 due to lack of regulatory criteria exceedances, and metals in groundwater exceeding NJDEP GWQS and/or USEPA MCLs were determined to be representative of background conditions (Section 4.2.5);
- Concentrations of detected constituents in surface water were determined to be attributed to upstream sources and not FTMM-04 (Section 4.3.4); and
- There were no exceedances of NJDEP or USEPA comparison criteria in sediment samples.

Unless otherwise indicated in the text, the fate and transport information presented in this section was derived from two primary sources: the online *Toxnet Hazardous Substances Data Bank* (HSDB; <http://toxnet.nlm.nih.gov/cgi-bin/sis/search>) and the *Framework for Metals Risk Assessment* (USEPA, 2007).

5.1 POTENTIAL ROUTES OF MIGRATION

Potential migration routes for metals and SVOCs detected in vadose zone soil at FTMM-04 include dissolution of soluble residual concentrations in the vadose zone into infiltrating precipitation that percolates through vadose zone soil to the water table. The constituents addressed in this section are not volatile; therefore, the volatilization pathway is not addressed.

5.2 CONTAMINANT PERSISTENCE

5.2.1 Metals

Metals are subject to various transformation processes in soil. For example, metals can exist in the environment in several valence forms, and they can also exist as organometallic compounds that have a metal-carbon bond. Metal transformation processes, such as metal methylation, complexation, and oxidation/reduction occur through interactions with other chemicals and biota in the environment. In general however, metals are elements that are not subject to natural degradation in the environment and therefore are expected to be relatively persistent in vadose zone soil at FTMM-04.

5.2.2 SVOCs

The PAHs benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and dibenz[a,h]anthracene are polyaromatic hydrocarbons having 18 to 22 carbon atoms. As the chain lengths of the hydrocarbons approach a size of approximately 15 - 20 carbon atoms, their vapor pressures and water solubilities become negligible, and partitioning to air or dissolution in water is unimportant (American Petroleum Institute [API], 2011). API (2011) generally

classifies petroleum substances in the C9 to C25 range as “not readily biodegradable” because their biodegradation rates are typically slower than lighter, more volatile fuels, such as gasoline or jet fuel. Therefore, PAHs are expected to be relatively persistent in vadose zone soil at FTMM-04.

Montgomery (1996) references a study where bis(2-ethylhexyl)phthalate degraded in both amended and unamended calcareous soil from New Mexico; after 146 days, 76% to 93% degraded to carbon dioxide (Fairbanks et al., 1985). Wolfe et al. (1980) reports that bis(2-ethylhexyl)phthalate hydrolyzes in water to phthalic acid and 2-ethylhexyl alcohol. However, bis(2-ethylhexyl)phthalate is relatively persistent in aerobic soil and sediments and very persistent in anaerobic conditions. The near-surface soil at FTMM-04 is expected to be aerobic. The online HSDB reports that if released to soil, bis(2-ethylhexyl)phthalate is expected to be immobile based upon the magnitude of its organic carbon partitioning coefficient. Biodegradation of bis(2-ethylhexyl) phthalate occurs in soil, but at a slower rate than in water, since adsorption onto the soil organic matter reduces the availability of this compound for degradation. The available information indicates that bis(2-ethylhexyl)phthalate is expected to be relatively persistent in vadose zone soil at FTMM-04.

5.3 CONTAMINANT MIGRATION

5.3.1 Metals

Because the behavior of metals in the environment defies simple generalities, understanding the chemistry of the particular metal and the environment of concern is necessary to assess the metal’s behavior in the environment in a detailed fashion. However, the factors that control metal chemistry and the environmental characteristics used to produce estimates of metal fate and effects can be generalized. The pH of the host medium is probably the single most important variable that influences the behavior of metals in the environment; most complexation and precipitation reactions are pH dependent.

Movement of metals through soils is dependent on the chemical properties controlling speciation, the presence of ligands that control complexation of metals within pore water and adsorption onto mineral surfaces, and the rate of water flux through the soil. Metals are lost from the soil by leaching into groundwater and through metal-specific uptake by plants. As metals age in soils, they decrease in potential bioavailability.

In the soil environment, metals can exist as cations (having a positive charge), anions (having a negative charge), or neutral species (having a zero charge). Their form significantly affects their sorption, solubility, and mobility. For example, most soils are chiefly negatively charged; thus, metal cations have a higher propensity to be sorbed by soil particles than do metal anions. For most soils in the U.S., negatively charged sites are more plentiful; less than 5% of the total available charge on the soil surface is positively charged. Metals existing as cationic species have a greater propensity to associate with such soils, making them less bioavailable. Anionic metals generally move into pore water—and so are more bioavailable—but leach out of the system much more rapidly. In summary, soil pH and availability of charged sites on soil surfaces are the primary soil factors controlling release of metals to pore water and, subsequently, bioavailability.

Metals are usually cations, including those listed in Section 4.1.5 except for selenium. The HSDB states that selenium has sorptive affinity for hydrous metal oxides, clays, and organic

materials, which may be present in varying degrees in the subsurface at FTMM-04. Therefore, metals in vadose zone soil at FTMM-04 (Section 4.1.2) are expected to be relatively immobile.

5.3.2 SVOCs

For the reasons described in Section 5.2, PAHs identified in near-surface soil at FTMM-04 (Section 4.1.2) are expected to be relatively immobile and will not readily leach to groundwater. The SVOC bis(2-ethylhexyl) phthalate is a component of plastics that sorbs readily to soil and moves very slowly in the vadose zone. HSDB reports that if released to soil, bis(2-ethylhexyl)phthalate is expected to be relatively immobile based upon the magnitude of its organic carbon partitioning coefficient. However, after disposal of plastic products in a landfill, this compound will slowly leach from the plastic and may migrate vertically downward within the vadose zone, eventually reaching the groundwater. If that occurs, the low solubility of bis(2-ethylhexyl) phthalate in water will limit the amount that will enter the environment by this route (http://www.eco-usa.net/toxics/chemicals/di_2-ethylhexyl_phthalate.shtml).

5.4 SUMMARY

Metals and SVOCs in vadose zone soil at FTMM-04 are expected to be relatively persistent and immobile, limiting their impact on groundwater quality. This observation is supported by the fact that 1) SVOCs were removed from the groundwater monitoring program after 2004 due to a lack of GWQS exceedances, and 2) metal concentrations detected in groundwater during the most recent eight quarterly sampling events were less than maximum background concentrations reported by Weston (1995).

SECTION 6 BASELINE RISK ASSESSMENT

The specific objective of this baseline HHRA is to provide a quantitative evaluation of the risk associated with exposure to soil, surface water, sediment, and groundwater at FTMM-04. The HHRA will determine if there is potential unacceptable risk to human health associated with exposure to contaminants present in these environmental media.

In a letter to Ms. Wanda Green, BRAC Environmental Coordinator at FTMM, dated August 27, 2012, NJDEP (2012) accepted the revised BEE submittal (Shaw, 2012), agreed that “all exceedances have been sufficiently evaluated and addressed for ecological receptor considerations”, and stated that “no additional ecological evaluation or assessment is necessary for the Main Post and Charles Wood Area.” Therefore, additional ecological risk evaluation was not performed for FTMM-04.

6.1 RISK ASSESSMENT PROCESS

6.1.1 Summary of Available Data for FTMM-04

This quantitative HHRA for FTMM-04 was based on the data collected by others during the investigations summarized in Section 2 of this RI. As described in Section 2, environmental sampling at the site included surface soil, sediment, surface water, and groundwater.

The analytical results for chemicals detected in each environmental medium at FTMM-04 are provided in data summary tables in Section 4 of this RI, **Tables 4.1** and **4.2** (soil), **Table 4.4** and **4.5** (groundwater), **Table 4.7** (surface water), and **Table 4.9** (sediment).

6.1.2 General HHRA Approach and Guidance Documents

Techniques and methods developed or recognized by the U.S. Army Corps of Engineers (USACE) and the USEPA were used for this HHRA. This quantitative HHRA used a risk ratio approach (which is further described in Section 6.2.1 below) to quantify potential carcinogenic risk and non-carcinogenic hazards. The risk ratio approach satisfies the requirements of USEPA’s RAGS because it addresses the four steps of a risk assessment (data evaluation and identification of COPCs, exposure assessment, toxicity assessment and risk evaluation), while streamlining the approach to facilitate movement to a potential corrective action. In order to be consistent with RAGS, and to properly estimate the risk, it is important that risk-based criteria are used to calculate the risk ratio. Therefore, USEPA human health screening values were used for the risk ratio analysis. Risk ratio analyses provide a conservative quantification of risk to human health due to exposure to site contamination.

The primary resources for conducting this quantitative risk ratio HHRA are listed and described below.

- Standard Scopes of Work for HTRW Risk Assessments (USACE, 2001) to provide risk assessors with recommended requirements for preparation of human health risk assessments; and
- RAGS (USEPA, 1989) to provide basic background and approach for performing standard HHRA’s (e.g., data evaluation, exposure assessments, etc.). General procedures identified in the USEPA’s RAGS (1989) were followed for this HHRA in

terms of data evaluation, the exposure assessment, and the toxicity assessment. Supplemental USEPA guidelines were also used in conjunction with RAGS.

6.1.3 Organization of HHRA Report

The overall risk assessment process consists of four key steps: data evaluation, exposure assessment, toxicity assessment, and risk characterization. These four steps of risk assessment provide the general outline of a quantitative risk assessment report. Because this HHRA uses the risk ratio approach, the outline and overall format is slightly modified from the traditional HHRA. This HHRA is still consistent with USEPA guidelines as presented in RAGS (USEPA, 1989) and supporting supplemental guidance including the Standard Scopes of Work for HTRW Risk Assessments (USACE, 2001). This HHRA is organized into five sections (including this one), as outlined below.

6.1 Risk Assessment Process;

6.2 Data Evaluation and Identification of Chemicals of Potential Concern;

6.3 Exposure Assessment;

6.4 Risk Ratio and Screening Criteria Assessment; and

6.5 Risk Assessment Results and Uncertainties.

6.2 DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Soil data included in the risk assessment were collected in 1998 (Versar, 2004). Groundwater data from the most recent eight quarters of groundwater monitoring data (November 2009 through July 2011) and the baseline data collected in August 2013 were evaluated. Surface water data from the most recent eight quarters (December 2008 through September 2010) was evaluated. Sediment data are included from samples collected in April 2000 (Versar, 2004). The validated data were evaluated in the selection of COPCs. Data validation classified the data through the use of several qualifiers. Data without qualifiers were considered appropriate for risk assessment purposes. Following USEPA guidance (1989), data with J, E or ER, and D qualifiers were considered detected concentrations and used for risk assessment purposes. U and UJ qualified data were considered to be nondetected but usable for risk assessment purposes. B and BJ qualified data were treated as nondetected chemicals because the chemical was detected in the associated blank and the estimated chemical concentration in the sample was not five or ten times greater than the concentration in the associated blank (USEPA, 1989).

Calcium, iron, magnesium, potassium, and sodium were not evaluated in the human health risk assessment because they are essential nutrients and are not expected to pose a risk to human health.

COPCs at FTMM-04 are those site-related contaminants for which there is evidence of a potential release due to the Department of Defense (DoD) site activities, and if detected concentrations are greater than USEPA screening criteria and background consistent with Section 4.1.2. COPCs are evaluated for their potential to pose a risk to human health. Soil, surface water, sediment, and groundwater have been sampled at the site. Sampling results for the chemicals detected in each environmental medium are summarized in **Tables 4.1 and 4.2** (soil), **Table 4.4 and 4.5** (groundwater), **Table 4.7** (surface water), and **Table 4.9** (sediment). COPCs

were identified in **Table 4.3** (soil), **Table 4.6** (groundwater), **Table 4.8** (surface water), and **Table 4.9** (sediment). Site-related COPCs in soil (**Table 4.3**) are the SVOCs acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene; the pesticides 4,4'-DDD and 4,4'-DDE; and the metals aluminum; antimony; arsenic; beryllium; cobalt; selenium; thallium; and vanadium.

- No site-related COPCs were identified in groundwater (**Table 4.6**);
- No site-related COPCs were identified in surface water (**Table 4.8**); and
- No site-related COPCs were identified in sediment (**Table 4.9**).

6.2.1 Risk Ratio Approach

This quantitative HHRA used a risk ratio approach to quantify potential carcinogenic risk and non-carcinogenic hazard for each COPC in each contaminated media. The general risk assessment process for FTMM-04 is summarized in **Figure 6.1**.

EPC are the concentrations of chemicals in a given medium to which a receptor may be exposed at a specific location known as the "exposure point." Initially, the maximum detected concentration of each COPC was used as the EPC to evaluate risk. Use of maximum concentrations provides a conservative (i.e., health-protective) estimate of exposure to that chemical. However, the use of maximum detected concentrations can also provide an overestimate of the potential exposure, if elevated concentrations of an analyte are limited to a small portion of a potential exposure area.

To calculate a risk ratio, the EPC was divided by the appropriate screening level for the environmental medium to determine the ratio of the site concentration to a risk-based health protective concentration. As discussed above, the criteria used to calculate the risk ratios were the USEPA Industrial RSLs ($TR = 1 \times 10^{-6}$; $THQ = 1.0$) and the calculated recreational user screening levels. Risk ratios are calculated for industrial workers and for recreational users (Section 6.3.2).

After calculating the risk ratios for individual COPCs, the ratios were then summed to determine the cumulative risk. Cumulative non-carcinogenic risk ratios greater than one indicate a potential unacceptable non-carcinogenic risk. Cumulative carcinogenic risk ratios greater than USEPA's acceptable risk range of 10^{-4} to 10^{-6} indicate a potential unacceptable carcinogenic risk.

For soil, after the cumulative carcinogenic risk or non-carcinogenic hazards were calculated, the COPCs posing the greatest risk are identified. These COPCs are the primary risk drivers and are the COPCs that pose more than 25% to the cumulative risk. To provide a more accurate estimate of exposure, the 95% UCL on the mean is calculated for each primary risk driver. The cumulative risk is then calculated using the 95% UCL in place of the maximum detected concentration for all primary risk drivers to represent the EPC, rather than the maximum detected concentration. The selected EPCs (maximum detected concentration or the 95% UCL) are identified on the risk ratio tables.

Generally, use of 95% UCL on the mean provides a conservative (i.e., health-protective) estimate of exposure to that chemical, but better represents the concentration that a receptor may be exposed to over a period of time. Therefore, the 95% UCL is less likely to overestimate the potential exposure than the use of a maximum concentration. The 95% UCL was calculated

using parametric methods (for a normal or lognormal distribution) or nonparametric methods if data are not normally or lognormally distributed (USEPA 1992). Data distribution was tested using the Shapiro-Wilk test prior to calculating the 95% UCL. Statistical evaluation was not conducted for analytes with fewer than eight detected concentrations in a data set. 95% UCLs were calculated using ProUCL (Version 5.0) (USEPA, 2013a). ProUCL output, including summary statistics, a graphic representing the data distribution (quantile plot) and an outlier test is provided in **Appendix B**.

USEPA guidance (USEPA, 1989) also allows elimination of COPCs if they are detected in fewer than 5 percent of the samples in a particular medium. This would require at least 20 samples. However, detection frequency was only qualitatively reviewed on a case by case basis in this HHRA and only following the risk ratio analysis (e.g., infrequently detected chemicals that are driving an unacceptable risk are identified). Thus, chemicals were not screened from the HHRA based on detection frequency. In summary, the site-related COPCs were evaluated in this HHRA.

6.2.2 Soil Samples

This HHRA evaluates chemicals identified as COPCs, which includes those analytes attributed to DoD site activities for which there is evidence of a release to environmental media. Therefore, organic compounds detected at concentrations greater than screening levels, and metals detected at concentrations greater than screening levels and greater than background concentrations, were included in the risk assessment. Surface soil at the site is defined as soil collected at depths less than 2 feet from the surface and would include exposure pathways with no, or very minor, soil disturbance (e.g., wind dispersion of surface soil, landscaping/groundskeeping activities in surface soil). Surface soil samples were collected during previous remedial investigations. Therefore, surface soil is evaluated in this HHRA. Each of the soil samples, except those prepared for VOC analysis, were collected between approximately 6 and 12 inches bgs. VOC samples were taken at approximately 24 inches bgs since surface soils would not be expected to retain volatile constituents over time. The sampling was based on the boundary at the time of collection. The FTMM-04 boundary has since been refined. Five of the soil samples occur outside the refined boundary (soil samples B-53, B-54, B-55, B-62 and B-63). However, these samples are included in the risk ratio calculations for the following reasons:

- They are approximately 25 feet from the refined landfill boundary and it is feasible that landfill-related contamination could have migrated offsite in precipitation runoff or via wind-transport of soil particles;
- The maximum detected concentrations of five analytes occur in sample B-55. The pesticides (4-DDD, 4-DDE, and 4-DDT) and metals (lead and mercury) detected in sample B-55 were also detected in samples from within the refined landfill footprint so they are not unique to sample location B-55;
- The concentrations of 4-DDE, 4-DDT, lead, and mercury detected within the landfill footprint were generally the same order of magnitude as those at B-55; and
- Elevated pesticide detections, relative to those detected in B-55, are not observed in other roadside samples (i.e., B-12, B-45, and B-34). Therefore, it does not appear that pest control spraying along the road contributes to observed pesticide concentrations.

1 **Tables 4.1 and 4.2** summarize the sampling results and sampling depths, and **Figure 2.1**
2 shows the soil sampling locations. **Table 4.3** shows the COPCs in soil that will be evaluated in
3 the HHRA.

4 **6.2.3 Groundwater Samples**

5 Multiple rounds of groundwater samples were collected from monitoring wells at FTMM-04
6 (**Figure 1.3**). Many of these samples were collected at the same wells during different time
7 frames and not all sampling activities included analyses for a complete suite of analytes.

8 The locations of groundwater wells at FTMM-04 are shown on **Figure 1.3**. **Tables 2.1, 2.2,**
9 **4.4, and 4.5** present the well construction summary, groundwater sampling summary, and
10 groundwater sampling results, respectively. **Table 4.6** indicates that no COPCs were identified
11 for groundwater at FTMM-4, and groundwater is not evaluated further in this HHRA.

12 **6.2.4 Surface Water Samples**

13 Surface water samples were collected from locations upgradient and downgradient of
14 FTMM-04 (**Figure 2.2**). The data set includes multiple samples collected at the same locations
15 at different times and not all sampling activities included analyses for a complete suite of
16 analytes. Because of the sampling strategy in the area and the potential for changing conditions
17 over time, only the maximum detected concentrations of the samples analyzed from the most
18 recent eight surface water sample events were evaluated in the risk ratio analysis, which includes
19 samples collected between December 29, 2008 and September 21, 2010. Two sample locations
20 have data for this time frame: SS-5 and SS-15. SS-5 is located downgradient of FTMM-04 at the
21 confluence of Lafetra Creek and Mill Creek and is considered saline. SS-15 is located
22 upgradient of FTMM-04 within Mill Creek and is fresh water. Since SS-5 is located
23 downgradient, samples collected from this location could represent a release of contaminants
24 from the landfill. Therefore, the maximum detected concentrations from SS-5 for the most
25 recent eight sampling events was screened in **Table 4.8**.

26 The surface water sample locations are shown on **Figure 2.2**. **Tables 2.3 and 4.7** present the
27 surface water sampling summary and surface water sampling results, respectively. **Table 4.8**
28 indicates that no COPCs were identified for surface water at FTMM-04, and surface water is not
29 evaluated further in this HHRA.

30 **6.2.5 Sediment Samples**

31 Six sediment samples were collected from locations within Mill Creek, which bisects the
32 west-central portion of FTMM-04 (**Figure 1.3**). The sediment sample locations are provided on
33 **Figure 2.2**. Sediment samples were collected in April 2000 and the results are provided in
34 **Table 4.9**.

35 **Table 4.9** indicates that no COPCs were identified for sediment at FTMM-04, and sediment
36 is not evaluated further in the HHRA.

37 **6.3 EXPOSURE ASSESSMENT**

38 The objective of the exposure assessment is to estimate the type and magnitude of potential
39 exposures to COPCs at the site. The exposure assessment includes identification of potential
40 exposure pathways, receptors, and exposure scenarios, as well as quantification of exposure.
41 Characterization of the exposure setting and identification of potentially exposed receptors and

exposure pathways are discussed in this section. A conceptual site model (CSM) showing results of the exposure assessment is shown on **Figure 6.2**. Quantification of exposure involves quantifying the magnitude, frequency, and duration of exposure for the receptors and exposure pathways of concern.

Soil was identified and evaluated as the only environmental media of concern at FTMM-04. The exposure pathways relevant to the site are described in this exposure assessment of the HHRA and shown in the CSM.

6.3.1 Conceptual Site Model

A CSM is an effective tool for defining site dynamics, streamlining risk assessments, establishing exposure hypotheses, and developing appropriate corrective actions. The CSM for FTMM-04 is provided as **Figure 6.2**. CSMs are useful for identifying complete exposure pathways between contaminated media and potential receptors. The purpose of the CSM is to aid in understanding and describing a site and presents the assumptions regarding:

- Suspected sources and types of contaminants present;
- Contaminant release and transport mechanisms;
- Affected media;
- Potential receptors that could come in contact with site-related contaminants in affected media under current and future land use scenarios; and
- Potential routes of exposure.

An overall description of contaminant sources, affected media, and removal actions has been provided in previous Sections. Potential receptors and complete exposure pathways are discussed in the following subsections.

6.3.2 Potential Receptors and Exposure Pathways

Potential human receptors are defined as individuals who may be exposed to site-related contaminants in environmental media. Consistent with USEPA RAGS (1989) guidance, current and reasonably anticipated land uses were considered in the receptor selection process.

USEPA (1989) defines an exposure pathway as: “The course a chemical or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) is also included.”

A review of potential exposure pathways links the sources, locations, and types of environmental releases with receptor locations and activity patterns to determine the significant pathways of concern.

Observations and reasonable assumptions for the potential human receptors for FTMM-04 are listed below, and summarized in **Figure 6.2**.

- **Current Receptors** – FTMM-04 is a landfill that was used for building demolition disposal. It is currently vacant and unused with a stable vegetative cover established.

FTMM-04 is undeveloped and there are no new development activities occurring or planned. Current activities at the site include infrequent visits, such as those that would be performed during routine landscaping/mowing. Incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil by an industrial receptor (outdoor worker) were assumed for this current land use scenario. This calculation assumes an exposure frequency of 250 days per year and an exposure duration of 25 years. Thus, it provides a conservative evaluation for a potential current industrial receptor (outdoor worker) who would be expected to have less frequent exposure at this particular site. Because the reuse plan calls for FTMM-04 to be passive open space, current receptors also include recreational users, assumed to spend part of the time onsite as adolescents (age 6 to 16) and part as adults (age 16 to 30). The screening levels for future recreational users assume that the recreational user would be onsite once a week, for 50 weeks of the year, approximately 2 hours per event. This exposure scenario also included a trespasser (both adolescents and adults) who may be present onsite, who would be expected to have less frequent exposure than the recreational user. Mill Creek bisects the west-central portion of FTMM-04. The surface water is not used as a potable water supply. Incidental ingestion of surface water/sediment, inhalation of volatiles and particulates from surface water and dermal contact with surface water/sediment were assumed for this current land use scenario. However, no COPCs were identified in surface water or sediment at the site. Therefore, current exposure to surface water/sediment is an incomplete pathway;

- **Future Receptors** – Evaluation of the outdoor worker as a current receptor would be protective of future outdoor workers as well and is not re-evaluated for the future scenario. There are no current plans to develop commercial buildings at the site, but if commercial buildings were constructed in the future, then indoor workers would potentially be exposed to soil. Evaluation of the current outdoor worker would also protect the hypothetical future indoor commercial worker because indoor commercial worker exposure to soil would be much less than the outdoor worker. Thus, the indoor worker exposure scenario was considered to be conservatively evaluated by the above current outdoor worker scenario. The Fort Monmouth Economic Redevelopment Planning Authority (FMERPA) reuse plan calls for FTMM-04 to be designated as passive open space. Because the site is planned to be passive open space, a future recreational user could be exposed to COPCs in the soil through incidental ingestion, dermal contact, and inhalation of volatiles and particulates. The calculation of the exposure of a recreational user to soil assumed that the person is onsite once a week for 50 weeks of the year, for 2 hours a day, for 24 years. Further, the site-specific screening value for the recreational user assumes that a portion of the time is spent on the site as an adolescent (age 6 to 16) and a portion as an adult (age 16 to 30). This provides a conservative evaluation for a future recreational user that is not likely to be onsite every week of the year. The site is not residential and no plans are in place to convert it to residential use. Therefore, the residential scenario was not evaluated;
- **Current Exposure to Groundwater** – Site groundwater is not available or used by current industrial workers (indoor or outdoor workers); municipal water is used by

current industrial workers, and groundwater is not accessible by recreational users. Further, no C OPCs were identified in groundwater at the site. Therefore, current exposure to groundwater is an incomplete pathway; and

- **Future Exposure to Groundwater** – Outdoor workers are expected to be onsite performing routine maintenance, and recreational use of the land as passive open space is anticipated for the future. However, no C OPCs were identified in groundwater at the site. Therefore, future exposure to groundwater is an incomplete pathway.

6.3.3 Soil Exposure Pathway

Exposure to site soil occurs by direct contact (ingestion and dermal contact) with site soil and wind dispersion of contaminants resulting in inhalation of contaminants. The receptors and pathways evaluated for soil are listed below.

- Incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil by a current industrial (outdoor) worker. This calculation assumes an exposure frequency of 250 days per year and an exposure duration of 25 years (USEPA, 2013). Thus, it provides a very conservative evaluation for a potential current outdoor industrial worker who would be expected to have much less exposure at this particular site;
- Incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil by a future industrial (outdoor) worker. This is a potentially complete exposure pathway but is not included in the risk ratio analysis because it is assumed to be conservatively evaluated under the current outdoor worker scenario (based on the exposure frequency and exposure duration);
- Incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil by a future indoor industrial worker. This is a potentially complete exposure pathway but is not included in the risk ratio analysis because it is assumed to be conservatively evaluated under the current outdoor industrial worker scenario (future indoor industrial workers would have much less exposure to soil); and
- Incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil by current and future recreational users. This calculation assumes an exposure frequency of 50 days per year and an exposure duration of 24 years (USEPA, 2013). Thus, it provides a conservative evaluation for current and future recreational users who may not access the site every week.

6.4 RISK RATIO AND SCREENING CRITERIA ASSESSMENT

This HHRA used a risk ratio and screening level approach to quantify potential carcinogenic risk and non-carcinogenic hazard for each chemical detected above background concentrations (metals only) in surface soil and sediment. This section describes the risk ratio and screening level assessment used in this HHRA.

6.4.1 Risk Ratio Assessment

The risk ratio method considered risk due to exposure to soil at FTMM-04. Therefore, a tiered approach was applied. For the risk ratio assessment, the EPC, either the maximum detected concentration or the 95% UCL (as defined in Section 6.2.1), was used to calculate risk.

In the risk ratio analysis, the ratio of the EPC was divided by the appropriate screening level for the environmental medium. The risk ratio was calculated separately for outdoor workers and recreational users. The risk ratio screening levels for soil are the USEPA RSLs ($TR = 1 \times 10^{-6}$; $THQ = 1.0$) for industrial receptors in soil and the calculated recreational user screening levels for soil.

Following calculation of the risk ratios for individual chemicals, the ratios were then summed to determine the cumulative risk due to exposure to each medium. Cumulative non-carcinogenic risk ratios greater than 1 (one) indicate a potential unacceptable non-carcinogenic risk. Cumulative carcinogenic risk ratios greater than USEPA's acceptable risk range of 10^{-4} to 10^{-6} indicate a potential unacceptable carcinogenic risk. In the first tier, carcinogenic chemicals were evaluated together, as were non-carcinogenic chemicals.

6.4.2 Risk Ratio Equations

Carcinogenic risks were estimated using the following equation. This equation assumes use of EPC as either the maximum detected concentration, or the 95% UCL, as defined in Section 6.2.1.

$$\text{Cumulative Risk} = \sum (TR) \frac{(EPC_i)}{SL_{c-i}}$$

where:

Cumulative Risk = Cumulative risk for carcinogenic COPCs one through "i" (unitless), where $(TR) \frac{(EPC_i)}{RSL_{c-i}}$ is the chemical-specific carcinogenic risk for chemical "i";

TR = Target lifetime excess carcinogenic risk of 10^{-6} (unitless);

EPC_i = Exposure point concentration for chemical "i" (mg/kg for soil; and

SL_{c-i} = Medium-specific human health screening level (mg/kg for soil and sediment) for carcinogenic chemical "i".

Non-carcinogenic risks were estimated using the following equation.

where:

$$HI = \sum (THQ) \frac{(EPC_i)}{SL_{nc-i}}$$

HI = Cumulative hazard index for non-carcinogenic COPCs one through “i” (unitless), where $(THQ) \frac{(EPC_i)}{RSL_{nc-i}}$ is the chemical-specific non-carcinogenic hazard quotient (HQ) for chemical “i”;

THQ = Target hazard quotient of one (unitless);

EPC_i = Exposure point concentration for chemical “i” (mg/kg for soil); and

SL_{nc-i} = Medium-specific human health screening levels (mg/kg for soil) for non-carcinogenic chemical “i”.

6.4.3 Soil Screening Criteria

The soil results were compared to the USEPA industrial RSLs (TR = 1X10⁻⁶; THQ = 1.0) and calculated recreational user screening levels. The USEPA RSL table indicates whether a chemical is considered carcinogenic, non-carcinogenic, or both.

The USEPA RSL is based on the combined exposure routes (i.e., ingestion, dermal contact, and inhalation). Thus, incidental ingestion of soil, inhalation of volatiles and particulates from soil, and dermal contact with soil were included as the combined exposure route.

The recreational user screening levels were calculated using the USEPA RSL calculator, using site-specific exposure parameters (USEPA, 2013b). The recreational user equations used in the calculator are provided in **Appendix B**. The calculated recreational user screening level is based on the combined exposure routes (i.e., ingestion, dermal contact, and inhalation). The exposure parameters for recreational users assumed exposure of one time per week, for two hours at a time, over the course of the year. Therefore, there are 50 exposure events per year. Further, the recreational user is expected to be onsite partially as an adolescent (age 6 to 16 years) and partially as an adult (age 16 to 30). The exposure parameters used in the recreational user screening levels calculations are shown in **Appendix B**. The outdoor worker screening levels are provided in the USEPA RSL tables, but for comparison, the exposure parameters for the outdoor worker are also shown in **Appendix B**.

6.5 RISK ASSESSMENT RESULTS AND UNCERTAINTIES

The primary objective of this HHRA was to quantitatively characterize the human health risk associated with current and reasonably expected future exposure to contaminated media at FTMM-04. As discussed in Section 6.3, potentially complete exposure pathways for the site were evaluated. The exposure pathways were outlined in Section 6.3 and were also shown on the CSM (**Figure 6.2**). The results of the risk ratio quantification are presented in this section.

6.5.1 Estimated Risks for Soil

The risk ratio calculations for potential exposure to soil by a future outdoor industrial worker are shown in **Table 6.1**. The risk ratio calculations for potential exposure to soil by a future recreational user are shown in **Table 6.2**.

Unacceptable risks for outdoor workers were calculated for the non-carcinogenic chemicals detected in soil at FTMM-04. Since there are no EPA criteria for acenaphthylene, phenanthrene, or benzo(g,h,i)perylene, risk was not calculated for these chemicals. The cumulative non-carcinogenic hazard ratio result, based on either the maximum detected concentration of each chemical, or the 95% UCL for each chemical (**Table 6.1**), was 25. The cumulative carcinogenic risk ratio, 4×10^{-5} , is within the USEPA acceptable range of carcinogenic risk of 1×10^{-4} to 1×10^{-6} , indicating that unacceptable risks associated with exposure to site soil for outdoor workers are unlikely.

Unacceptable risks for recreational user exposure to soil were calculated for the non-carcinogenic chemicals detected in soil at FTMM-04. Since there are no EPA criteria for acenaphthylene, phenanthrene, or benzo(g,h,i)perylene, risk was not calculated for these chemicals. The cumulative non-carcinogenic hazard ratio result, based on either the maximum detected concentration of each chemical, or the 95% UCL for each chemical (**Table 6.2**), was 4. The cumulative carcinogenic risk ratio, 8×10^{-6} , is within the USEPA acceptable range of carcinogenic risk of 1×10^{-4} to 1×10^{-6} , indicating that unacceptable risks associated with exposure to site soil for recreational users are unlikely.

For the non-carcinogenic chemicals detected in soil, for both the outdoor worker and the recreational user, the risks were primarily driven by a single detection of thallium. Based on a qualitative review of the dataset, the maximum detected concentration of thallium appears to be an outlier; that is, there may be a localized area (i.e., a hot spot) of thallium contamination within FTMM-04. Specifically, thallium was detected in only one sample (B-34) at a concentration of 242 mg/kg, and was not detected in any other soil samples at the site. Without this detection of thallium, the cumulative non-carcinogenic hazard ratio for outdoor workers is 1 and the cumulative non-carcinogenic hazard ratio for recreational users is 0.1.

Thallium, for both outdoor workers and recreational user, drives the noncarcinogenic risk, but was detected in one soil sample (B-34) out of 66 samples. Thallium is believed to be a false positive result. It was reported according to Method 6010 in 1998, and that method has in the past been implicated with very high false positive rates for thallium, and high bias in the quantitation of arsenic (Chapnick et al., 2010). Matrix interferences are apparent given the isolated and anomalous results for the inorganic substances reported in sample B-34. Thallium is not believed to be a valid COC for the soil at FTMM-04; rather, there are strong indications of false positive analytical results.

FTMM-04 was used to dispose of building demolition debris. There is no evidence to implicate thallium as a contaminant based on site activities. Major releases of thallium to the environment via atmospheric deposition may occur from processes such as coal-burning and smelting (ASTDR, 1992), but neither of those activities are of concern for FTMM-04. Thallium is not distributed across the site and the sample at B-34 was detected from 6 to 12 inches bgs, and significant atmospheric deposition or disposal practices resulting in contamination by thallium are not apparent or reasonably likely.

Thallium was detected at low concentrations in less than 1 percent of the samples, and thus the cumulative hazard ratio of 1 (outdoor worker) and 0.1 (recreational user) are appropriately representative of expected site conditions.

6.5.2 Risk Assessment Uncertainties

All risk assessments involve use of assumptions, professional judgments, and imperfect data to varying degrees, which result in uncertainty in the final estimates of risk. Risk assessment in general is often based on conservative assumptions and scenarios. Uncertainty can be introduced into a risk assessment at every step of the process outlined in this document. Uncertainties are present in a risk assessment because it requires integration of the following:

- Release of constituents into the environment, and the areal and vertical distribution of these materials in soil and groundwater;
- Fate and transport of constituents in a variety of different and variable environments by processes that are often poorly understood or too complex to quantify accurately;
- Potential for adverse health effects in humans based on extrapolations from animal studies; and
- Probability of adverse effects in a human population that is highly variable with respect to genetics, age, activity level, and lifestyle.

This section qualitatively describes the inherent and site-specific uncertainties of the assessments process.

6.5.2.1 Uncertainty in Data Collection and Evaluation

The analysis of uncertainties focuses on determining whether the available data are representative of contaminant concentrations and site conditions, and whether features of sampling, analyses, or statistical treatment of the data result in an over- or underestimation of potential risk.

Constituents detected at the site and included in the risk assessment were retained regardless of how frequently they had been detected. EPA's ProUCL 5.0 will calculate UCLs for datasets with small sample sizes in order to accommodate the Incremental Sampling Method (USEPA, 2013). Because the soil samples collected at FTMM-14 were collected as discrete samples, not all UCLs calculated or suggested by ProUCL are appropriate for use in the risk calculations. Parametric and non-parametric methods (i.e., Chebyshev (Mean, Sd), KM (Percentile Bootstrap), KM (Chebyshev), Adjusted Gamma KM, and Approximate Gamma KM,) were used to determine the 95 percent UCL for the analytes with six or more samples. For analytes with six samples or less, or if ProUCL generated a warning with regards to unreliable statistics, the maximum detected concentration was used as the exposure point concentration. The use of the maximum detected concentration introduces uncertainty into the risk assessment, since the use of one analytical result likely does not accurately represent the concentration of the constituent in the volume of soil that is being evaluated. In cases where the analyte is infrequently detected, the use of the maximum concentration will likely overestimate the actual exposure point concentration, resulting in an overestimate of the risk. In cases with few total samples, the use of the maximum detected concentration can either over- or underestimate the exposure concentration depending on the distribution of the actual concentrations in the medium of concern.

USEPA has researched how to determine the appropriate method for calculating a 95 percent UCL based on the data distribution, data set size, skewness, and percentage of non-detect observations. The ProUCL output included in **Appendix B** states, “Suggestions regarding the selection of a 95 percent UCL are provided to help the user select the most appropriate 95 percent UCL.” ProUCL generates UCLs using all available methods for each data set, regardless of the appropriateness of the method. The results listed under “Suggested UCLs to Use” are the results recommended by ProUCL based on data size, data distribution, and skewness of the data set, as well as the results of simulation studies. Where more than one result was listed in the ProUCL output in “Suggested UCLs to Use”, the most conservative (highest) of the recommended “Suggested UCLs to Use” was selected for use as the EPC. This is a default selection made without regard to scientific validity. The use of the most conservative UCL may overestimate the EPC and, therefore, the risk.

Detected analytes that do not have screening values are not identified as COPCs. If these analytes are present in environmental media, not including them in the risk assessment may underestimate the risk for exposure to that medium.

Chemicals that were never detected in any samples were eliminated from the HHRA. It is possible that some chemicals may have been present in samples below the sample quantitation limit and not retained in the risk assessment. However, because samples were collected from areas where concentrations were expected to be high and because maximum detected concentrations or 95% UCLs were used in the HHRA comparisons, it is very unlikely that chemicals were present at health-significant levels and not detected in at least one sample.

6.5.2.2 Uncertainty in Exposure Assessment

The risk assessment estimates are conditional on actual and potential exposure pathways identified at the site. If exposure does not occur, no risks are present. Furthermore, the risk assessment process does not factor in the probability of exposure occurring. For example, there may not be a reason for an outdoor worker to be present on site 250 days per year. The actual exposure for the potential landscaper/groundskeeper is likely to be less often than 250 days per year.

Current land uses and characterization of the site’s current physical setting provided the basis for predicting future land use at and in the vicinity of the site. Steady-state conditions were assumed for evaluation of potential future exposures. The assumption of steady-state conditions may tend to overestimate long-term exposure and health risk because contaminant concentrations may decline over time due to natural dissipation processes. In some cases, depending on the contaminant and or the release mechanisms involved, steady-state assumptions could potentially underestimate risk (e.g., a continuous source contributing to contamination in another media).

There is also some concern as to how well an exposure scenario approximates the actual conditions that a receptor may be exposed to at a given site. Potential human exposures could deviate from those used in the risk assessment through differences in exposure frequency, contact rates, exposure durations, body weight, and life span. Each of these factors has a degree of uncertainty associated with it that could over- or underestimate risk.

Evaluation of risk for recreational user exposure to soil includes calculation of the risk to adolescents. Other sensitive subpopulations such as children, elderly people, pregnant or nursing women, and people with chronic illnesses were not specifically evaluated in this risk assessment.

These subpopulations may be more sensitive to certain chemical exposures. However, USEPA generally considers sensitive subpopulations when developing toxicity factors. Additionally, there are no daycare or school facilities, healthcare facilities onsite, nursing homes, retirement communities, or residential areas with children or adolescents onsite currently.

6.5.2.3 Uncertainty in Toxicity Assessment

Some uncertainty is also inherent in the toxicity values used in the risk assessment. Carcinogenic slope factors and route-specific values were derived only for compounds that have been shown to cause an increased incidence of tumors in either human or animal studies. This dose-response curve is then assumed to be linear at low doses (e.g., those found in situations of environmental contamination) and is used to predict tumor incidence at low exposure levels. When an animal study is used, the final slope factor is adjusted to account for extrapolation of animal data to humans. If the studies used to derive the slope factor were conducted for less than the life span of the test organism, the final slope factor had also been adjusted to reflect risk associated with lifetime exposure. The chronic RfD for a compound is based on studies where either human or animal populations were exposed to a given compound by a given route of exposure for a major portion of the life span (as a USEPA guideline, seven years to a lifetime; USEPA, 1989). RfDs are derived by determining dose-specific effect levels from available quantitative studies and applying uncertainty factors to the most appropriate effect level to determine an RfD for humans. The slope factors and RfD for compounds are used to calculate the default USEPA RSLs or the calculated recreational user screening levels for soil, and are used to calculate the USEPA RSLs for tapwater. The screening levels are then based on conservative assumptions, and tend to overestimate risk.

6.5.2.4 Uncertainty in Estimating Chemical Risk

The expression of the potential risk associated with contaminants detected at the site is a result of the combined steps of data evaluation, exposure assessment, and toxicity assessment. This combination can magnify the uncertainties present in these steps of the HHRA process.

Screening criteria are developed using very conservative (health-protective) exposure and intake assumptions. The HHRA comparisons also use conservative concentrations of the chemicals detected at the site. In addition, screening criteria used in the HHRA are considered health-protective for carcinogenic and non-carcinogenic chemical mixtures. Carcinogenic chemicals correspond to the conservative 1×10^{-6} (one in a million) excess cancer risk level, providing a very protective screening value. Non-carcinogens use a target HQ of 1 and also account for the cumulative non-cancer risk for chemicals with the same toxic endpoint or mechanism of action.

6.5.3 Conclusions

The human health risk assessment was conducted to evaluate the potential for human health impacts as a result of potential exposures to chemicals in soil at FTMM-04.

The cumulative carcinogenic risks and non-carcinogenic hazards estimated for current and future outdoor workers and recreational user exposure to soil are as follows.

- Current / future outdoor worker exposed to surface soil: The cumulative carcinogenic risk of 4×10^{-5} is within the USEPA acceptable range of carcinogenic risk of 1×10^{-4} to 10^{-6} . The cumulative non-carcinogenic hazard ratio result, based on either the

maximum detected concentration of each chemical, or the 95% UCL for each chemical (**Table 6.1**), was 25;

- Future recreational users exposed to surface soil: The cumulative carcinogenic risk of 8×10^{-6} is within the USEPA acceptable range of carcinogenic risk of 1×10^{-4} to 10^{-6} . The cumulative non-carcinogenic hazard ratio result, based on either the maximum detected concentration of each chemical, or the 95% UCL for each chemical (**Table 6.2**), was 4; and
- For the non-carcinogenic chemicals detected in soil, for both the outdoor worker and the recreational user, the risks were primarily driven by a single detection of thallium. Based on a qualitative review of the dataset, the maximum detected concentration of thallium appears to be an outlier; that is, there may be a localized area (i.e., a hot spot) of thallium contamination within FTMM-04. Specifically, thallium was detected in only one sample (B-34) at a concentration of 242 mg/kg, and was not detected in any other soil samples at the site. Without this detection of thallium, the cumulative non-carcinogenic hazard ratio for outdoor workers is 1 and the cumulative non-carcinogenic hazard ratio for recreational users is 0.1. The single detection of thallium may be due to a laboratory error, further, thallium was detected at low concentrations in less than 1 percent of the samples, and thus the cumulative hazard ratio of 1 (outdoor worker) and 0.1 (recreational user) are appropriately representative of expected site conditions.

SECTION 7 REMEDIAL INVESTIGATION SUMMARY AND CONCLUSIONS

7.1 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of targeted constituents exceeding NJDEP and/or USEPA comparison criteria in sampled media at FTMM-04 are summarized below.

7.1.1 Soil

Soil samples were collected at FTMM-04 during RI sampling activities in March 1998. No VOCs in soil samples exceeded current residential or non-residential direct contact comparison criteria. Concentrations of the following constituents exceeded the current NJDEP RDCSRS and/or USEPA residential RSL in at least one soil sample:

- The SVOCs benzo(a)anthracene, bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene (classified as PAHs except for bis(2-Ethylhexyl)phthalate);
- The pesticides 4,4'-DDE and 4,4'-DDD; and
- The metals aluminum, antimony, arsenic, beryllium, cobalt, iron, selenium, thallium, and vanadium.

Concentrations of the following constituents exceeded the current NJDEP NRDCSRS and/or USEPA industrial RSLs in at least one soil sample:

- The SVOCs benzo(a)anthracene, bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz[a,h]anthracene (classified as PAHs except for bis(2-Ethylhexyl)phthalate); and
- The metals arsenic, cobalt, and thallium.

Concentrations of the following constituents exceeded the current NJDEP IGW soil screening level and/or USEPA Groundwater Protection RSL in at least one soil sample:

- The VOCs acetone, methylene chloride, and ethylbenzene;
- The SVOCs 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, di-n-butylphthalate, pyrene, benzo(a)anthracene, chrysene, bis(2-Ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene;
- The pesticides 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT; and
- The metals aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

These exceedances occurred in samples collected at 6 to 12 inches bgs (SVOCs, pesticides, and metals) and 24 inches bgs (VOCs). For many of the analytical results that exceeded the then-current NJDEP RDCSCC, the "compliance averaging" approach was used by Versar (2004) to determine compliance with NJDEP technical requirements. In most cases, compliance averages were either below the applicable NJDEP regulatory criteria or were considered

1 marginal (e.g., within 1 to 2 mg/kg of the RDCSRS). Evaluation of the analytical results did not
2 define a “source area” or level of contamination that necessitated the identification and
3 evaluation of potential targeted remedial actions (Versar, 2004).

4 The maximum detected concentrations of 20 of the 23 metals targeted for analysis exceed
5 the maximum background concentrations for the MP presented in Weston (1995). Therefore,
6 these metals cannot be assumed to be representative of natural background conditions at every
7 one of the 63 soil boring locations.

8 Based on comparison to USEPA residential RSLs and (in the case of metals) maximum
9 background concentrations presented in Weston (1995), COPCs in soil that are evaluated in the
10 risk assessment include the SVOCs acenaphthylene, phenanthrene, benzo[a]anthracene,
11 benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene,
12 dibenz[a,h]anthracene, benzo[g,h,i]perylene; the pesticides 4,4'-DDE and 4,4'-DDD; and the
13 metals aluminum, antimony, arsenic, beryllium, cobalt, selenium, thallium, and vanadium.

14 **7.1.2 Groundwater**

15 Previous RI reports for FTMM-04 have identified up to 12 metals (aluminum, antimony,
16 arsenic, beryllium, cadmium, iron, lead, manganese, nickel, silver, selenium, and thallium) as the
17 primary constituents exceeding NJDEP GWQS in site groundwater (Versar 2005; U.S. Army,
18 2012). Versar (2005) observed that the metals that exceeded NJDEP cleanup criteria with
19 elevated concentrations are routinely observed in groundwater samples because they are
20 common constituents of Monmouth County and the MP soils. Versar (2005) also concluded that
21 the concentrations of metals in groundwater were due to a combination of a natural, dissolved
22 component along with input from sample turbidity. Similarly, the U.S. Army (2012) concluded
23 that metals detected at concentrations exceeding NJDEP GWQS are not considered to be site-
24 related as they are naturally-occurring metals within the soils of Fort Monmouth, and no source
25 areas are apparent. Overall, the data presented in Section 4.2 supports the conclusion that
26 detected concentrations of metals are representative of background conditions, and there are no
27 site-related COPCs in FTMM-04 groundwater.

28 **7.1.3 Surface Water**

29 Previous RI reports for FTMM-04 have identified three VOCs (PCE, TCE, and methylene
30 chloride) and three metals (antimony, arsenic, and mercury) as the primary constituents
31 exceeding NJDEP SWQS in surface water samples collected from locations related to FTMM-04
32 (Versar 2005; U.S. Army, 2012). During the most recent eight quarters of surface water
33 sampling, PCE was the only VOC that exceeded SWQS. However, since PCE concentrations
34 exceeding the SWQS were detected at surface water sampling point SS-15 (located upstream, at
35 FTMM's MP boundary), the PCE concentrations detected in Mill Creek surface water originate
36 from upstream, and are considered an offsite source. Metals that exceeded SWQS were detected
37 at the upstream sampling location SS-15 and are not associated with FTMM-04. There are no
38 site-related COPCs in surface water associated with FTMM-04.

39 **7.1.4 Sediment**

40 Sediment sampling was conducted in April 2000 on Mill Creek to evaluate PCB-related
41 impacts to stream sediments associated with the M-4 landfill. PCBs were detected in one of six
42 samples collected (B-5) at a concentration of 0.051 mg/kg. This concentration is less than the

NJDEP RDCSRS of 0.2 mg/kg for total PCBs. Therefore, there were no screening criteria exceedances and no site-related COPCs in sediment.

7.2 CONTAMINANT FATE AND TRANSPORT

Detected constituents of interest in terms of contaminant fate and transport at FTMM-04 include metals and SVOCs in vadose zone soil. The migration route of interest includes dissolution of soluble residual concentrations in the vadose zone into infiltrating precipitation that percolates through vadose zone soil to the water table. Metals and SVOCs in vadose zone soil at FTMM-04 are expected to be relatively persistent and immobile, limiting their impact on groundwater quality. This observation is supported by the fact that 1) SVOCs were removed from the groundwater monitoring program after 2004 due to a lack of GWQS exceedances, and 2) metal concentrations detected in groundwater during the most recent eight quarterly sampling events and August 2013 are representative of natural background conditions.

7.3 BASELINE RISK ASSESSMENT

An evaluation of the potential risk resulting from human exposure to soil, surface water, sediment, and groundwater was conducted as part of this RI. No COPCs were identified in groundwater, surface water or sediment. Therefore, further evaluation of groundwater, surface water and sediment in the baseline risk assessment was not conducted and no unacceptable risks are expected from human exposure to groundwater, surface water or sediment. The human health risk assessment utilized a conservative approach that initially assumed exposure to the maximum detected concentration of analytes in soil. If some analytes were determined to be risk drivers, that is, a single analyte contributing more than 25 percent of the cumulative risk, then a 95% UCL was calculated for that analyte and used in the risk ratio.

The calculated risk ratio for outdoor workers exposed to soil was 25, and for recreational users exposed to soil was 4 for non-carcinogenic analytes, which consisted almost entirely of the hazard associated with exposure to thallium in soil. The risk ratios associated with the other non-carcinogens in soil were 1 (outdoor worker) and 0.1 (recreational user) if thallium was not included in the cumulative risk. Based on qualitative evaluation of the thallium present at the site, the cumulative risk ratios of 1 (outdoor worker) and 0.1 (recreational user) are expected to be more representative of expected site conditions and therefore thallium is not identified as a COC in soil at FTMM-04. For carcinogens, the calculated cumulative risk ratio for outdoor workers exposed to soil was 4×10^{-5} , and for recreational users exposed to soil was 8×10^{-6} . These calculated cumulative risk ratios were within the acceptable range of 1×10^{-4} to 1×10^{-6} for analytes.

In summary, no COCs have been identified in soil or other media at FTMM-04. Based on a qualitative evaluation of the thallium data for soil, thallium was excluded as a COC for the following reasons:

- There are no unacceptable hazards calculated for the site, other than the calculated risk ratio for soil of 25 for outdoor workers and 4 for recreational users for non-carcinogenic analytes. These risk ratios are associated entirely of the hazard associated with exposure to thallium in one soil sample;
- Thallium was detected in soil from only one of 63 borings; it was not detected in the soil from the other 62 borings;

- Based on a qualitative review of the dataset, the maximum detected concentration of thallium in soil appears to be an outlier. Specifically, thallium (outdoor worker risk ratio of 24 and recreational user risk ratio of 4) was detected in only one sample (B-34) at a concentration of 242 mg/kg. Without this detection of thallium, the cumulative non-carcinogenic hazard ratio for non-residential receptors is 0.07; and
- The assumptions used in the risk assessment are conservative and are likely to overestimate the actual risk at the site (e.g., the maximum detected concentration of thallium was used to calculate the risk ratio, because it was detected in only one sample and a mean could not be estimated).

7.4 RECOMMENDATIONS

The nature and extent of site-related contamination and associated risks to human health have been characterized. The RI dataset is sufficient to support preparation of an FS; however, a FS is not recommended for FTMM-04 because risks to human health and the environment are within acceptable ranges for the current and future intended land use and no COCs have been identified for the site.

SECTION 8 FEASIBILITY STUDY

A FS was not performed for FTMM-04. Because the RI concluded that risks to human health and the environment are within acceptable ranges for the current and future intended land use, no COCs were identified for FTMM-04 and a FS is not required. No further action is required at FTMM-04 under CERCLA.

A vegetated soil cover will be placed over the landfill area to provide safety protection for future non-residential use. The soil cap will be placed consistent with the NJDEP Solid Waste regulations (N.J.A.C. 7:26-2A). Additional soil will be added to the existing soil cover to provide a minimum of two feet of soil between the ground surface and landfilled debris. The use of a vegetated native soil cover will prevent future exposure to solid waste at the landfill and control surface water runoff and erosion.

ICs to maintain the soil cover and prevent residential land use will also be implemented at FTMM-04. The U.S. Army will prepare a land use control implementation plan during the remedy design phase to document the location of the engineering control and detail the landfill cover inspection, reporting and long-term management requirements. The U.S. Army will be responsible for documenting and implementing the ICs through the filing of a deed notice, and will also be responsible to conduct biennial reviews to ensure that the ICs remain protective of human health and the environment. However, the Army will not be responsible for obtaining a remedial action permit under New Jersey Technical Requirements for Site Remediation. When the property is transferred to private ownership, the ICs will be incorporated into the title and the new owner will be responsible for complying with the ICs. Although the Army may later transfer its procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Army shall retain ultimate responsibility for remedy integrity.

The estimated TPV of the soil cover and ICs is approximately \$520,000. Costs associated with ICs include preparation of a Land Use Control Implementation Plan, delineating the area onto Master Planning maps, as well as annual IC inspection and reporting for a 30-year duration. Costs associated with the vegetative cover include advancement of two geotechnical borings, placement of 18 inches of a soil cover over the 1.4-acre landfill area, followed by 6 inches of a vegetative cover, grading for runoff, and seeding. The cost estimate is provided in **Appendix C**.

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TABLE 1.1
CHRONOLOGY OF EVENTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

1918 – Fort Monmouth (FTMM) was established.
1980 – William F. Cosulich performed landfill study which identified major areas on the base where landfill activities occurred. FTMM-04 was not part of the study, but the land adjacent to the north was included. Surface water samples were collected from Parkers Creek, Lafetra Brook, and Mill Creek (USATHAMA, 1988).
1993 – Weston (2005) performed a Site Investigation (SI) that addressed 45 sites identified by FTMM and NJDEP. Additional remedial investigation was recommended for FTMM-04.
1995 – Weston (1995) performed additional SI activities which included installation of three shallow monitoring wells and collection of two rounds of groundwater samples.
1996. October – Beginning of quarterly surface water sampling program to determine whether contamination of groundwater has impacted nearby surface water. Samples were collected from three locations in Mill Creek. Results are presented in Versar (2005). Monitoring continued until September 2010.
1997 – Surface water sampling conducted. Results are presented in Versar (2005).
1997. May – Beginning of quarterly groundwater sampling program. Initially, samples were collected from three wells, and the program was later expanded when additional wells were added to the site.
1998 – Soil sampling conducted. Results are presented in Versar (2004).
1998 – Groundwater and surface water sampling conducted. Results are presented in Versar (2005).
1999 – Groundwater and surface water sampling conducted. Results are presented in Versar (2005).
1999 – One additional monitoring well installed.
2000 – Groundwater and surface water sampling conducted. Results are presented in Versar (2005).
2001 – Groundwater and surface water sampling conducted. Results are presented in Versar (2005).
2001. August – Groundwater Monitoring Program Results and Request for No Further Action: M-4 was submitted by ATC Associates, Inc. based on the following: • The pesticide 4'-4'-DDT was only detected once in July 1998 and was below the NJDEP Groundwater Quality Standard (GWQS). • No TCL compounds were detected above NJDEP GWQS. • All metals detected above NJDEP GWQS were below their respective maximum background concentrations.
2001 – Groundwater and surface water sampling conducted. Results are presented in Remedial Investigation Report Addendum (RIRA)(2 nd Quarter 2001 through 3 rd Quarter 2010) (U.S. Army, 2012).
2002 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2003 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2004 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).

TABLE 1.1
CHRONOLOGY OF EVENTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

2004. February – RI Report presenting results of sediment quality evaluation performed to determine potential PCB-related impacts to sediments in Mill Creek. Six borings installed with 13 sediment samples collected and analyzed for PCBs. PCBs were detected in one of six samples but at a concentration less than NJDEP residential direct contact soil remediation standard (RDCSRS) and EPA regional screening level (RSL) (Versar, 2004).
2004. March – RI Report for Near-Surface Soils presented analysis results for near-surface soil samples collected from 63 borings in 1998. Based on results, the Army requested a No Further Action determination for VOCs, SVOCs, pesticides/PCBs, and most metals in near surface soils at the FTMM-04 landfill (Versar, 2004).
2004. November – FTMM requested changes to the groundwater sampling program at FTMM-04 (U.S. Army Fort Monmouth, 2004). Analysis of VOCs, SVOCs, pesticides, and PCBs was discontinued with NJDEP (2004) approval. TAL metals continue to be sampled quarterly.
2005 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2005. January – Remedial Investigation Report (Versar, 2005). Presents results of 16 quarterly groundwater sampling events from May 1997 through January 2001, and of 22 quarterly surface water sampling events from October 1996 through February 2001.
2006 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2007 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2008 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2008. August – FTMM submits proposal to NJDEP to conduct a landfill delineation study consisting of test pits and soil borings (U.S. Army Fort Monmouth, 2012). The request was approved on August 19, 2008 by NJDEP. Following the delineation study, the landfill boundaries were adjusted based on the findings.
2009 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2010 – Groundwater and surface water sampling conducted. Results are presented in U.S. Army (2012).
2010 – Two additional monitoring wells installed in July and September.
2010. June – Preliminary tidal evaluation of select monitoring wells throughout the Main Post including M4MW05, M4MW07, and M4MW10. The M4 landfill site is not considered to be within the primary zone of potential tidal influence (Brinkerhoff, 2010).
2010. June-October – a Baseline Ecological Evaluation (BEE) was conducted for MPA and CWA (Shaw Environmental, Inc., 2012).
2011. June – A groundwater Classification Exception Area Information Report for lead in groundwater at FTMM-04 was finalized (Brinkerhoff Environmental Services, Inc., 2011). Although the CEA application was submitted to the NJDEP, FTMM subsequently withdrew the application and NJDEP never approved it.
2012. February – RIRA (2 nd Quarter 2001 through 3 rd Quarter 2010). Documents investigations conducted by the Army to evaluate soil, groundwater, surface water, and sediment conditions at the M-4 landfill (U.S. Army, 2012).
2012. August – In an August 27, 2012 letter, the NJDEP approved “no additional ecological evaluation or assessment for the Main Post and Charles Wood Area.”

TABLE 2.1
WELL CONSTRUCTION SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Site	Well Permit #	Y Coord. (Northing)	X Coord. (Easting)	Installation Date	Depth (ft bgs)	Casing Length (ft)	Screen Length (ft)	Top of Casing (ft amsl)	Slot Size (inches)
M4MW05	E201010539	539053.807	617377.099	9/27/2010	20.00	5.00	15.00	13.29	0.01
M4MW06	E201007328	539043.295	617299.69	7/21/2010	20.00	5.00	15.00	14.31	0.01
M4MW07	29-32571	538781.862	617626.356	12/14/1994	15.50	5.50	10.00	15.44	0.01
M4MW08	29-32572	538882.419	617501.908	12/13/1994	19.00	4.00	15.00	9.38	0.01
M4MW09	P201009618	539074.791	617524.170	12/13/1994	22.00	7.00	15.00	8.36	0.01
M4MW10	29-41644	538791.272	617486.878	11/23/1999	18.00	3.00	15.00	11.15	0.01

Notes:

ft = feet

bgs - below ground surface

amsl = above mean sea level

TABLE 2.2
GROUNDWATER SAMPLING SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Date	Well ID					
	M4MW05	M4MW06	M4MW07	M4MW08	M4MW09	M4MW10
May-97	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Aug-97	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Oct-97	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Feb-98	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
May-98	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Jul-98	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Oct-98	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Feb-99	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Apr-99	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Jul-99	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Oct-99	--	--	V,S,P,M	V,S,P,M	V,S,P,M	--
Jan-00	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
May-00	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Aug-00	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Aug-00	--	--	M	M	M	M
Oct-00	--	--	M	M	M	M
Oct-00	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jan-01	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Apr-01	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jul-01	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Oct-01	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jan-02	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Apr-02	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jul-02	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Oct-02	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jan-03	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Apr-03	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jul-03	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Oct-03	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jan-04	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
May-04	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jul-04	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Oct-04	--	--	V,S,P,M	V,S,P,M	V,S,P,M	V,S,P,M
Jan-05	--	--	M	M	M	M
Apr-05	--	--	M	M	M	M
Jul-05	--	--	M	M	M	M
Oct-05	--	--	M	M	M	M

TABLE 2.2
GROUNDWATER SAMPLING SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	Well ID					
Date	M4MW05	M4MW06	M4MW07	M4MW08	M4MW09	M4MW10
Jan-06	--	--	M	M	M	M
Apr-06	--	--	M	M	M	M
Jul-06	--	--	M	M	M	M
Oct-06	--	--	M	M	M	M
Jan-07	--	--	M	M	M	M
Apr-07	--	--	M	M	M	M
Jul-07	--	--	M	M	M	M
Oct-07	--	--	M	M	M	M
Jan-08	--	--	M	M	M	M
Apr-08	--	--	M	M	M	M
Jul-08	--	--	M	M	M	M
Oct-08	--	--	M	M	M	M
Mar-09	--	--	M	M	M	M
May-09	--	--	M	M	M	M
Jul-09	--	--	M	M	M	M
Nov-09	--	--	M	M	M	M
Jan-10	--	--	M	M	M	M
Apr-10	--	--	M	M	M	M
Jul-10	--	--	M	M	M	M
Aug-10	--	V,M	--	--	--	--
Aug-10	--	V,M	--	--	--	--
Oct-10	M	M	M	M	M	M
Feb-11	M	M	M	M	M	M
Apr-11	M	M	M	M	M	M
Jul-11	M	M	M	M	M	M

Notes:

V = volatile organic compounds + tentatively-identified compounds (TICs),
S = semivolatile organic compounds + TICs, M = metals,
P = pesticides and polychlorinated biphenyls (PCBs), dash (--) = not sampled.

TABLE 2.3
SURFACE WATER SAMPLING SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Date	Location		
	SS-5	SS-15	SS-16
10/8/96	V	V	V
11/25/96	V	V	V
12/12/96	V	V	V
1/29/97	V	V	V
2/26/97	V	V	V
3/10/97	V	V	V
4/8/97	V	V	V
7/17/97	V	V	V
10/30/97	V	V	V
2/10/98	V	V	V
4/21/98	V	V	V
8/19/98	V	V	V
11/17/98	V	V	V
11/17/98	V	V	V
2/25/99	V	V	V
6/29/99	V	V	V
9/22/99	V	V	V
12/8/99	V	V	V
3/1/00	V	V	V
6/12/00	V,P	V,P	V,P
8/24/00	V,P	V,P	V,P
11/20/00	V,P	V,P	V,P
3/8/01	V,P	V,P	V,P
5/16/01	V,P	V,P	V,P
9/25/01	V,P	V,P	V,P
11/14/01	V,P	V,P	V,P
2/11/02	V,P	V,P	V,P
6/18/02	V,P	V,P	V,P
9/18/02	V,P	V,P	V,P
11/4/02	V,P	V,P	V,P
3/13/03	V,P	V,P	V,P
5/21/03	V,P	V,P	V,P
9/17/03	V,P	V,P	V,P
11/4/03	V,P	V,P	V,P

TABLE 2.3
SURFACE WATER SAMPLING SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Date	Location		
	SS-5	SS-15	SS-16
3/17/04	V,P	V,P	V,P
6/29/04	V,P	V,P	V,P
8/26/04	V,P	V,P	V,P
11/23/04	V,P	V,P,M	--
3/3/05	V,P	V,P,M	--
6/15/05	V,P	V,P,M	--
9/13/05	V,P	V,P,M	--
12/1/05	V,P	V,P,M	--
2/22/06	V,P	V,P,M	--
5/31/06	V,P	V,P,M	--
9/20/06	V,P	V,P,M	--
12/11/06	V,P	V,P,M	--
3/13/07	V,P	V,P,M	--
6/26/07	V,P	V,P,M	--
9/13/07	V,P	V,P,M	--
12/19/07	V,P	V,P,M	--
3/25/08	V,P	V,P,M	--
6/26/08	V,P	V,P,M	--
9/30/08	V,P	V,P,M	--
12/29/08	V,P	V,P,M	--
3/24/09	V	V,M	--
6/29/09	V	V,M	--
9/25/09	V	V,M	--
12/7/09	V	V,M	--
3/28/10	V	V,M	--
6/22/10	V	V,M	--
9/21/10	V	V,M	--

Notes:

V = volatile organic compounds + tentatively-identified compounds

M = metals, P = pesticides/PCBs, dash (--) = not sampled.

TABLE 4.1
SOIL SAMPLING RESULTS - COMPARISON TO NJDEP STANDARDS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Field Sample Location	NJDEP RDCSRS ⁽¹⁾	NJDEP NRDCSRS ⁽¹⁾	NJDEP Impact to Groundwater ⁽²⁾	Weston Background ⁽³⁾	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	
Sample Date					03/09/98	03/09/98	03/09/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	
Volatile Organic Compounds (VOCs; µg/kg)																						
Lab Sample ID (VOCs only collected 24 in. bgs)					3396.02	3396.04	3396.06	3398.02	3398.04	3398.06	3398.08	3398.10	3398.12	3398.14	3398.16	3398.18	3399.02	3399.04	3399.06	3399.08	3399.10	
Acetone	70000000	NLE	19,000	-	24000	< 550	< 560	< 610	< 570	< 560	< 550	< 550	< 650	< 550	< 490	< 540	< 570	< 500	< 520	< 510	< 580	
Methylene Chloride	34,000	97,000	10	-	1000	< 550	< 560	< 610	< 570	< 560	< 550	< 550	< 650	< 550	< 490	< 540	< 570	< 500	< 520	< 510	< 580	
Ethylbenzene	7,800,000	110,000,000	13,000	-	< 480	< 550	< 560	< 610	< 570	< 560	< 550	< 550	< 650	< 550	< 490	< 540	< 570	< 500	< 520	< 510	< 580	
TICs	NLE	NLE		-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Semivolatile Organic Compounds (SVOCs; µg/kg)																						
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in. bgs)					3396.01	3396.03	3396.05	3398.01	3398.03	3398.05	3398.07	3398.09	3398.11	3398.13	3398.15	3398.17	3399.01	3399.03	3399.05	3399.07	3399.09	
4-Methylphenol	31,000	340,000	NLE	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	< 570	< 530	< 540	< 560	130	J	< 570	< 570	< 530	
Naphthalene	6,000	17,000	25,000	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	770	J	< 540	< 560	120	J	< 570	< 570	< 530	
2-Methylnaphthalene	230,000	2,400,000	8,000	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	180	J	< 530	< 540	< 560	88	J	< 570	< 570	
Acenaphthylene	NLE	300,000,000	NLE	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	< 570	110	J	< 540	< 560	< 560	< 570	< 570	< 530	
Acenaphthene	3,400,000	37,000,000	110,000	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	1800	< 530	< 540	< 560	< 560	< 570	< 570	< 530		
Dibenzofuran	NLE	NLE	NLE	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	540	J	< 530	< 540	< 560	< 560	< 570	< 570		
Diethylphthalate	49,000,000	550,000,000	88,000	-	< 590	59	J	< 540	< 540	54	J	< 540	< 570	< 530	77	J	110	J	60	J	160	
Fluorene	2,300,000	24,000,000	170,000	-	< 590	< 550	< 540	< 540	< 540	< 540	< 570	< 530	1000	< 530	< 540	< 560	< 560	< 570	< 570	< 530		
Phenanthrene	NLE	300,000,000	NLE	-	360	J	< 550	< 540	< 540	< 540	< 570	< 530	6300	200	J	100	J	140	J	250		
Anthracene	17,000,000	30,000,000	2,400,000	-	81	J	< 550	< 540	< 540	< 540	< 570	< 530	1800	< 530	< 540	< 560	< 560	< 570	< 570	< 530		
Di-n-butylphthalate	6,100,000	68,000,000	760,000	-	240	JB	900	B	560	B	380	JB	500	JB	220	JB	530	JB	640	B	470	
Fluoranthene	2,300,000	24,000,000	1,300,000	-	1100	< 550	< 540	< 540	< 540	86	J	< 570	< 530	6600	300	J	170	J	200	J	460	
Pyrene	1,700,000	18,000,000	840,000	-	1100	< 550	< 540	< 540	< 540	90	J	< 570	< 530	6200	490	J	180	J	320	J	480	
Benzo[a]anthracene	600	2,000	800	-	860	55	J	< 540	< 540	< 540	< 570	< 530	3700	230	J	110	J	250	J	230	J	
Chrysene	62,000	230,000	80,000	-	1400	92	J	65	J	< 540	58	J	85	J	< 570	< 530	4600	460	J	180	J	
bis(2-Ethylhexyl)phthalate	35,000	140,000	1,200,000	-	< 590	64	J	60	J	61	J	230	J	56	J	62	J	62	J	73	J	
Benzo[b]fluoranthene	600	2,000	2,000	-	740	75	J	58	J	< 540	< 540	< 570	< 530	4000	170	J	100	J	69	J	250	
Benzo[k]fluoranthene	6,000	23,000	25,000	-	820	94	J	70	J	< 540	< 540	< 570	< 530	2100	210	J	87	J	230	J	210	
Benzo[a]pyrene	200	200	200	-	1000	140	J	76	J	< 540	< 540	< 570	< 530	3500	320	J	150	J	< 560	210	J	
Indeno[1,2,3-cd]pyrene	600	2,000	7,000	-	520	J	110	J	< 540	< 540	< 540	< 570	< 530	1900	220	J	100	J	< 560	210	J	
Dibenz[a,h]anthracene	200	200	800	-	200	J	< 550	< 540	< 540	< 540	< 570	< 530	690	< 530	< 540	< 560	< 560	< 570	< 570	< 530		
Benzo[g,h,i]perylene	380,000,000	30,000,000	NLE	-	520	J	96	J	< 540	< 540	< 570	< 530	1600	< 530	80	J	< 560	190	J	< 570	< 570	
Total TICs	NLE	NLE	NLE	-	4580	9240	4630	ND	12410	5070	6830	6950	19290	4640	1900	23840	27000	8140	3890	3180	8000	

Notes:

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(2) NJDEP Impact to Groundwater (NJDEP guidance document; Nov 2013).

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E = Estimated value.

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NA = not analyzed.

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mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

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Detections are bolded.

Shaded cells = concentration exceeds NJDEP Impact to Groundwater Criterion.

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Shaded cells = concentration exceeds all NJDEP criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.1
SOIL SAMPLING RESULTS - COMPARISON TO NJDEP STANDARDS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Field Sample Location	NJDEP RDCSRS ⁽¹⁾	NJDEP NRDCSRS ⁽¹⁾	NJDEP Impact to Groundwater ⁽²⁾	Weston Background ⁽³⁾	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17
Sample Date					03/09/98	03/09/98	03/09/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/10/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98
Pesticides/PCBs (mg/kg)																					
4,4'-DDE	2	9	18	-	0.093	0.213	0.162	0.105	0.042	0.19	0.008	0.007	0.024	0.199	0.061	0.081	0.155	0.031	0.017	0.033	0.037
Endosulfan II	470	6,800	4	-	< 0.0002	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.008	< 0.0002	0.01	< 0.0002
4,4'-DDD	3	13	4	-	< 0.0039	0.04	0.04	0.043	< 0.0004	0.038	< 0.0004	< 0.0004	< 0.0004	0.051	0.036	0.086	0.066	< 0.0004	0.001	0.003	0.017
4,4'-DDT	2	8	11	-	0.168	0.035	0.034	0.034	0.041	0.059	< 0.0001	0.005	0.061	0.059	0.042	0.119	0.026	0.026	0.013	0.033	0.052
Metals (mg/kg)																					
Aluminum	78,000	NA	6,000	15,200	9445	10130	14020	12760	15930	13620	8828	6435	11800	13140	10280	14860	17930	12960	7229	8273	13460
Antimony	31	450	6	ND	1.284	1.466	2.225	1.3	1.356	1.956	1.481	0.736	1.886	2.156	1.487	2.553	2.467	1.765	1.401	1.377	0.776
Arsenic	19	19	19	22.9	12.96	12.27	22.31	7.751	9.701	12.05	30.95	4.872	15.67	16.23	9.697	25.22	20.03	18.43	11.68	12.41	12.59
Barium	16,000	59,000	2,100	32.3	25.37	45.01	49.94	31.31	39.96	46.74	26	16.94	42.69	45.05	34.9	63.22	55.32	47.58	19.55	24.96	41.7
Beryllium	16	140	0.70	2	0.8537	1.014	1.678	0.8095	1.061	1.202	1.007	0.4497	1.473	1.485	1.044	1.92	1.821	1.605	0.7984	0.989	0.9142
Cadmium	78	78	2	ND	< 0.060	< 0.055	< 0.050	< 0.053	< 0.052	< 0.058	< 0.057	< 0.053	< 0.052	< 0.044	< 0.059	< 0.040	< 0.051	< 0.055	< 0.046	< 0.045	< 0.057
Calcium	NLE	NLE	NLE	921	1214	1870	2000	1030	1347	1590	1174	684.7	1695	1761	1504	1687	2946	2186	1330	1452	3545
Chromium	NLE	NLE	NLE	269	75.85	83.52	129	68.88	85.85	98.45	75.95	36.55	113.7	112.6	81.99	150.9	150	121.9	81.31	85.01	130.8
Cobalt	1,600	590	90	2.5	1.315	1.765	2.714	1.734	2.15	2.312	1.325	1.1	2.041	2.576	1.681	2.807	3.356	3.055	1.3	1.48	3.081
Copper	3,100	45,000	11,000	8	6.873	6.473	10.75	4.954	5.973	7.537	4.121	4.341	6.824	19.79	10.83	14.31	18.94	7.179	7.592	9.626	10.83
Iron	NLE	NLE	NLE	55,800	23260	27010	41270	24520	29380	30740	24800	12860	36160	35790	26750	46460	46470	38660	23250	26930	43610
Lead	400	800	90	19.5	33.59	26.29	22.22	9.185	11.77	17.06	8.044	16.24	22.24	35.74	21.93	33.22	39.36	18.69	14.15	17.01	19.63
Magnesium	NLE	NLE	NLE	7,230	2528	2808	5079	2548	3319	3804	2717	1223	4547	4495	2983	5838	6329	4893	2557	3033	5496
Manganese	11,000	5,900	65	90.7	35.52	36.78	56.29	27.33	33.97	51.08	36.11	23.54	47.22	59.79	42.69	73.85	74.08	156.8	27.25	28.77	67.37
Mercury	23	65	0.10	ND	0.063	0.042	0.05	0.0335	0.0329	0.0489	0.0282	0.0195	0.0716	0.0362	0.0352	0.0441	0.055	0.04	0.039	0.05	0.08
Nickel	1,600	23,000	48	8.4	4.741	5.959	8.751	5.768	7.245	7.622	5.251	3.712	7.444	8.45	6.448	10.2	11.07	9.405	4.537	5.372	9.741
Potassium	NLE	NLE	NLE	15,400	7070	5790	11410	5828	7789	8158	7498	3267	9890	10310	6338	14310	13970	10620	54.17	6613	12940
Selenium	390	5,700	11	1.9	< 0.359	< 0.328	< 0.299	< 0.318	< 0.315	< 0.347	< 0.342	< 0.315	< 0.315	< 0.265	< 0.354	< 0.240	< 0.308	< 0.331	< 0.274	< 0.270	0.726
Silver	390	5,700	1	1.1	< 0.359	< 0.328	< 0.299	< 0.318	< 0.315	< 0.347	< 0.342	< 0.315	< 0.315	< 0.265	< 0.354	< 0.240	< 0.308	< 0.331	< 0.274	< 0.270	< 0.342
Sodium	NLE	NLE	NLE	51.6	46.39	37.39	66.26	114.1	81.27	84.97	39.76	39.17	205.3	188	90.27	202.3	218.9	79.45	47.5	87.05	140.7
Thallium	5	79	3	ND	< 0.359	< 0.328	< 0.299	< 0.318	< 0.315	< 0.347	< 0.342	< 0.315	< 0.315	< 0.265	< 0.354	< 0.240	< 0.308	< 0.331	< 0.274	< 0.270	< 0.342
Vanadium	78	1,100	NLE	94.1	34.02	31.28	50.05	40.86	49.68	49.62	35.85	23.22	46.84	46.94	42.37	52.96	74.26	48.97	56.55	49.97	50.45
Zinc	23,000	110,000	930	81.4	31.28	47.69	67.57	29.65	37.72	50.75	34.03	25.78	56.89	78.94	47.55	90.04	91.33	67.23	44.11	43.34	70.58

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SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Field Sample Location	NJDEP RDCSRS ⁽¹⁾	NJDEP NRDCSRS ⁽¹⁾	NJDEP Impact to Groundwater ⁽²⁾	Weston Background ⁽³⁾	B-18	B-19	B-20	B-21	B-22	B-23	B-23 DUP	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31	B-32	B-33																	
Sample Date					03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/12/98	03/12/98	03/12/98	03/12/98																	
Volatile Organic Compounds (VOCs; µg/kg)																																						
Lab Sample ID (VOCs only collected 24 in. bgs)					3399.12	3399.14	3399.16	3399.18	3399.20	3399.22	3399.30	3399.24	3399.26	3399.28	3399.32	3399.34	3399.36	3403.02	3403.04	3403.06	3403.08																	
Acetone	70000000	NLE	19,000	-	< 480	< 530	< 510	< 550	< 510	< 540	< 730	< 520	< 500	< 580	< 540	< 520	< 580	< 580	< 560	< 570	< 680																	
Methylene Chloride	34,000	97,000	10	-	< 480	< 530	< 510	< 550	< 510	< 540	< 730	< 520	< 500	< 580	< 540	< 520	< 580	< 580	< 560	< 570	< 680																	
Ethylbenzene	7,800,000	110,000,000	13,000	-	< 480	< 530	< 510	< 550	< 510	< 540	< 730	< 520	< 500	< 580	< 540	< 520	< 580	< 580	< 560	< 570	< 680																	
TICs	NLE	NLE	NLE	-	ND	ND	ND	ND	4100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND																	
Semivolatile Organic Compounds (SVOCs; µg/kg)																																						
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in. bgs)					3399.11	3399.13	3399.15	3399.17	3399.19	3399.21	3399.29	3399.23	3399.25	3399.27	3399.31	3399.33	3399.35	3403.01	3403.03	3403.05	3403.07																	
4-Methylphenol	31,000	340,000	NLE	-	<800	<550	<280,000	<550	<570	<560	<580	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550																	
Naphthalene	6,000	17,000	25,000	-	200	J	470	J	<280,000	<550	<570	<560	66	J	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550														
2-Methylnaphthalene	230,000	2,400,000	8,000	-	170	J	420	J	<280,000	<550	<570	<560	84	J	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550														
Acenaphthylene	NLE	300,000,000	NLE	-	<800	<550	<280,000	<550	<570	<560	62	J	64	J	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550															
Acenaphthene	3,400,000	37,000,000	110,000	-	<800	<550	<280,000	<550	<570	<560	<580	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550																	
Dibenzofuran	NLE	NLE	NLE	-	<800	130	J	<280,000	<550	<570	<560	<580	<550	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550																	
Diethylphthalate	49,000,000	550,000,000	88,000	-	<800	<550	<280,000	210	JB	<570	61	JB	<580	330	JB	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550														
Fluorene	2,300,000	24,000,000	170,000	-	<800	<550	<280,000	<550	<570	<560	<580	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550																	
Phenanthrene	NLE	300,000,000	NLE	-	180	J	800	<280,000	180	J	<570	110	J	160	J	420	J	<5,500	97	J	<5,600	<310,000	<290,000	<280,000	<110,000	120	J	88	J									
Anthracene	17,000,000	30,000,000	2,400,000	-	<800	120	J	<280,000	<550	<570	<560	<580	<550	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<570	<550																	
Di-n-butylphthalate	6,100,000	68,000,000	760,000	-	660	JB	200	JB	<280,000	810	B	280	JB	610	B	210	JB	480	JB	1200	JB	240	JB	1300	JBD	<310,000	<290,000	<280,000	<110,000	57	JB	<550						
Fluoranthene	2,300,000	24,000,000	1,300,000	-	220	J	870		<280,000	260	J	500	J	150	J	210	J	360	J	660	JD	160	J	<5,600	<310,000	<290,000	<280,000	<110,000	370	J	100	J						
Pyrene	1,700,000	18,000,000	840,000	-	420	J	1200		<280,000	340	J	570		260	J	380	J	630		1000	JD	190	J	<5,600	<310,000	<290,000	<280,000	<110,000	260	J	110	J						
Benzo[a]anthracene	600	2,000	800	-	<800	360	J	<280,000	160	J	300	J	110	J	150	J	200	J	<5,500	93	J	<5,600	<310,000	<290,000	<280,000	<110,000	180	J	73	J	J							
Chrysene	62,000	230,000	80,000	-	<800	1200		<280,000	360	J	580	210	J	420	J	460	J	740	JD	160	J	<5,600		<310,000		<290,000		<280,000		<110,000	220	J	110	J				
bis(2-Ethylhexyl)phthalate	35,000	140,000	1,200,000	-	350	JB	120	JB	10537588	EBD	110	JB	150	JB	180	JB	200	JB	170	JB	43000	BD	100	JB	1900000	EBD	8000000	EBD	9000000	EBD	3300000	BD	1500000	EBD	120	JB	81	JB
Benzo[b]fluoranthene	600	2,000	2,000	-	<800	420	J	<280,000	160	J	300	J	91	J	120	J	130	J	<5,500	67	J	<5,600		<310,000		<290,000		<280,000		<110,000	110	J	<550					
Benzo[k]fluoranthene	6,000	23,000	25,000	-	<800	670		<280,000	160	J	230	J	160	J	260	J	290	J	<5,500	100	J	<5,600		<310,000		<290,000		<280,000		<110,000	130	J	56	J				
Benzo[a]pyrene	200	200	200	-	<800	660		<280,000	250	J	390	J	<560	<580	230	J	<5,500	<570	<5,600		<310,000		<290,000		<280,000		<110,000	160	J	90	J							
Indeno[1,2,3-cd]pyrene	600	2,000	7,000	-	<800	<550	<280,000	170	J	<570	<560	<580	160	J	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<110,000	<110,000	<110,000	<110,000	130	J	86	J									
Dibenz[a,h]anthracene	200	200	800	-	<800	<550	<280,000	<550	<570	<560	<580	<550	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	95	J	<550																
Benzo[g,h,i]perylene	380,000,000	30,000,000	NLE	-	<800	<550	<280,000	150	J	<570	<560	<580	160	J	<5,500	<570	<5,600	<310,000	<290,000	<280,000	<110,000	<110,000	<110,000	<110,000	<110,000	120	J	84	J									
Total TICs	NLE	NLE	NLE	-	6790	7210	ND	11560	9410	17930	3570	10880	ND	ND	89000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND						

Notes:
(1) New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Remediation Standards (RDCSRS) and Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) (N.J.A.C 7:26D; amended May 7, 2012). Available at: <http://www.state.nj.us/dep/srp/regs/rs/>. NJDEP Non-residential
(2) NJDEP Impact to Groundwater (NJDEP guidance document; Nov 2013).
(3) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.
NJDEP criteria for total xylenes are used for xylene isomers (m+p, o).
NJDEP criteria for endrin is used for endrin aldehyde.
NJDEP criteria for 4,4'-DDD and 4,4'-DDT are for total DDD and total DDT, respectively.
Dash (-) = only background concentrations for metals are being used as comparison criteria.
B = Analyte detected in both sample and associated laboratory blank.
D = Result from dilution of sample.
DUP = field duplicate sample.
E = Estimated value.
J = Analyte detected between MDL and practical quantitation limit (PQL).
NA = not analyzed.
ND = not detected.
NLE = No limit established.
< = analyte not detected above method detection limit (MDL).
µg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
VOCs = volatile organic compounds.
in. = inches.
bgs = below ground surface.
Detections are bolded.
Shaded cells = concentration exceeds NJDEP Impact to Groundwater Criterion.
Shaded cells = concentration exceeds one or both NJDEP Direct Contact Criteria.
Shaded cells = concentration exceeds all NJDEP criteria.
Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.1
SOIL SAMPLING RESULTS - COMPARISON TO NJDEP STANDARDS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Field Sample Location	NJDEP RDCSRS ⁽¹⁾	NJDEP NRDCSRS ⁽¹⁾	NJDEP Impact to Groundwater ⁽²⁾	Weston Background ⁽³⁾	B-18	B-19	B-20	B-21	B-22	B-23	B-23 DUP	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31	B-32	B-33
Sample Date					03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/11/98	03/12/98	03/12/98	03/12/98	03/12/98
Pesticides/PCBs (mg/kg)																					
4,4'-DDE	2	9	18	-	0.037	< 0.0002	< 0.0002	0.025	0.075	0.134	0.0007	0.277	0.283	0.08	1.035	0.13	0.086	0.022	0.174	0.069	0.008
Endosulfan II	470	6,800	4	-	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001
4,4'-DDD	3	13	4	-	0.015	< 0.0004	< 0.0004	< 0.0004	< 0.0004	0.112	0.08	0.102	0.111	0.033	0.573	0.054	0.055	0.024	0.102	0.018	0.004
4,4'-DDT	2	8	11	-	0.026	< 0.0001	< 0.0001	0.022	0.036	0.052	0.071	0.123	0.103	0.045	0.547	0.086	0.088	0.017	0.128	0.049	0.029
Metals (mg/kg)																					
Aluminum	78,000	NA	6,000	15,200	13460	8262	7344	75543	9030	9257	5524	7754	4361	6896	10810	7635	13440	7129	5509	4760	5664
Antimony	31	450	6	ND	0.776	0.847	0.67	0.698	1.354	1.174	1.42	0.921	0.39	0.966	1.42	1.05	2.608	2.333	0.531	0.646	0.743
Arsenic	19	19	19	22.9	12.59	10.61	6.726	11.04	14	9.005	17.79	9.278	7.189	7.951	17.79	16.85	21.71	20.51	10.38	6.695	5.212
Barium	16,000	59,000	2,100	32.3	41.7	40.98	45.11	44.59	50.84	38	42.18	31.85	25.04	30.98	42.18	39.21	54.77	54.33	29.39	29.77	17.11
Beryllium	16	140	0.70	2	0.9412	0.854	0.6179	0.7675	0.9173	0.909	1.28	0.7427	0.4093	0.7361	1.28	0.8306	1.723	0.6548	0.6454	0.4611	0.3167
Cadmium	78	78	2	ND	< 0.086	< 0.061	< 0.062	< 0.054	< 0.062	< 0.044	< 0.043	< 0.063	0.1351	< 0.060	< 0.059	< 0.067	< 0.062	< 0.053	< 0.058	< 0.061	< 0.061
Calcium	NLE	NLE	NLE	921	3545	1839	1676	1337	2283	1903	2457	2489	9215	1605	2457	2145	2145	7643	1709	1315	783.2
Chromium	NLE	NLE	NLE	269	74.84	55.22	38.05	55.85	60.23	69.83	86.69	51.79	26.49	56.79	86.69	1897	122	142.4	41.66	29.77	35.6
Cobalt	1,600	590	90	2.5	3.285	3.73	3.196	2.363	4.181	1.86	2.435	2.002	1.213	1.151	2.435	2.653	2.948	4.567	1.38	2.401	1.835
Copper	3,100	45,000	11,000	8	52.39	51.16	62.67	26.96	31.6	12.19	3.497	20.36	14.38	5.834	8.497	14.03	11.58	257.4	10.04	18.72	10.46
Iron	NLE	NLE	NLE	55,800	31470	20450	16430	20310	25640	22440	30440	19070	11760	18300	30440	20890	40280	25140	15760	13530	11490
Lead	400	800	90	19.5	22.6	34.72	39.07	51.26	47.79	33.17	22.79	63.28	51.8	19.55	22.79	31.1	20.23	37.22	21.27	43.74	12.38
Magnesium	NLE	NLE	NLE	7,230	6310	2152	1674	2046	2142	2827	3446	2555	5489	1858	3446	2238	2555	5081	1924	1526	929.2
Manganese	11,000	5,900	65	90.7	152.6	63.23	75.38	37.95	63.45	38.96	66.4	54.66	48.92	38.55	66.4	55.25	55.22	70.63	36.64	48.32	19.63
Mercury	23	65	0.10	ND	0.024	0.041	0.048	0.086	0.074	0.096	0.058	0.042	0.067	0.09	0.033	0.034	0.025	0.016	0.028	0.043	0.014
Nickel	1,600	23,000	48	8.4	28.74	9.756	8.264	7.841	9.726	6.028	3.798	7.847	4.677	4.796	8.798	7.342	9.403	13.31	4.738	6.569	3.612
Potassium	NLE	NLE	NLE	15,400	8285	5453	3717	6382	5928	6039	3612	5748	51.8	4429	7038	6111	10820	3285	3867	2169	1823
Selenium	390	5,700	11	1.9	< 0.515	< 0.365	< 0.373	0.663	< 0.373	0.286	< 0.258	< 0.376	0.685	< 0.358	< 0.354	0.508	< 0.371	0.423	< 0.345	< 0.368	< 0.368
Silver	390	5,700	1	1.1	< 0.515	< 0.365	< 0.373	< 0.323	< 0.373	< 0.264	< 0.258	< 0.376	< 0.295	< 0.358	< 0.354	< 0.399	< 0.371	< 0.320	< 0.345	< 0.368	< 0.368
Sodium	NLE	NLE	NLE	51.6	634.1	28.88	151.5	118.4	83.07	94.95	58.32	87.82	49.99	119.1	57.86	92.32	89.84	165.7	33.1	59.76	138.5
Thallium	5	79	3	ND	< 0.515	< 0.365	< 0.373	< 0.323	< 0.373	< 0.264	< 0.258	< 0.376	< 0.295	< 0.358	< 0.354	< 0.399	< 0.371	< 0.320	< 0.345	< 0.368	< 0.368
Vanadium	78	1,100	NLE	94.1	133.4	32.32	31.83	26.24	41.16	36.5	16.62	28.9	16.66	21.57	30.35	24.73	33.62	27.55	16.43	22.35	31.98
Zinc	23,000	110,000	930	81.4	63.7	134.5	50.75	44.38	96.52	87.61	63.27	89.06	52.4	40.01	70.01	56.38	67.11	54.09	38.48	46.2	27.11

Notes:

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NJDEP criteria for 4,4'-DDD and 4,4'-DDT are for total DDD and total DDT, respectively.

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B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

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J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

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< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded.

Shaded cells = concentration exceeds NJDEP Impact to Groundwater Criterion.

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Sample Date					03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/13/98	
Volatile Organic Compounds (VOCs; µg/kg)																							
Lab Sample ID (VOCs only collected 24 in. bgs)					3403.10	3403.12	3403.14	3403.16	3403.18	3403.20	3403.22	3403.38	3403.24	3403.26	3403.28	3403.30	3403.32	3403.34	3403.36	3403.40	3403.42	3408.02	
Acetone	70000000	NLE	19,000	-	< 610	< 550	< 600	< 590	< 590	< 530	< 570	< 630	< 610	< 630	< 540	< 640	< 550	< 570	< 570	< 560	< 550	< 540	
Methylene Chloride	34,000	97,000	10	-	< 610	< 550	< 600	< 590	< 590	< 530	< 570	< 630	< 610	< 630	< 540	< 640	< 550	< 570	< 570	< 560	< 550	< 540	
Ethylbenzene	7,800,000	110,000,000	13,000	-	< 610	< 550	< 600	< 590	< 590	< 530	< 570	< 630	< 610	< 630	49 J	< 640	< 550	< 570	< 570	< 560	< 550	< 540	
TICs	NLE	NLE	NLE	-	ND	ND	ND	ND	ND	ND	5700	ND	ND	ND	12000	ND	ND	ND	ND	ND	ND	3700	
Semivolatile Organic Compounds (SVOCs; µg/kg)																							
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in. bgs)					3403.09	3403.11	3403.13	3403.15	3403.17	3403.19	3403.21	3403.37	3403.23	3403.25	3403.27	3403.29	3403.31	3403.33	3403.35	3444.02	3444.03	3408.01	
4-Methylphenol	31,000	340,000	NLE	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Naphthalene	6,000	17,000	25,000	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
2-Methylnaphthalene	230,000	2,400,000	8,000	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Acenaphthylene	NLE	300,000,000	NLE	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	97 J	<1000	<1200	<1100	<540	
Acenaphthene	3,400,000	37,000,000	110,000	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Dibenzofuran	NLE	NLE	NLE	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Diethylphthalate	49,000,000	550,000,000	88,000	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Fluorene	2,300,000	24,000,000	170,000	-	<580	<600	<5,400	<550	<5,300	70 J	<580	<610	<550	<580	<570	<570	<530	<520	<1000	<1200	<1100	<540	
Phenanthrene	NLE	300,000,000	NLE	-	<580	<600	610 JD	170 J	<5,300	740	66 J	120 J	130 J	110 J	120 J	57 J	120 J	400 J	660 J	<1200	<1100	81 J	
Anthracene	17,000,000	30,000,000	2,400,000	-	<580	<600	<5,400	<550	<5,300	200 J	<580	<610	<550	<580	<570	<570	120 J	99 J	240 J	<1200	<1100	<540	
Di-n-butylphthalate	6,100,000	68,000,000	760,000	-	350 JB	570 JB	<5,400	470 JB	890 JB	350 JB	490 JB	210 JB	530 JB	230 JB	620 B	470 JB	260 JB	630 B	3700	3400	3400	560 B	
Fluoranthene	2,300,000	24,000,000	1,300,000	-	110 J	<600	900 JD	280 J	<5,300	1400	120 J	250 J	310 J	180 J	290 J	80 J	200 J	1200	2400	170 J	<1100	160 J	
Pyrene	1,700,000	18,000,000	840,000	-	79 J	61 J	840 JD	320 J	<5,300	1000	110 J	210 J	210 J	150 J	200 J	58 J	140 J	810	2100	170 J	<1100	160 J	
Benzo[a]anthracene	600	2,000	800	-	59 J	<600	<5,400	180 J	<5,300	600	67 J	110 J	140 J	82 J	120 J	<570	93 J	610	1300	<1200	<1100	99 J	
Chrysene	62,000	230,000	80,000	-	94 J	48 J	750 JD	290 J	<5,300	770	130 J	230 J	270 J	180 J	230 J	63 J	160 J	930	1600	180 J	<1100	180 J	
bis(2-Ethylhexyl)phthalate	35,000	140,000	1,200,000	-	77 JB	160 JB	<5,400	510 JB	<5,300	110 JB	130 JB	200 JB	89 JB	120 JB	100 JB	72 JB	210 JB	110 JB	170 JB	150 J	150 J	130 JB	
Benzo[b]fluoranthene	600	2,000	2,000	-	<580	<600	<5,400	160 J	<5,300	460 J	<580	110 J	130 J	72 J	110 J	<570	71 J	510 J	1300	<1200	<1100	120 J	
Benzo[k]fluoranthene	6,000	23,000	25,000	-	<580	<600	<5,400	170 J	<5,300	370 J	100 J	130 J	190 J	99 J	170 J	<570	130 J	560	1400	150 J	<1100	95 J	
Benzo[a]pyrene	200	200	200	-	64 J	<600	<5,400	210 J	<5,300	570	87 J	140 J	190 J	100 J	170 J	<570	110 J	750	1600	<1200	<1100	130 J	
Indeno[1,2,3-cd]pyrene	600	2,000	7,000	-	62 J	<600	<5,400	170 J	<5,300	410 J	<580	<610	140 J	<580	110 J	<570	<530	380 J	1200	<1200	<1100	<540	
Dibenz[a,h]anthracene	200	200	800	-	<580	<600	<5,400	<550	<5,300	<570	<580	<610	<550	<580	<570	<570	<530	<520	410 J	<1200	<1100	<540	
Benzo[g,h,i]perylene	380,000,000	30,000,000	NLE	-	63 J	<600	<5,400	180 J	<5,300	380 J	<580	<610	130 J	<580	100 J	<570	58 J	350 J	1100	130 J	<1100	<540	
Total TICs	NLE	NLE	NLE	-	5260	8150	ND	11710	7700	10440	29480	11190	7570	15050	9930	10080	5120	5440	14120	9300	14700	5970	

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SITE FTMM-04
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Field Sample Location	NJDEP RDCSRS ⁽¹⁾	NJDEP NRDCSRS ⁽¹⁾	NJDEP Impact to Groundwater ⁽²⁾	Weston Background ⁽³⁾	B-34	B-35	B-36	B-37	B-38	B-39	B-40	B-40 DUP	B-41	B-42	B-43	B-44	B-45	B-46	B-47	B-48	B-49	B-50	
Sample Date					03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/12/98	03/13/98	
Pesticides/PCBs (mg/kg)																							
4,4'-DDE	2	9	18	-	0.03	0.012	0.192	0.063	0.03	0.071	0.055	0.028	0.073	0.101	0.057	0.042	0.043	0.021	0.042	0.074	< 0.0004	0.047	
Endosulfan II	470	6,800	4	-	< 0.0002	0.003	0.008	< 0.0002	0.005	< 0.0002	< 0.0002	< 0.0002	0.008	< 0.0002	< 0.0001	< 0.0002	< 0.0001	0.011	< 0.0003	< 0.0003	< 0.0003	< 0.0001	
4,4'-DDD	3	13	4	-	0.007	< 0.0004	0.156	0.029	0.039	0.032	0.019	0.008	0.048	0.033	0.021	0.013	0.017	< 0.0014	0.014	0.043	< 0.0007	0.058	
4,4'-DDT	2	8	11	-	0.013	0.011	0.283	0.023	0.048	0.011	0.023	0.014	0.044	0.046	0.023	0.02	0.023	0.019	0.035	0.035	< 0.0002	0.016	
Metals (mg/kg)																							
Aluminum	78,000	NA	6,000	15,200	12240	2508	7563	6754	8838	13160	9460	9340	10070	8391	12010	10240	7337	7212	5794	15230	14850	8151	
Antimony	31	450	6	ND	25.19	0.664	1.208	0.833	1.929	2.093	1.873	1.723	2.145	1.314	1.621	1.587	1.32	1.344	0.649	2.731	2.93	0.976	
Arsenic	19	19	19	22.9	266	4.396	9.209	10.74	12.98	20.66	17.72	17.37	19.16	15.72	15.77	8.882	10.24	11.43	5.398	11.49	10.09	7.422	
Barium	16,000	59,000	2,100	32.3	3015	7.602	26.61	27.7	31.15	58.44	44.43	47.38	50.51	35.26	43.89	30.53	30.44	38.98	34.47	54.95	66.47	26.2	
Beryllium	16	140	0.70	2	7.334	0.2595	0.7587	0.5435	1.13	1.716	1.171	47.32	1.279	0.9981	1.275	1.181	0.8449	0.9026	0.4261	1.417	1.385	0.7182	
Cadmium	78	78	2	ND	5.102	< 0.060	< 0.055	< 0.051	< 0.058	< 0.058	< 0.060	1.22	< 0.057	< 0.061	< 0.059	< 0.059	< 0.059	< 0.050	< 0.051	< 0.056	< 0.056	< 0.054	
Calcium	NLE	NLE	NLE	921	1745	670.8	1964	2653	2564	2650	1751	1352	2574	2255	1432	1129	1521	1892	2101	1105	1291	1269	
Chromium	NLE	NLE	NLE	269	108.7	35.96	58	48.97	91.27	131.9	93.44	94.18	97.05	76.75	93.79	94.14	67.21	68.94	31.59	174.4	179.7	63.39	
Cobalt	1,600	590	90	2.5	64.74	0.1813	1.903	3.722	2.6	3.777	2.215	1.834	2.193	1.776	3.053	1.407	1.3	3.325	1.34	1.312	1.341	1.388	
Copper	3,100	45,000	11,000	8	60.35	2.149	20.72	20.27	9.05	7.27	8.687	6.153	9.789	8.903	11.99	3.861	6.834	21.19	6.902	7.642	6.07	5.644	
Iron	NLE	NLE	NLE	55,800	30970	7532	20600	16810	25710	40650	28820	29400	30410	24800	33680	28840	20350	21770	11890	34910	34310	20640	
Lead	400	800	90	19.5	104.5	1.518	47.86	17.31	14.93	15.18	23.7	15.09	29.28	30.3	22.5	9.522	32.34	37.68	69.47	13.33	8.121	20.93	
Magnesium	NLE	NLE	NLE	7,230	3453	956.9	2638	3319	3530	4651	3125	3057	3693	3008	3542	3539	2369	2131	1266	5235	5362	2397	
Manganese	11,000	5,900	65	90.7	110.3	4.277	39.28	67.89	83.96	100.5	63.6	38.37	52.1	49.55	91.67	40.1	43.74	38.6	41.1	23.87	22.8	17.92	
Mercury	23	65	0.10	ND	0.028	0.063	0.052	0.027	0.018	0.04	0.062	0.061	0.075	0.052	0.065	0.031	0.054	0.042	0.036	0.042	0.034	0.031	
Nickel	1,600	23,000	48	8.4	72.26	0.9898	6.88	8.189	8.007	9.086	7.517	6.576	8.082	6.739	9.795	6.188	5.052	6.81	4.669	5.982	5.757	4.984	
Potassium	NLE	NLE	NLE	15,400	6216	2266	6895	4836	6366	10160	5995	6135	6669	4758	6771	6444	5968	4027	2394	12030	11700	5086	
Selenium	390	5,700	11	1.9	244.4	< 0.362	< 0.331	0.311	< 0.349	0.446	< 0.361	< 0.353	< 0.344	< 0.364	< 0.353	< 0.355	0.574	< 0.300	< 0.309	0.416	0.585	< 0.322	
Silver	390	5,700	1	1.1	4.833	< 0.362	< 0.331	< 0.304	< 0.349	< 0.345	< 0.361	< 0.353	< 0.344	< 0.364	< 0.353	< 0.355	< 0.354	< 0.300	< 0.309	< 0.336	< 0.337	< 0.322	
Sodium	NLE	NLE	NLE	51.6	103.4	362.74	39.07	253.5	101.6	76.5	54.9	39.88	34.44	52.01	93.94	33.79	53.97	60.76	75.82	145.7	168.1	64.93	
Thallium	5	79	3	ND	242	< 0.362	< 0.331	< 0.304	< 0.349	< 0.345	< 0.361	< 0.353	< 0.344	< 0.364	< 0.353	< 0.355	< 0.354	< 0.300	< 0.309	< 0.336	< 0.337	< 0.322	
Vanadium	78	1,100	NLE	94.1	115.6	8.127	37.76	22.69	23.09	38.86	32.44	28.11	35.12	34.16	55.03	44.63	29.25	25.28	21.11	63.65	62.41	35.8	
Zinc	23,000	110,000	930	81.4	162.8	10.73	63.19	35.78	56.88	73.32	60.25	51.91	65.96	60.64	57.34	37.47	43.91	125.8	73.25	53.73	55.37	32.89	

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SITE FTMM-04
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Sample Date					03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98														
Volatile Organic Compounds (VOCs; µg/kg)																																
Lab Sample ID (VOCs only collected 24 in. bgs)					3408.04	3408.06	3408.08	3408.10	3408.12	3408.14	3408.16	3408.18	3408.20	3408.22	3408.30	3408.24	3408.26	3408.28														
Acetone	70000000	NLE	19,000	-	< 550	< 530	< 570	< 550	< 540	< 520	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540														
Methylene Chloride	34,000	97,000	10	-	< 550	< 530	< 570	< 550	< 540	< 520	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540														
Ethylbenzene	7,800,000	110,000,000	13,000	-	< 550	< 530	< 570	< 550	< 540	< 520	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540														
TICs	NLE	NLE	NLE	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND														
Semivolatile Organic Compounds (SVOCs; µg/kg)																																
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in. bgs)					3408.03	3408.05	3408.07	3408.09	3408.11	3408.13	3408.15	3408.17	3408.19	3408.21	3408.29	3408.23	3408.25	3408.27														
4-Methylphenol	31,000	340,000	NLE	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Naphthalene	6,000	17,000	25,000	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
2-Methylnaphthalene	230,000	2,400,000	8,000	-	75	J	<560	<540	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Acenaphthylene	NLE	300,000,000	NLE	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Acenaphthene	3,400,000	37,000,000	110,000	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Dibenzofuran	NLE	NLE	NLE	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Diethylphthalate	49,000,000	550,000,000	88,000	-	<550	<560	<540	<570	<570	<570	<580	<550	<580	<610	<590	<570	<570	<540														
Fluorene	2,300,000	24,000,000	170,000	-	<550	<560	<540	<570	<570	<570	<580	89	J	<580	<610	<590	<570	<540														
Phenanthrene	NLE	300,000,000	NLE	-	270	J	270	J	86	J	71	J	230	J	80	J	180	J	980		<580	140	J	220	J	230	J	<570	<540			
Anthracene	17,000,000	30,000,000	2,400,000	-	<550	<560	<540	<570	<570	<570	<580	280	J	<580	<610	<590	<570	<570	<540													
Di-n-butylphthalate	6,100,000	68,000,000	760,000	-	960	B	670	B	420	JB	270	JB	480	JB	140	JB	450	JB	200	JB	260	JB	240	JB	550	JB	260	JB	500	JB	490	JB
Fluoranthene	2,300,000	24,000,000	1,300,000	-	650		610		86	J	110	J	300	J	120	J	290	J	1900		100	J	280	J	400	J	510	J	<570	<540		
Pyrene	1,700,000	18,000,000	840,000	-	540	J	550	J	92	J	100	J	320	J	120	J	220	J	1600		90	J	260	J	330	J	350	J	<570	<540		
Benzo[a]anthracene	600	2,000	800	-	280	J	300	J	<540		<570		140	J	75	J	150	J	920		67	J	140	J	180	J	190	J	<570	<540		
Chrysene	62,000	230,000	80,000	-	520	J	540	J	91	J	110	J	280	J	140	J	200	J	1300		110	J	270	J	340	J	360	J	<570	<540		
bis(2-Ethylhexyl)phthalate	35,000	140,000	1,200,000	-	170	JB	200	JB	96	JB	100	JB	120	JB	61	JB	91	JB	97	JB	82	JB	140	JB	95	JB	83	JB	110	JB	120	JB
Benzo[b]fluoranthene	600	2,000	2,000	-	240	J	260	J	<540		<570		110	J	64	J	93	J	760		<580		120	J	160	J	180	J	<570	<540		
Benzo[k]fluoranthene	6,000	23,000	25,000	-	380	J	260	J	<540		65	J	160	J	86	J	120	J	710		110	J	120	J	190	J	220	J	<570	<540		
Benzo[a]pyrene	200	200	200	-	340	J	380	J	<540		<570		170	J	95	J	150	J	940		85	J	180	J	220	J	260	J	<570	<540		
Indeno[1,2,3-cd]pyrene	600	2,000	7,000	-	190	J	<560		<540		<570		<570		97	J	540	J	<580		<610		<590		170	J	<570	<540				
Dibenz[a,h]anthracene	200	200	800	-	<550	<560	<540	<570	<570	<570	<580	420	J	<580	<610	<590	<570	<570	<540													
Benzo[g,h,i]perylene	380,000,000	30,000,000	NLE	-	180	J	230	J	<540		<570		96	J	<570		78	J	470	J	<580		130	J	160	J	<570	<570	<540			
Total TICs	NLE	NLE	NLE	-	5810		78870		19390		15290		16860		1980		4330		5000		4230		13580		17570		11570		6030		27520	

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Sample Date					03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98	03/13/98
Pesticides/PCBs (mg/kg)																		
4,4'-DDE	2	9	18	-	0.054	0.256	0.376	0.6	3.263	0.163	0.207	0.057	0.067	0.187	0.238	0.283	0.003	0.183
Endosulfan II	470	6,800	4	-	0.008	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001
4,4'-DDD	3	13	4	-	0.047	0.188	0.175	0.205	3.056	0.073	0.29	0.043	0.057	0.164	0.227	0.259	< 0.0004	0.032
4,4'-DDT	2	8	11	-	0.044	0.236	0.124	0.247	1.539	0.086	0.329	0.039	0.054	0.046	0.064	0.355	0.007	0.113
Metals (mg/kg)																		
Aluminum	78,000	NA	6,000	15,200	12730	13290	7741	10610	11110	10680	9156	6126	14580	8288	10190	11360	7809	3825
Antimony	31	450	6	ND	1.247	< 0.236	1.49	1.563	2.369	2.186	1.634	0.751	1.701	1.648	2.035	2.181	1.501	0.733
Arsenic	19	19	19	22.9	8.636	23.96	7.025	13.65	11.22	10.14	39.46	7.415	16.7	12.48	16.94	18.4	8.055	3.938
Barium	16,000	59,000	2,100	32.3	31.1	59.14	15.77	32.12	89.73	24.35	32.87	41.94	41.4	45.9	46.58	40.3	12.76	9.505
Beryllium	16	140	0.70	2	0.9375	1.59	0.8519	1.28	1.207	1.065	0.9149	0.4819	1.19	0.8244	1.371	1.344	0.8714	0.527
Cadmium	78	78	2	ND	< 0.055	< 0.059	< 0.055	< 0.056	< 0.053	< 0.057	0.6425	< 0.054	< 0.060	< 0.056	< 0.060	< 0.059	< 0.060	0.0615
Calcium	NLE	NLE	NLE	921	1299	1792	1141	1138	1321	1568	2800	7721	1216	1255	1196	711	932.3	569.2
Chromium	NLE	NLE	NLE	269	79.45	109.3	79.46	104	135.9	135.3	90.87	27.81	107.7	81.01	104.5	106.2	79.73	40.66
Cobalt	1,600	590	90	2.5	3.064	3.275	0.969	1.842	1.986	1.161	2.401	1.632	2.191	1.406	2.001	2.266	1.079	0.6481
Copper	3,100	45,000	11,000	8	6.688	14.79	4.382	6.471	4.448	5.694	42.95	19.98	23.01	8.988	7.248	5.772	3.57	1.627
Iron	NLE	NLE	NLE	55,800	27360	43790	23620	31990	31160	30220	26570	12200	33100	21840	32780	33630	25180	12750
Lead	400	800	90	19.5	25.74	28.11	13.03	18.31	182.1	9.413	38.42	28.48	39.6	21	13.92	16.36	5.622	4.535
Magnesium	NLE	NLE	NLE	7,230	2918	4727	2921	4046	3842	3643	3133	1678	4010	2461	3596	3761	2755	1352
Manganese	11,000	5,900	65	90.7	22.82	59.07	20.37	41.93	40.93	23.45	48.42	92.82	63.55	22.21	19.97	52.54	22.08	12.34
Mercury	23	65	0.10	ND	0.039	0.063	0.055	0.063	0.118	0.033	0.078	0.052	0.061	0.063	0.036	0.057	0.026	0.02
Nickel	1,600	23,000	48	8.4	7.351	9.428	3.802	6.245	6.915	5.351	9.223	5.185	6.428	5.831	7.391	7.26	4.255	2.492
Potassium	NLE	NLE	NLE	15,400	6320	10210	5180	7947	7598	6615	5112	2472	7785	4846	7955	7869	6284	3483
Selenium	390	5,700	11	1.9	< 0.330	< 0.354	< 0.332	< 0.338	< 0.318	< 0.340	< 0.339	< 0.325	< 0.360	< 0.337	< 0.358	0.388	< 0.359	< 0.323
Silver	390	5,700	1	1.1	< 0.330	< 0.354	< 0.332	< 0.338	< 0.318	< 0.340	< 0.339	< 0.325	< 0.360	< 0.337	< 0.358	< 0.353	< 0.359	< 0.323
Sodium	NLE	NLE	NLE	51.6	92.26	137.3	72.83	89.3	73.73	50.53	63.01	93.04	75.37	61.85	27.43	50.28	44.23	26.58
Thallium	5	79	3	ND	< 0.330	< 0.354	< 0.332	< 0.338	< 0.318	< 0.340	< 0.339	< 0.325	< 0.360	< 0.337	< 0.358	< 0.353	< 0.359	< 0.323
Vanadium	78	1,100	NLE	94.1	44.5	54.72	41.1	46.21	50.22	45.64	36.99	20.13	56.36	27.69	25.13	36.35	37.93	19.58
Zinc	23,000	110,000	930	81.4	49.06	67.68	31.73	48.47	75.25	41.51	61.17	58.84	71.37	50.69	60.95	59.44	29.2	18.08

Notes:

(1) New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Remediation Standards (RDCSRS) and Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) (N.J.A.C 7:26D; amended May 7, 2012). Available at: <http://www.state.nj.us/dep/srp/regs/rs/>.

(2) NJDEP Impact to Groundwater (NJDEP guidance document; Nov 2013).

(3) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

NJDEP criteria for total xylenes are used for xylene isomers (m+p, o).

NJDEP criteria for endrin is used for endrin aldehyde.

NJDEP criteria for 4,4'-DDD and 4,4'-DDT are for total DDD and total DDT, respectively.

Dash (-) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded.

Shaded cells = concentration exceeds NJDEP Impact to Groundwater Criterion.

Shaded cells = concentration exceeds one or both NJDEP Direct Contact Criteria.

Shaded cells = concentration exceeds all NJDEP criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-1		B-2		B-3		B-4		B-5		B-6		B-7		B-8		B-9		B-10		B-11		B-12		B-13		B-14	
					03/09/98		03/09/98		03/09/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/11/98	
Volatile Organic Compounds (VOCs; µg/kg)																																
Lab Sample ID (VOCs only collected 24 in bgs)					3396.02		3396.04		3396.06		3398.02		3398.04		3398.06		3398.08		3398.10		3398.12		3398.14		3398.16		3398.18		3399.02		3399.04	
Acetone	6,100,000	63,000,000	240	-	24000		< 550		< 560		< 610		< 570		< 560		< 550		< 550		< 650		< 550		< 490		< 540		< 570		< 500	
Methylene Chloride	36,000	310,000	2.20	-	1000		< 550		< 560		< 610		< 570		< 560		< 550		< 550		< 650		< 550		< 490		< 540		< 570		< 500	
Ethylbenzene	5,400	27,000	1.50	-	< 480		< 550		< 560		< 610		< 570		< 560		< 550		< 550		< 650		< 550		< 490		< 540		< 570		< 500	
TICs	NLE	NLE	NLE	-	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Semivolatile Organic Compounds (SVOCs; µg/kg)																																
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in bgs)					3396.01		3396.03		3396.05		3398.01		3398.03		3398.05		3398.07		3398.09		3398.11		3398.13		3398.15		3398.17		3399.01		3399.03	
4-Methylphenol	610,000	6,200,000	110	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		< 570		< 530		< 540		< 560		130	J	< 570	
Naphthalene	3,600	18,000	0.47	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		770		56	J	< 540		< 560		120	J	< 570	
2-Methylnaphthalene	23,000	220,000	14	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		180	J	< 530		< 540		< 560		88	J	< 570	
Acenaphthylene	NLE	NLE	NLE	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		< 570		110	J	< 540		< 560		< 560		< 570	
Acenaphthene	340,000	3,300,000	410	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		1800		< 530		< 540		< 560		< 560		< 570	
Dibenzofuran	7,800	100,000	11	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		540	J	< 530		< 540		< 560		< 560		< 570	
Diethylphthalate	4,900,000	49,000,000	470	-	< 590		59	J	< 540		< 540		54	J	< 540		< 570		< 530		77	J	110	J	60	J	160	J	< 560		< 570	
Fluorene	230,000	2,200,000	400	-	< 590		< 550		< 540		< 540		< 540		< 540		< 570		< 530		1000		< 530		< 540		< 560		< 560		< 570	
Phenanthrene	NLE	NLE	NLE	-	360	J	< 550		< 540		< 540		< 540		< 540		< 570		< 530		6300		200	J	100	J	140	J	250	J	130	J
Anthracene	1,700,000	17,000,000	4,200	-	81	J	< 550		< 540		< 540		< 540		< 540		< 570		< 530		1800		< 530		< 540		< 560		< 560		< 570	
Di-n-butylphthalate	610,000	6,200,000	170	-	240	JB	900	B	560	B	380	JB	500	JB	220	JB	530	JB	640	B	470	JB	690	B	280	JB	630	B	550	JB	460	JB
Fluoranthene	230,000	2,200,000	7,000	-	1100		< 550		< 540		< 540		< 540		86	J	< 570		< 530		6600		300	J	170	J	200	J	460	J	210	J
Pyrene	170,000	1,700,000	950	-	1100		< 550		< 540		< 540		< 540		90	J	< 570		< 530		6200		490	J	180	J	320	J	480	J	220	J
Benzo[a]anthracene	150	2,100	10	-	860		55	J	< 540		< 540		< 540		< 540		< 570		< 530		3700		230	J	110	J	250	J	230	J	130	J
Chrysene	15,000	210,000	1,100	-	1400		92	J	65	J	< 540		58	J	85	J	< 570		< 530		4600		460	J	180	J	350	J	490	J	200	J
bis(2-Ethylhexyl)phthalate	35,000	120,000	1,100	-	< 590		64	J	60	J	61	J	230	J	56	J	62	J	62	J	73	J	74	J	< 540		110	J	130	JB	98	JB
Benzo[b]fluoranthene	150	2,100	35	-	740		75	J	58	J	< 540		< 540		< 540		< 570		< 530		4000		170	J	100	J	69	J	250	J	140	J
Benzo[k]fluoranthene	1,500	21,000	350	-	820		94	J	70	J	< 540		< 540		59	J	< 570		< 530		2100		210	J	87	J	230	J	210	J	99	J
Benzo[a]pyrene	15	210	4	-	1000		140	J	76	J	< 540		< 540		< 540		< 570		< 530		3500		320	J	150	J	< 560		210	J	120	J
Indeno[1,2,3-cd]pyrene	150	2,100	200	-	520	J	110	J	< 540		< 540		< 540		< 540		< 570		< 530		1900		220	J	100	J	< 560		210	J	< 570	
Dibenz[a,h]anthracene	15	210	11	-	200	J	< 550		< 540		< 540		< 540		< 540		< 570		< 530		690		< 530		< 540		< 560		< 560		< 570	
Benzo[g,h,i]perylene	NLE	NLE	NLE	-	520	J	96	J	< 540		< 540		< 540		< 540		< 570		< 530		1600		< 530		80	J	< 560		190	J	< 570	
Total TICs	NLE	NLE	NLE	-	4580		9240		4630		ND		12410		5070		6830		6950		19290		4640		1900		23840		27000		8140	
Pesticides/PCBs (mg/kg)																																
4,4'-DDE	1.40	5.10	0.05	-	0.093		0.213		0.162		0.105		0.042		0.19		0.008		0.007		0.024		0.199		0.061		0.081		0.155		0.031	
Endosulfan II	37	370	0.11	-	< 0.0002		< 0.0002		< 0.0002		< 0.0001		< 0.0001		< 0.0002		< 0.0002		< 0.0001		< 0.0002		< 0.0002		< 0.0001		< 0.0002		< 0.0002		0.008	
4,4'-DDD	2.00	7.20	0.01	-	< 0.0039		0.04		0.04		0.043		< 0.0004		0.038		< 0.0004		< 0.0004		< 0.0004		0.051		0.036		0.086		0.066		< 0.0004	
4,4'-DDT	1.70	7	0.07	-	0.168		0.035		0.034		0.034		0.041		0.059		< 0.0001		0.005		0.061		0.059		0.042		0.119		0.026		0.026	
Metals (mg/kg)																																
Aluminum	7,700	99,000	2,300	15,200	9445		10130		14020		12760		15930		13620		8828		6435		11800		13140		10280		14860		17930		12960	
Antimony	3.10	41	0.03	ND	1.284		1.466		2.225		1.3		1.356		1.956		1.481		0.756		1.886		2.156		1.487		2.553		2.457		1.765	
Arsenic	0.61	2.40	0.0013	22.9	12.96		12.27		22.31		7.751		9.701		12.05		80.95		4.872		15.67		16.23		9.697		25.22		20.03		18.43	
Barium	1,500	19,000	12	32.3	25.37		45.01		49.94		31.31		39.96		46.71		26		16.94		42.69		45.03		34.9		63.22		55.32		47.54	
Beryllium	16	200	1.30	2	0.8537		1.014		1.678		0.8095		1.061		1.202		1.007		0.4497		1.473		1.485		1.044		1.92		1.821		1.605	
Cadmium	7	80	0.05	ND	< 0.060		< 0.055		< 0.050		< 0.053	</																				

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-1		B-2		B-3		B-4		B-5		B-6		B-7		B-8		B-9		B-10		B-11		B-12		B-13		B-14	
					03/09/98		03/09/98		03/09/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/10/98		03/11/98		03/11/98	
Potassium	NLE	NLE	NLE	15,400	7070		5790		11410		5828		7789		8158		7498		3267		9890		10310		6338		14310		13970		10620	
Selenium	39	510	0.04	1.9	< 0.359		< 0.328		< 0.299		< 0.318		< 0.315		< 0.347		< 0.342		< 0.315		< 0.315		< 0.265		< 0.354		< 0.240		< 0.308		< 0.331	
Silver	39	510	0.06	1.1	< 0.359		< 0.328		< 0.299		< 0.318		< 0.315		< 0.347		< 0.342		< 0.315		< 0.315		< 0.265		< 0.354		< 0.240		< 0.308		< 0.331	
Sodium	NLE	NLE	NLE	51.6	46.39		37.39		66.26		114.1		81.27		84.97		39.76		39.17		205.3		188		90.27		202.3		218.9		79.45	
Thallium	0.08	1	0.0011	ND	< 0.359		< 0.328		< 0.299		< 0.318		< 0.315		< 0.347		< 0.342		< 0.315		< 0.315		< 0.265		< 0.354		< 0.240		< 0.308		< 0.331	
Vanadium	39	510	6.30	94.1	34.02		31.28		50.05		40.86		49.68		49.62		35.85		23.22		46.84		46.94		42.37		52.96		74.26		48.97	
Zinc	2,300	31,000	29	81.4	31.28		47.69		67.57		29.65		37.72		50.75		34.03		25.78		56.89		78.94		47.55		90.04		91.33		67.23	

Notes:

(1) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(2) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

USEPA RSL for Endosulfan is used for Endosulfan II

USEPA RSL for Chromium III is used for Chromium

Dash (--) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded

Shaded cells = concentration exceeds USEPA Groundwater Protection RSL.

Shaded cells = concentration exceeds USEPA Residential and/or Industrial RSL.

Shaded cells = concentration exceeds all three USEPA comparison criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-15		B-16		B-17		B-18		B-19		B-20		B-21		B-22		B-23		B-23 Dup		B-24		B-25		B-26		B-27		
					03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98
Volatile Organic Compounds (VOCs; µg/kg)																																	
Lab Sample ID (VOCs only collected 24 in bgs)					3399.06		3399.08		3399.10		3399.12		3399.14		3399.16		3399.18		3399.20		3399.22		3399.30		3399.24		3399.26		3399.28		3399.32		
Acetone	6,100,000	63,000,000	240	-	< 520		< 510		< 580		< 480		< 530		< 510		< 550		< 510		< 540		< 730		< 520		< 500		< 580		< 540		
Methylene Chloride	36,000	310,000	2.20	-	< 520		< 510		< 580		< 480		< 530		< 510		< 550		< 510		< 540		< 730		< 520		< 500		< 580		< 540		
Ethylbenzene	5,400	27,000	1.50	-	< 520		< 510		< 580		< 480		< 530		< 510		< 550		< 510		< 540		< 730		< 520		< 500		< 580		< 540		
TICs	NLE	NLE	NLE	-	ND		ND		ND		ND		ND		ND		ND		4100		ND		ND		ND		ND		ND		ND		
Semivolatile Organic Compounds (SVOCs; µg/kg)																																	
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in bgs)					3399.05		3399.07		3399.09		3399.11		3399.13		3399.15		3399.17		3399.19		3399.21		3399.29		3399.23		3399.25		3399.27		3399.31		
4-Methylphenol	610,000	6,200,000	110	-	< 570		< 530		<580		<800		<550		<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Naphthalene	3,600	18,000	0.47	-	< 570		< 530		<580		200	J	470	J	<280,000		<550		<570		<560		66	J	<550		<5,500		<570		<5,600		
2-Methylnaphthalene	23,000	220,000	14	-	< 570		< 530		<580		170	J	420	J	<280,000		<550		<570		<560		84	J	<550		<5,500		<570		<5,600		
Acenaphthylene	NLE	NLE	NLE	-	< 570		< 530		<580		<800		<550		<280,000		<550		<570		<560		62	J	64	J	<5,500		<570		<5,600		
Acenaphthene	340,000	3,300,000	410	-	< 570		< 530		<580		<800		<550		<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Dibenzofuran	7,800	100,000	11	-	< 570		< 530		<580		<800		130	J	<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Diethylphthalate	4,900,000	49,000,000	470	-	80	JB	< 530		<580		<800		<550		<280,000		210	JB	<570		61	JB	<580		330	JB	<5,500		<570		<5,600		
Fluorene	230,000	2,200,000	400	-	< 570		< 530		<580		<800		<550		<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Phenanthrene	NLE	NLE	NLE	-	< 570		80	J	63	J	180	J	800		<280,000		180	J	<570		110	J	160	J	420	J	<5,500		97	J	<5,600		
Anthracene	1,700,000	17,000,000	4,200	-	< 570		< 530		<580		<800		120	J	<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Di-n-butylphthalate	610,000	6,200,000	170	-	560	JB	220	JB	200	JB	660	JB	200	JB	<280,000		810	B	280	JB	610	B	210	JB	480	JB	1200	JBD	240	JB	1300	JBD	
Fluoranthene	230,000	2,200,000	7,000	-	64	J	110		81	J	220	J	870		<280,000		260	J	500	J	150	J	210	J	360	J	660	JD	160	J	<5,600		
Pyrene	170,000	1,700,000	950	-	75	J	180		140	J	420	J	1200		<280,000		340	J	570		260	J	380	J	630		1000	JD	190	J	<5,600		
Benzo[a]anthracene	150	2,100	10	-	< 570		76		<580		<800		360	J	<280,000		160	J	300	J	110	J	150	J	200	J	<5,500		93	J	<5,600		
Chrysene	15,000	210,000	1,100	-	69	J	130		180	J	<800		1200		<280,000		360	J	580		210	J	420	J	460	J	740	JD	160	J	<5,600		
bis(2-Ethylhexyl)phthalate	35,000	120,000	1,100	-	96	JB	120	JB	1000	B	350	JB	120	JB	10537588	EBD	110	JB	150	JB	180	JB	200	JB	170	JB	43000	BD	100	JB	1900000	EBD	
Benzo[b]fluoranthene	150	2,100	35	-	< 570		< 530		<580		<800		420	J	<280,000		160	J	300	J	91	J	120	J	130	J	<5,500		67	J	<5,600		
Benzo[k]fluoranthene	1,500	21,000	350	-	< 570		66	J	110	J	<800		670		<280,000		160	J	230	J	160	J	260	J	290	J	<5,500		100	J	<5,600		
Benzo[a]pyrene	15	210	4	-	< 570		< 530		<580		<800		660		<280,000		250	J	390	J	<560		<580		230	J	<5,500		<570		<5,600		
Indeno[1,2,3-cd]pyrene	150	2,100	200	-	< 570		< 530		<580		<800		<550		<280,000		170	J	<570		<560		<580		160	J	<5,500		<570		<5,600		
Dibenz[a,h]anthracene	15	210	11	-	< 570		< 530		<580		<800		<550		<280,000		<550		<570		<560		<580		<550		<5,500		<570		<5,600		
Benzo[g,h,i]perylene	NLE	NLE	NLE	-	< 570		< 530		<580		<800		<550		<280,000		150	J	<570		<560		<580		160	J	<5,500		<570		<5,600		
Total TICs	NLE	NLE	NLE	-	3890		3180		8000		6790		7210		ND		11560		9410		17930		3570		10880		ND		ND		89000		
Pesticides/PCBs (mg/kg)																																	
4,4'-DDE	1.40	5.10	0.05	-	0.017		0.033		0.037		0.037		< 0.0002		< 0.0002		0.025		0.075		0.134		0.0007		0.277		0.283		0.08		1.035		
Endosulfan II	37	370	0.11	-	< 0.0002		0.01		< 0.0002		< 0.0002		< 0.0002		< 0.0001		< 0.0001		< 0.0002		< 0.0002		< 0.0001		< 0.0002		< 0.0001		< 0.0001		< 0.0002		
4,4'-DDD	2.00	7.20	0.01	-	0.001		0.003		0.017		0.015		< 0.0004		< 0.0004		< 0.0004		< 0.0004		0.112		0.08		0.102		0.111		0.033		0.573		
4,4'-DDT	1.70	7	0.07	-	0.013		0.033		0.052		0.026		< 0.0001		< 0.0001		0.022		0.036		0.052		0.071		0.123		0.103		0.045		0.547		
Metals (mg/kg)																																	
Aluminum	7,700	99,000	2,300	15,200	7229		8273		13460		13460		8262		7344		75543		9030		9257		5524		7754		4361		6896		10810		
Antimony	3.10	41	0.03	ND	1.491		1.377		0.776		0.776		0.847		0.67		0.698		1.354		1.174		1.42		0.921		0.39		0.966		1.42		
Arsenic	0.61	2.40	0.0013	22.9	11.68		12.41		12.59		12.59		10.61		6.726		11.04		14		9.005		17.79		9.278		7.189		7.951		17.79		
Barium	1,500	19,000	12	32.3	19.55		24.96		41.7		41.7		40.88		43.11		44.59		50.84		38		42.18		31.85		25.04		30.98		42.18		
Beryllium	16	200	1.30	2	0.7984		0.989		0.9142		0.9412		0.854		0.6179		0.7675		0.9173		0.909		1.28		0.7427		0.4093		0.7361		1.28		
Cadmium	7	80	0.05	ND	< 0.046		< 0.045		< 0.057		< 0.086		< 0.061		< 0.062		< 0.054		< 0.062		< 0.044		< 0.043		< 0.063		0.1351		< 0.060		< 0.059		
Calcium	NLE	NLE	NLE	921	1330		1452																										

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-15		B-16		B-17		B-18		B-19		B-20		B-21		B-22		B-23		B-23 Dup		B-24		B-25		B-26		B-27	
					03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98		03/11/98	
Potassium	NLE	NLE	NLE	15,400	54.17		6613		12940		8285		5453		3717		6382		5928		6039		3612		5748		51.8		4429		7038	
Selenium	39	510	0.04	1.9	< 0.274		< 0.270		0.726		< 0.515		< 0.365		< 0.373		0.663		< 0.373		0.286		< 0.258		< 0.376		0.685		< 0.358		< 0.354	
Silver	39	510	0.06	1.1	< 0.274		< 0.270		< 0.342		< 0.515		< 0.365		< 0.373		< 0.323		< 0.373		< 0.264		< 0.258		< 0.376		< 0.295		< 0.358		< 0.354	
Sodium	NLE	NLE	NLE	51.6	47.5		87.05		140.7		634.1		28.88		151.5		118.4		85.07		94.95		58.32		87.82		49.99		119.1		57.86	
Thallium	0.08	1	0.0011	ND	< 0.274		< 0.270		< 0.342		< 0.515		< 0.365		< 0.373		< 0.323		< 0.373		< 0.264		< 0.258		< 0.376		< 0.295		< 0.358		< 0.354	
Vanadium	39	510	6.30	94.1	56.55		49.97		50.45		133.4		32.32		31.83		26.24		41.16		36.5		16.62		28.9		16.66		21.57		30.35	
Zinc	2,300	31,000	29	81.4	44.11		43.34		70.58		63.7		134.5		50.75		44.38		96.52		87.61		63.27		89.06		52.4		40.01		70.01	

Notes:

(1) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(2) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

USEPA RSL for Endosulfan is used for Endosulfan II

USEPA RSL for Chromium III is used for Chromium

Dash (--) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded

Shaded cells = concentration exceeds USEPA Groundwater Protection RSL.

Shaded cells = concentration exceeds USEPA Residential and/or Industrial RSL.

Shaded cells = concentration exceeds all three USEPA comparison criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-28		B-29		B-30		B-31		B-32		B-33		B-34		B-35		B-36		B-37		B-38		B-39		B-40		B-40 Dup		B-41	
					03/11/98		03/11/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98	
Volatile Organic Compounds (VOCs; µg/kg)																																		
Lab Sample ID (VOCs only collected 24 in bgs)						3399.34		3399.36		3403.02		3403.04		3403.06		3403.08		3403.10		3403.12		3403.14		3403.16		3403.18		3403.20		3403.22		3403.38		3403.24
Acetone	6,100,000	63,000,000	240	-	< 520		< 580		< 580		< 560		< 570		< 680		< 610		< 550		< 600		< 590		< 590		< 530		< 570		< 630		< 610	
Methylene Chloride	36,000	310,000	2.20	-	< 520		< 580		< 580		< 560		< 570		< 680		< 610		< 550		< 600		< 590		< 590		< 530		< 570		< 630		< 610	
Ethylbenzene	5,400	27,000	1.50	-	< 520		< 580		< 580		< 560		< 570		< 680		< 610		< 550		< 600		< 590		< 590		< 530		< 570		< 630		< 610	
TICs	NLE	NLE	NLE	-	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		5700		ND		ND	
Semivolatile Organic Compounds (SVOCs; µg/kg)																																		
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in bgs)						3399.33		3399.35		3403.01		3403.03		3403.05		3403.07		3403.09		3403.11		3403.13		3403.15		3403.17		3403.19		3403.21		3403.37		3403.23
4-Methylphenol	610,000	6,200,000	110	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Naphthalene	3,600	18,000	0.47	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
2-Methylnaphthalene	23,000	220,000	14	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Acenaphthylene	NLE	NLE	NLE	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Acenaphthene	340,000	3,300,000	410	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Dibenzofuran	7,800	100,000	11	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Diethylphthalate	4,900,000	49,000,000	470	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Fluorene	230,000	2,200,000	400	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		70	J	<580		<610		<550	
Phenanthrene	NLE	NLE	NLE	-	<310,000		<290,000		<280,000		<110,000		120	J	88	J	<580		<600		610	JD	170	J	<5,300		740	J	66	J	120	J	130	J
Anthracene	1,700,000	17,000,000	4,200	-	<310,000		<290,000		<280,000		<110,000		<570		<550		<580		<600		<5,400		<550		<5,300		200	J	<580		<610		<550	
Di-n-butylphthalate	610,000	6,200,000	170	-	<310,000		<290,000		<280,000		<110,000		57	JB	<550		350	JB	570	JB	<5,400		470	JB	890	JBD	350	JB	490	JB	210	JB	530	JB
Fluoranthene	230,000	2,200,000	7,000	-	<310,000		<290,000		<280,000		<110,000		370	J	100	J	110	J	<600		900	JD	280	J	<5,300		1400		120	J	250	J	310	J
Pyrene	170,000	1,700,000	950	-	<310,000		<290,000		<280,000		<110,000		260	J	110	J	79	J	61	J	840	JD	320	J	<5,300		1000		110	J	210	J	210	J
Benzo[a]anthracene	150	2,100	10	-	<310,000		<290,000		<280,000		<110,000		180	J	73	J	59	J	<600		<5,400		180	J	<5,300		600		67	J	110	J	140	J
Chrysene	15,000	210,000	1,100	-	<310,000		<290,000		<280,000		<110,000		220	J	110	J	94	J	48	J	750	JD	290	J	<5,300		770		130	J	230	J	270	J
bis(2-Ethylhexyl)phthalate	35,000	120,000	1,100	-	8000000	EBD	9000000	EBD	3300000	BD	1500000	EBD	120	JB	81	JB	77	JB	160	JB	<5,400		510	JB	<5,300		110	JB	130	JB	200	JB	89	JB
Benzo[b]fluoranthene	150	2,100	35	-	<310,000		<290,000		<280,000		<110,000		110	J	<550		<580		<600		<5,400		160	J	<5,300		460	J	<580		110	J	130	J
Benzo[k]fluoranthene	1,500	21,000	350	-	<310,000		<290,000		<280,000		<110,000		130	J	56	J	<580		<600		<5,400		170	J	<5,300		370	J	100	J	130	J	190	J
Benzo[a]pyrene	15	210	4	-	<310,000		<290,000		<280,000		<110,000		160	J	90	J	64	J	<600		<5,400		210	J	<5,300		570		87	J	140	J	190	J
Indeno[1,2,3-cd]pyrene	150	2,100	200	-	<310,000		<290,000		<280,000		<110,000		130	J	86	J	62	J	<600		<5,400		170	J	<5,300		410	J	<580		<610		140	J
Dibenz[a,h]anthracene	15	210	11	-	<310,000		<290,000		<280,000		<110,000		95	J	<550		<580		<600		<5,400		<550		<5,300		<570		<580		<610		<550	
Benzo[g,h,i]perylene	NLE	NLE	NLE	-	<310,000		<290,000		<280,000		<110,000		120	J	84	J	63	J	<600		<5,400		180	J	<5,300		380	J	<580		<610		130	J
Total TICs	NLE	NLE	NLE	-	ND		ND		ND		ND		ND		ND		5260		8150		ND		11710		7700		10440		29480		11190		7570	
Pesticides/PCBs (mg/kg)																																		
4,4'-DDE	1.40	5.10	0.05	-	0.13		0.086		0.022		0.174		0.069		0.008		0.03		0.012		0.192		0.063		0.03		0.071		0.055		0.028		0.073	
Endosulfan II	37	370	0.11	-	< 0.0002		< 0.0002		< 0.0002		< 0.0002		< 0.0002		< 0.0001		< 0.0002		0.003		0.008		< 0.0002		0.005		< 0.0002		< 0.0002		< 0.0002		0.008	
4,4'-DDD	2.00	7.20	0.01	-	0.054		0.055		0.024		0.102		0.018		0.004		0.007		< 0.0004		0.156		0.029		0.039		0.032		0.019		0.008		0.048	
4,4'-DDT	1.70	7	0.07	-	0.086		0.088		0.017		0.128		0.049		0.029		0.013		0.011		0.283		0.023		0.048		0.011		0.023		0.014		0.044	
Metals (mg/kg)																																		
Aluminum	7,700	99,000	2,300	15,200	7635		13440		7129		5509		4760		5664		12240		2508		7563		6754		8838		13160		9460		9340		10070	
Antimony	3.10	41	0.03	ND	1.05		2.608		2.353		0.551		0.646		0.743		25.19		0.664		1.208		0.833		1.929		2.093		1.873		1.723		2.145</	

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-28		B-29		B-30		B-31		B-32		B-33		B-34		B-35		B-36		B-37		B-38		B-39		B-40		B-40 Dup		B-41	
					03/11/98		03/11/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98	
Potassium	NLE	NLE	NLE	15,400	6111		10820		3285		3867		2169		1823		6216		2266		6895		4836		6366		10160		5995		6135		6669	
Selenium	39	510	0.04	1.9	0.508		< 0.371		0.423		< 0.345		< 0.368		< 0.368		244.4		< 0.362		< 0.331		0.311		< 0.349		0.446		< 0.361		< 0.353		< 0.344	
Silver	39	510	0.06	1.1	< 0.399		< 0.371		< 0.320		< 0.345		< 0.368		< 0.368		4.833		< 0.362		< 0.331		< 0.304		< 0.349		< 0.345		< 0.361		< 0.353		< 0.344	
Sodium	NLE	NLE	NLE	51.6	92.32		89.84		165.7		33.1		59.76		138.3		103.4		62.79		59.07		253.5		101.6		76.5		54.9		39.88		84.44	
Thallium	0.08	1	0.0011	ND	< 0.399		< 0.371		< 0.320		< 0.345		< 0.368		< 0.368		242		< 0.362		< 0.331		< 0.304		< 0.349		< 0.345		< 0.361		< 0.353		< 0.344	
Vanadium	39	510	6.30	94.1	24.73		33.62		27.55		16.43		22.35		31.98		115.6		8.127		37.76		22.69		23.09		38.86		32.44		28.11		35.12	
Zinc	2,300	31,000	29	81.4	56.38		67.11		54.09		38.48		46.2		27.11		162.8		10.73		63.19		35.78		56.88		73.32		60.25		51.91		65.96	

Notes:

(1) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(2) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

USEPA RSL for Endosulfan is used for Endosulfan II

USEPA RSL for Chromium III is used for Chromium

Dash (--) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded

Shaded cells = concentration exceeds USEPA Groundwater Protection RSL.

Shaded cells = concentration exceeds USEPA Residential and/or Industrial RSL.

Shaded cells = concentration exceeds all three USEPA comparison criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-42		B-43		B-44		B-45		B-46		B-47		B-48		B-49		B-50		B-51		B-52		B-53		B-54		B-55		B-56	
					03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98	
Volatile Organic Compounds (VOCs; µg/kg)																																		
Lab Sample ID (VOCs only collected 24 in bgs)					3403.26		3403.28		3403.30		3403.32		3403.34		3403.36		3403.40		3403.42		3408.02		3408.04		3408.06		3408.08		3408.10		3408.12		3408.14	
Acetone	6,100,000	63,000,000	240	-	< 630		< 540		< 640		< 550		< 570		< 570		< 560		< 550		< 540		< 550		< 530		< 570		< 550		< 540		< 520	
Methylene Chloride	36,000	310,000	2.20	-	< 630		< 540		< 640		< 550		< 570		< 570		< 560		< 550		< 540		< 550		< 530		< 570		< 550		< 540		< 520	
Ethylbenzene	5,400	27,000	1.50	-	< 630	49	J	< 640		< 550		< 570		< 570		< 560		< 550		< 540		< 550		< 530		< 570		< 550		< 540		< 520		
TICs	NLE	NLE	NLE	-	ND	12000		ND		ND		ND		ND		ND		ND		3700		ND		ND		ND		ND		ND		ND		ND
Semivolatile Organic Compounds (SVOCs; µg/kg)																																		
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in bgs)					3403.25		3403.27		3403.29		3403.31		3403.33		3403.35		3444.02		3444.03		3408.01		3408.03		3408.05		3408.07		3408.09		3408.11		3408.13	
4-Methylphenol	610,000	6,200,000	110	-	<580		<570		<570		<530		<520		<1000		<1200		<1100		<540		<550		<560		<540		<570		<570		<570	
Naphthalene	3,600	18,000	0.47	-	<580		<570		<570		<530		<520		<1000		<1200		<1100		<540		<550		<560		<540		<570		<570		<570	
2-Methylnaphthalene	23,000	220,000	14	-	<580		<570		<570		<530		<520		<1000		<1200		<1100		<540	75	J	<560		<540		<570		<570		<570		
Acenaphthylene	NLE	NLE	NLE	-	<580		<570		<570		<530	97	J	<1000		<1200		<1100		<540		<550		<560		<540		<570		<570		<570		
Acenaphthene	340,000	3,300,000	410	-	<580		<570		<570		<530	<520	<1000	<1200	<1100	<540	<550	<560	<540	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570		
Dibenzofuran	7,800	100,000	11	-	<580		<570		<570		<530	<520	<1000	<1200	<1100	<540	<550	<560	<540	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570		
Diethylphthalate	4,900,000	49,000,000	470	-	<580		<570		<570		<530	<520	<1000	<1200	<1100	<540	<550	<560	<540	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570		
Fluorene	230,000	2,200,000	400	-	<580		<570		<570		<530	<520	<1000	<1200	<1100	<540	<550	<560	<540	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570		
Phenanthrene	NLE	NLE	NLE	-	110	J	120	J	57	J	120	J	400	J	660	J	<1200	<1100	81	J	270	J	270	J	86	J	71	J	230	J	80	J		
Anthracene	1,700,000	17,000,000	4,200	-	<580		<570		<570		120	J	99	J	240	J	<1200	<1100	<540	<550	<560	<540	<570	<570	<570	<570	<570	<570	<570	<570	<570	<570		
Di-n-butylphthalate	610,000	6,200,000	170	-	230	JB	620	B	470	JB	260	JB	630	B	3700		3400		3400		560	B	960	B	670	B	420	JB	270	JB	480	JB	140	JB
Fluoranthene	230,000	2,200,000	7,000	-	180	J	290	J	80	J	200	J	1200		2400		170	J	<1100		160	J	650		610		86	J	110	J	300	J	120	J
Pyrene	170,000	1,700,000	950	-	150	J	200	J	58	J	140	J	810		2100		170	J	<1100		160	J	540	J	550	J	92	J	100	J	320	J	120	J
Benzo[a]anthracene	150	2,100	10	-	82	J	120	J	<570		93	J	610		1300		<1200		<1100		99	J	280	J	300	J	<540		<570		140	J	75	J
Chrysene	15,000	210,000	1,100	-	180	J	230	J	63	J	160	J	930		1600		180	J	<1100		180	J	520	J	540	J	91	J	110	J	280	J	140	J
bis(2-Ethylhexyl)phthalate	35,000	120,000	1,100	-	120	JB	100	JB	72	JB	210	JB	110	JB	170	J	150	J	150	J	130	JB	170	JB	200	JB	96	JB	100	JB	120	JB	61	JB
Benzo[b]fluoranthene	150	2,100	35	-	72	J	110	J	<570		71	J	510	J	1300		<1200		<1100		120	J	240	J	260	J	<540		<570		110	J	64	J
Benzo[k]fluoranthene	1,500	21,000	350	-	99	J	170	J	<570		130	J	560		1400		150	J	<1100		95	J	380	J	260	J	<540		65	J	160	J	86	J
Benzo[a]pyrene	15	210	4	-	100	J	170	J	<570		110	J	750		1600		<1200		<1100		130	J	340	J	380	J	<540		<570		170	J	95	J
Indeno[1,2,3-cd]pyrene	150	2,100	200	-	<580		110	J	<570		<530		380	J	1200		<1200		<1100		<540		190	J	<560		<540		<570		<570		<570	
Dibenz[a,h]anthracene	15	210	11	-	<580		<570		<570		<530		<520		410	J	<1200		<1100		<540		<550		<560		<540		<570		<570		<570	
Benzo[g,h,i]perylene	NLE	NLE	NLE	-	<580		100	J	<570		58	J	350	J	1100		130	J	<1100		<540		180	J	230	J	<540		<570		96	J	<570	
Total TICs	NLE	NLE	NLE	-	15050		9930		10080		5120		5440		14120		9300		14700		5970		5810		78870		19390		15290		16860		1980	
Pesticides/PCBs (mg/kg)																																		
4,4'-DDE	1.40	5.10	0.05	-	0.101		0.057		0.042		0.043		0.021		0.042		0.074		< 0.0004		0.047		0.054		0.256		0.376		0.6		3.263		0.163	
Endosulfan II	37	370	0.11	-	< 0.0002		< 0.0001		< 0.0002		< 0.0001		0.011		< 0.0003		< 0.0003		< 0.0003		< 0.0001		0.008		< 0.0002		< 0.0002		< 0.0002		< 0.0002		< 0.0002	
4,4'-DDD	2.00	7.20	0.01	-	0.033		0.021		0.013		0.017		< 0.0014		0.014		0.043		< 0.0007		0.058		0.047		0.188		0.175		0.205		3.056		0.073	
4,4'-DDT	1.70	7	0.07	-	0.046		0.023		0.02		0.023		0.019		0.035		0.035		< 0.0002		0.016		0.044		0.236		0.124		0.247		1.539		0.086	
Metals (mg/kg)																																		
Aluminum	7,700	99,000	2,300	15,200	8391		12010		10240		7337		7212		5794		15230																	

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-42		B-43		B-44		B-45		B-46		B-47		B-48		B-49		B-50		B-51		B-52		B-53		B-54		B-55		B-56	
					03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/12/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98	
Potassium	NLE	NLE	NLE	15,400	4758		6771		6444		5968		4027		2394		12030		11700		5086		6320		10210		5180		7947		7598		6615	
Selenium	39	510	0.04	1.9	< 0.364		< 0.353		< 0.355		0.574		< 0.300		< 0.309		0.416		0.585		< 0.322		< 0.330		< 0.354		< 0.332		< 0.338		< 0.318		< 0.340	
Silver	39	510	0.06	1.1	< 0.364		< 0.353		< 0.355		< 0.354		< 0.300		< 0.309		< 0.336		< 0.337		< 0.322		< 0.330		< 0.354		< 0.332		< 0.338		< 0.318		< 0.340	
Sodium	NLE	NLE	NLE	51.6	52.01		95.94		83.79		53.97		60.76		75.82		145.7		168.1		64.93		92.26		137.3		72.03		89.3		73.73		50.53	
Thallium	0.08	1	0.0011	ND	< 0.364		< 0.353		< 0.355		< 0.354		< 0.300		< 0.309		< 0.336		< 0.337		< 0.322		< 0.330		< 0.354		< 0.332		< 0.338		< 0.318		< 0.340	
Vanadium	39	510	6.30	94.1	34.16		55.03		44.63		29.25		25.28		21.11		63.65		62.41		35.8		44.5		54.72		41.1		46.21		50.22		45.64	
Zinc	2,300	31,000	29	81.4	60.64		57.34		37.47		43.91		125.8		73.25		53.73		55.37		32.89		49.06		67.68		31.73		48.47		75.25		41.51	

Notes:

(1) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(2) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

USEPA RSL for Endosulfan is used for Endosulfan II

USEPA RSL for Chromium III is used for Chromium

Dash (--) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded

Shaded cells = concentration exceeds USEPA Groundwater Protection RSL.

Shaded cells = concentration exceeds USEPA Residential and/or Industrial RSL.

Shaded cells = concentration exceeds all three USEPA comparison criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-57		B-58		B-59		B-60		B-60 Dup		B-61		B-62		B-63	
					03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98	
Volatile Organic Compounds (VOCs; µg/kg)																				
Lab Sample ID (VOCs only collected 24 in bgs)					3408.16		3408.18		3408.20		3408.22		3408.30		3408.24		3408.26		3408.28	
Acetone	6,100,000	63,000,000	240	-	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590
Methylene Chloride	36,000	310,000	2.20	-	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590
Ethylbenzene	5,400	27,000	1.50	-	< 560	< 600	< 510	< 570	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590	< 540	< 490	< 590
TICs	NLE	NLE	NLE	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (SVOCs; µg/kg)																				
Lab Sample ID (All analysis except VOCs - collected 6 to 12 in bgs)					3408.15		3408.17		3408.19		3408.21		3408.29		3408.23		3408.25		3408.27	
4-Methylphenol	610,000	6,200,000	110	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Naphthalene	3,600	18,000	0.47	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
2-Methylnaphthalene	23,000	220,000	14	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Acenaphthylene	NLE	NLE	NLE	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Acenaphthene	340,000	3,300,000	410	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Dibenzofuran	7,800	100,000	11	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Diethylphthalate	4,900,000	49,000,000	470	-	<580	<550	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Fluorene	230,000	2,200,000	400	-	<580	89	J	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Phenanthrene	NLE	NLE	NLE	-	180	J	980	<580	140	J	220	J	230	J	<570	<570	<570	<570	<540	<540
Anthracene	1,700,000	17,000,000	4,200	-	<580	280	J	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<570	<540	<540
Di-n-butylphthalate	610,000	6,200,000	170	-	450	JB	200	JB	260	JB	240	JB	550	JB	260	JB	500	JB	490	JB
Fluoranthene	230,000	2,200,000	7,000	-	290	J	1900	100	J	280	J	400	J	510	J	<570	<570	<540	<540	<540
Pyrene	170,000	1,700,000	950	-	220	J	1600	90	J	260	J	330	J	350	J	<570	<570	<540	<540	<540
Benzo[a]anthracene	150	2,100	10	-	150	J	920	67	J	140	J	180	J	190	J	<570	<570	<540	<540	<540
Chrysene	15,000	210,000	1,100	-	200	J	1300	110	J	270	J	340	J	360	J	<570	<570	<540	<540	<540
bis(2-Ethylhexyl)phthalate	35,000	120,000	1,100	-	91	JB	97	JB	82	JB	140	JB	95	JB	83	JB	110	JB	120	JB
Benzo[b]fluoranthene	150	2,100	35	-	93	J	760	<580	120	J	160	J	180	J	<570	<570	<540	<540	<540	<540
Benzo[k]fluoranthene	1,500	21,000	350	-	120	J	710	110	J	120	J	190	J	220	J	<570	<570	<540	<540	<540
Benzo[a]pyrene	15	210	4	-	150	J	940	85	J	180	J	220	J	260	J	<570	<570	<540	<540	<540
Indeno[1,2,3-cd]pyrene	150	2,100	200	-	97	J	540	J	<580	<610	<590	170	J	<570	<570	<570	<570	<540	<540	<540
Dibenz[a,h]anthracene	15	210	11	-	<580	420	J	<580	<610	<590	<570	<570	<570	<570	<570	<570	<570	<540	<540	<540
Benzo[g,h,i]perylene	NLE	NLE	NLE	-	78	J	470	J	<580	130	J	160	J	<570	<570	<570	<570	<540	<540	<540
Total TICs	NLE	NLE	NLE	-	4330	5000	4230	13580	17570	11570	6030	27520								
Pesticides/PCBs (mg/kg)																				
4,4'-DDE	1.40	5.10	0.05	-	0.207	0.057	0.067	0.187	0.238	0.283	0.003	0.183								
Endosulfan II	37	370	0.11	-	< 0.0002	0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0001	< 0.0001							
4,4'-DDD	2.00	7.20	0.01	-	0.29	0.043	0.057	0.164	0.227	0.259	< 0.0004	0.032								
4,4'-DDT	1.70	7	0.07	-	0.329	0.039	0.054	0.046	0.064	0.355	0.007	0.113								
Metals (mg/kg)																				
Aluminum	7,700	99,000	2,300	15,200	9156	6126	14580	8288	10190	11360	7809	3825								
Antimony	3.10	41	0.03	ND	1.634	0.751	1.701	1.648	2.035	2.181	1.501	0.735								
Arsenic	0.61	2.40	0.0013	22.9	39.46	7.415	16.7	12.48	16.94	18.4	8.055	3.938								
Barium	1,500	19,000	12	32.3	32.87	41.94	41.4	45.9	46.58	40.3	12.76	9.505								
Beryllium	16	200	1.30	2	0.9149	0.4819	1.19	0.8244	1.371	1.344	0.8714	0.527								
Cadmium	7	80	0.05	ND	0.6475	< 0.054	< 0.060	< 0.056	< 0.060	< 0.059	< 0.060	0.0616								
Calcium	NLE	NLE	NLE	921	2900	7771	1216	1255	1196	711	932.3	569.2								
Chromium	12,000	150,000	2,800,000	269	90.87	27.81	107.7	81.01	104.5	106.2	79.73	40.66								
Cobalt	2.30	30	0.02	2.5	2.401	1.632	2.191	1.406	2.001	2.266	1.079	0.6481								
Copper	310	4,100	2.20	8	42.95	19.98	23.01	8.988	7.248	5.772	3.57	1.627								
Iron	5,500	72,000	27	55,800	26570	12200	33100	21840	32780	33630	25180	12750								
Lead	400	800	NLE	19.5	38.42	28.48	39.6	21	13.92	16.36	5.622	4.535								
Magnesium	NLE	NLE	NLE	7,230	3133	1678	4010	2461	3596	3761	2755	1352								
Manganese	180	2,300	2.10	90.7	48.42	97.82	63.55	22.21	19.97	52.54	22.08	12.34								
Mercury	1	4.30	0.0033	ND	0.078	0.052	0.061	0.063	0.036	0.057	0.026	0.02								
Nickel	150	2,000	2	8.4	5.223	5.185	6.428	5.831	7.391	7.26	4.255	2.492								

TABLE 4.2
SOIL SAMPLING RESULTS - COMPARISON TO USEPA RSLs
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

SITE FTMM-04	USEPA RSL Residential (HQ=0.1) ⁽¹⁾	USEPA RSL Industrial (HQ=0.1)	USEPA RSL Groundwater Protection (Risk-based)	Weston Background ⁽²⁾	B-57		B-58		B-59		B-60		B-60 Dup		B-61		B-62		B-63	
					03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98		03/13/98	
Potassium	NLE	NLE	NLE	15,400	5112		2472		7785		4846		7955		7869		6284		3483	
Selenium	39	510	0.04	1.9	< 0.339		< 0.325		< 0.360		< 0.337		< 0.358		0.388		< 0.359		< 0.323	
Silver	39	510	0.06	1.1	< 0.339		< 0.325		< 0.360		< 0.337		< 0.358		< 0.353		< 0.359		< 0.323	
Sodium	NLE	NLE	NLE	51.6	63.01		93.04		75.37		61.85		27.43		50.28		44.23		26.58	
Thallium	0.08	1	0.0011	ND	< 0.339		< 0.325		< 0.360		< 0.337		< 0.358		< 0.353		< 0.359		< 0.323	
Vanadium	39	510	6.30	94.1	36.99		20.13		56.36		27.69		25.13		36.35		37.93		19.58	
Zinc	2,300	31,000	29	81.4	61.17		58.84		71.37		50.69		60.95		59.44		29.2		18.08	

Notes:

(1) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(2) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

USEPA RSL for Endosulfan is used for Endosulfan II

USEPA RSL for Chromium III is used for Chromium

Dash (--) = only background concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and associated laboratory blank.

D = Result from dilution of sample.

DUP = field duplicate sample.

E = Estimated value.

J = Analyte detected between MDL and practical quantitation limit (PQL).

NA = not analyzed.

ND = not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/kg = micrograms per kilogram.

mg/kg = milligrams per kilogram.

VOCs = volatile organic compounds.

in. = inches.

bgs = below ground surface.

Detections are bolded

Shaded cells = concentration exceeds USEPA Groundwater Protection RSL.

Shaded cells = concentration exceeds USEPA Residential and/or Industrial RSL.

Shaded cells = concentration exceeds all three USEPA comparison criteria.

Shaded cells = concentration exceeds Weston (1995) background concentration.

TABLE 4.3
SOIL SAMPLING SUMMARY OF EXCEEDANCES
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

						Number of Exceedances							
Analyte	Maximum Detected Concentration		Location of Maximum Concentration	Number of Samples	Number of Detections	Residential Direct Contact		Non-Residential Direct Contact		Impact to Groundwater		Background	Evaluated as COPC in Risk Assessment? ⁽⁴⁾
						NJDEP RDCSRS ⁽¹⁾	USEPEA Residential RSL (HQ =0.1) ⁽²⁾	NJDEP NRDCSRS ⁽¹⁾	USEPA Industrial RSL (HQ=0.1) ⁽²⁾	NJDEP Impact to Groundwater ⁽¹⁾	USEPA Groundwater Protection RSL Risk Based ⁽²⁾	Maximum Background (Weston, 1995) ⁽³⁾	
Volatile Organic Compounds (µg/kg)													
Acetone	24,000		B-1	66	1	0	0	NLE	0	0	1	n/a	No
Methylene Chloride	1000		B-1	66	1	0	0	0	0	0	1	n/a	No
Ethylbenzene	49	J	B-49	66	1	0	0	0	0	0	1	n/a	No
TICs	12,000		B-43	66	4	NLE	NLE	NLE	NLE	NLE	NLE	n/a	No
Semi-Volatile Organic Compounds (µg/kg)													
4-Methylphenol	130	J	B-13	66	1	0	0	0	0	NLE	1	n/a	No
Naphthalene	770		B-9	66	6	0	0	0	0	0	6	n/a	No
2-Methylnaphthalene	420	J	B-19	66	6	0	0	0	0	0	6	n/a	No
Acenaphthylene	110	J	B-10	66	4	NLE	NLE	0	NLE	NLE	NLE	n/a	Yes
Acenaphthene	1800		B-9	66	1	0	0	0	0	0	1	n/a	No
Dibenzofuran	540	J	B-9	66	2	NLE	0	NLE	0	NLE	2	n/a	No
Diethylphthalate	330	JB ⁽⁵⁾	B-24	66	10	0	0	0	0	0	0	n/a	No
Fluorene	1000		B-9	66	3	0	0	0	0	0	1	n/a	No
Phenanthrene	6300		B-9	66	42	NLE	NLE	0	NLE	NLE	NLE	n/a	Yes
Anthracene	1800		B-9	66	8	0	0	0	0	0	0	n/a	No
Di-n-butylphthalate	3700		B-47	66	59	0	0	0	0	0	57	n/a	No
Fluoranthene	6600		B-9	66	49	0	0	0	0	0	0	n/a	No
Pyrene	6200		B-9	66	50	0	0	0	0	0	7	n/a	No
Benzo[a]anthracene	3700		B-9	66	40	5	19	1	1	3	40	n/a	Yes
Chrysene	4600		B-9	66	52	0	0	0	0	0	5	n/a	No
bis(2-Ethylhexyl)phthalate	10,537,588	EBD	B-20	66	62	7	7	6	6	6	7	n/a	No
Benzo[b]fluoranthene	4000		B-9	66	36	4	16	1	1	1	36	n/a	Yes
Benzo[k]fluoranthene	2100		B-9	66	44	0	1	0	0	0	8	n/a	Yes
Benzo[a]pyrene	3500		B-9	66	36	17	36	17	15	16	36	n/a	Yes
Indeno[1,2,3-cd]pyrene	1900		B-9	66	21	2	13	0	0	0	8	n/a	Yes
Dibenz[a,h]anthracene	690		B-9	66	5	3	5	3	3	0	5	n/a	Yes
Benzo[g,h,i]perylene	1600		B-9	66	23	0	NLE	0	NLE	0	NLE	n/a	Yes
Total TICs	89,000		B-27	66	55	NLE	NLE	NLE	NLE	NLE	NLE	n/a	No
Pesticides/PCBs (mg/kg)													
4,4'-DDE	3.263		B-55	66	63	1	1	0	0	0	41	n/a	Yes
Endosulfan II	0.011		B-46	66	9	0	0	0	0	0	0	n/a	No
4,4'-DDD	3.056		B-55	66	52	1	1	0	0	0	49	n/a	Yes
4,4'-DDT	1.539		B-55	66	62	0	0	0	0	0	18	n/a	No
Metals (mg/kg)													
Aluminum	75,543		B-21	66	66	0	47	0	0	57	66	4	Yes
Antimony	25.19		B-34	66	65	0	1	0	0	1	65	65	Yes
Arsenic	266		B-34	66	66	11	66	11	66	11	66	5	Yes
Barium	301.5		B-34	66	66	0	0	0	0	0	64	41	No
Beryllium	47.37		B-40 DUP	66	66	1	1	0	0	54	15	2	Yes
Cadmium	6.102		B-34	66	5	0	0	0	0	1	5	5	No

TABLE 4.3
SOIL SAMPLING SUMMARY OF EXCEEDANCES
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Analyte	Maximum Detected Concentration		Location of Maximum Concentration	Number of Samples	Number of Detections	Number of Exceedances							Evaluated as COPC in Risk Assessment? ⁽⁴⁾
						Residential Direct Contact		Non-Residential Direct Contact		Impact to Groundwater		Background	
						NJDEP RDCSRS ⁽¹⁾	USEPEA Residential RSL (HQ =0.1) ⁽²⁾	NJDEP NRDCSRS ⁽¹⁾	USEPA Industrial RSL (HQ=0.1) ⁽²⁾	NJDEP Impact to Groundwater ⁽¹⁾	USEPA Groundwater Protection RSL Risk Based ⁽²⁾	Maximum Background (Weston, 1995) ⁽³⁾	
Calcium ⁽⁶⁾	9215		B-25	66	66	NLE	NLE	NLE	NLE	NLE	NLE	60	No
Chromium	1897		B-28	66	66	NLE	0	NLE	0	NLE	0	1	No
Cobalt	64.74		B-34	66	66	0	27	0	1	0	66	21	Yes
Copper	257.4		B-30	66	66	0	0	0	0	0	64	38	No
Iron ⁽⁶⁾	46,470		B-13	66	66	NLE	66	NLE	0	NLE	66	0	No
Lead	182.1		B-14	66	66	0	0	0	0	2	0	41	No
Magnesium ⁽⁶⁾	6329		B-13	66	66	NLE	NLE	NLE	NLE	NLE	NLE	0	No
Manganese	156.8		B-14	66	66	0	0	0	0	15	66	6	No
Mercury	0.118		B-55	66	66	0	0	0	0	1	66	66	No
Nickel	72.26		B-34	66	66	0	0	0	0	1	65	18	No
Potassium ⁽⁶⁾	14310		B-12	66	66	NLE	NLE	NLE	NLE	NLE	NLE	0	No
Selenium	244.4		B-34	66	13	0	1	0	0	1	13	1	Yes
Silver	4.833		B-34	66	1	0	0	0	0	1	1	1	No
Sodium ⁽⁶⁾	634.1		B-18	66	66	NLE	NLE	NLE	NLE	NLE	NLE	52	No
Thallium	242		B-34	66	1	1	1	1	1	1	1	1	Yes
Vanadium	133.4		B-18	66	66	2	27	0	0	NLE	66	2	Yes
Zinc	162.8		B-34	66	66	0	0	0	0	0	62	8	No

Notes:

(1) New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Remediation Standards (RDCSRS) and Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) (N.J.A.C 7:26D; amended May 7, 2012). Available at: <http://www.state.nj.us/dep/srp/regs/rs/>. NJDEP Non-Residential standard is based a risk of 1X 10E6 cancer or non-cancer HQ = 1.0.

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Soil (TR=1E-06, HQ = 0.1). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

(4) Analytes with no screening criteria (i.e., no limit established (NLE)) are carried through to the risk assessment as COPCs.

(5) B and BJ qualified data were treated as nondetected chemicals and are not considered COPCs.

(6) Essential nutrients (calcium, iron, magnesium, potassium, and sodium) are not considered COPCs.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram.

Dash (--) = only bckground concentrations for metals are being used as comparison criteria.

B = Analyte detected in both sample and blank.

COPC = contaminant of potential concern.

D = Results from dilution of sample.

DUP = Field duplicate sample.

E = Estimated value.

J = Estimated concentration exceeds the method detection limit (MDL) and is less than the reporting limit (RL).

n/a = all concentrations were less th

ND = not detected in any background sample, no background concentration available.

NLE = no limit established.

NJDEP criteria for Endrin are used for Endrin aldehyde.

USEPA RSL for Endosulfan is used for Endosulfan II.

USEPA RSL for Chromium III is used for Chromium.

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	 Background Concentration ⁽³⁾	M4MW05					M4MW06									
Round No.				LF1	LF2	LF3	LF4	LF5	LF1	LF2	LF3	LF4	LF5	LF5 Dup	LF6	LF6 Dup		
Date Collected:				10/6/2010	10/21/2010	2/7/2011	4/6/2011	7/5/2011	8/6/2010	8/20/2010	10/6/2010	2/7/2011	4/6/2011	4/6/2011	7/5/2011	7/5/2011		
ANALYTE / Lab ID:				1043101	1045301	1103702	1113304	1127804	1033301	1035601	1043006	1103701	1113303	1113302	1127803	1127802		
Metals (µg/L)																		
Aluminum	200	1600	121000	278	314	<200	<200	976	ND		48.6		<200	<200	<200	282	202	<200
Antimony	6	0.60	20.7	<6.0	<6.0	<6.0	<6.0	<6.0	ND		<4.8		<6.0	<6.0	<6.0	<6.0	<6.0	<6.0
Arsenic	3	0.05	89.3	<3.0	<3.0	<3.0	<3.0	<3.0	ND		0.83	ER	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Barium	6,000	290	699	<200	<200	<200	<200	<200	23.2		22.3		<200	<200	<200	<200	<200	<200
Beryllium	1	1.60	2.1	<1.0	<1.0	<1.0	<1.0	<1.0	0.198	ER	0.17	ER	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	4	0.69	9.50	<3.0	<3.0	<3.0	<3.0	<3.0	ND		<0.5		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Calcium	NLE	NLE	45400	<5000	<5000	<5000	5400	5750	ND		2430		<5000	<5000	<5000	<5000	<5000	<5000
Chromium	70	0.03	191	<10	<10	<10	<10	11.8	1.19	ER	<1.0		<10	<10	<10	<10	<10	<10
Cobalt	NLE	0.47	18.30	<50	<50	<50	<50	<50	ND		3.05		<50	<50	<50	<50	<50	<50
Copper	1300	62	65.6	<10	<10	<10	<10	<10	ND		<1.0		<10	<10	<10	<10	<10	<10
Iron	300	1,100	431000	514	642	<100	240	3130	ND		<43.0		<100	<100	290	771	515	390
Lead	5	NLE	22.7	<3.0	<3.0	<3.0	<3.0	<3.0	ND		<2.4		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Magnesium	NLE	NLE	62700	<5000	<5000	<5000	5510	<5000	ND		3260		<5000	<5000	<5000	<5000	<5000	<5000
Manganese	50	32	331	<15	<15	15.4	22.4	29.3	ND		9.97		<15	<15	<15	<15	<15	<15
Mercury	2	0.06	0.26	NA	NA	<0.20	<0.20	<0.20	ND		<0.05		NA	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel	100	30	187	10	10.4	11.3	15.2	14.8	7.51		8.67		<10	<10	10.5	12.3	11.8	11.2
Potassium	NLE	NLE	137000	<10000	<10000	<10000	<10000	<10000	ND		2660		<10000	<10000	<10000	<10000	<10000	<10000
Selenium	40	7.80	29.6	<10	<10	<10	<10	<10	NR		20.1		<10	<10	<10	<10	<10	<10
Silver	40	7.10	ND	<10	<10	<10	<10	<10	ND		0.57	ER	<10	<10	<10	<10	<10	<10
Sodium	50000	NLE	21500	<10000	<10000	<10000	<10000	<10000	ND		3120	ER	<10000	<10000	<10000	<10000	<10000	<10000
Thallium	0.5	0.02	5.50	<2.0	<2.0	<2.0	<2.0	<2.0	ND		<0.53		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Vanadium	NLE	6.30	108	<50	<50	<50	<50	<50	ND		<0.6		<50	<50	<50	<50	<50	<50
Zinc	2000	470	233	41.1	40.2	47.9	63.8	58.2	ND		43.5	ER	43.2	47.9	54	54.2	84.8	57.2

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.
(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).
(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

NA = Not analyzed.

ND = Not detected.

NLE = No limit established.

< = analyte not detected above method detection limit (MDL).

µg/L = micrograms per liter.

Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

Shaded cells = concentration exceeds USEPA Tapwater RSLs

Shaded cells = concentration exceeds the NJDEP GWQS and USEPA Tapwater RSLs.

Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW07																					
Round No.				46	46 Dup	47	47 Dup	48	49	50	51	51 Dup	52	52 Dup											
Date Collected:				1/8/2008	1/8/2008	4/3/2008	4/3/2008	7/10/2008	10/10/2008	3/12/2009	5/20/2009	5/20/2009	7/20/2009	7/20/2009											
ANALYTE / Lab ID:				8001003	8001002	8011003	8011002	8022803	8036103	9010503	9020703	9020702	9030303	9030302											
Metals (µg/L)																									
Aluminum	200	1600	121000	251		283		153		134		1540		970		125		379		382		784		782	
Antimony	6	0.60	20.7	<0.7		<0.7		<0.7		<0.7		<1.2		<1.2		5.24	ER	2.88	ER	1.3	ER	5.21	ER	<4.8	
Arsenic	3	0.05	89.3	<2.7		<2.7		<2.7		<2.7		<2.4		<2.4		9.05		7.36		5.37		5.28		14.8	
Barium	6,000	290	699	19.5		20.9		12.4		11.4		79.9		68.5		15.7		27.2		29.1		48.4		50.9	
Beryllium	1	1.60	2.1	0.326	ER	0.329	ER	0.134	ER	0.122	ER	0.604		0.597		<0.1		0.15	ER	0.154	ER	0.377	ER	0.35	ER
Cadmium	4	0.69	9.50	0.471	ER	0.678	ER	<0.2		<0.2		1.3	ER	0.278	ER	<0.2		<0.2		<0.2		0.906	ER	0.519	ER
Calcium	NLE	NLE	45400	9820		10400		5670		5640		28000		16900		7240		9180		9720		16600		17300	
Chromium	70	0.03	191	<0.2		<0.2		<0.2		<0.2		0.521	ER	2.56	ER	0.495	ER	1.79	ER	1.26	ER	<1.0		<1.0	
Cobalt	NLE	0.47	18.30	2.09		2.22		1.19		1.18		6.67		3.29		1.09		1.34	ER	1.27	ER	3.32		3.67	
Copper	1300	62	65.6	<0.5		<0.5		<0.5		<0.5		<0.7		<0.7		<0.7		<0.7		<0.7		<1.0		<1.0	
Iron	300	1,100	431000	<323		<323		<323		<323		507		5760		136		844		282	ER	528		407	ER
Lead	5	NLE	22.7	<0.7		<0.7		<0.7		<0.7		<1.3		<1.3		4.46	ER	2.5	ER	2.39	ER	<2.4		<2.4	
Magnesium	NLE	NLE	62700	2990		3150		1680		1700		8420		8380		2330		3650		3900		5620		5830	
Manganese	50	32	331	24.8		26.1		16.2		14.8		85.7		81.8		22.7		31.9		33.8		55.9		57.9	
Mercury	2	0.06	0.26	<0.13		<0.13		<0.13		<0.13		<0.073		<0.073		<0.073		<0.073		<0.073		0.06	ER	0.08	ER
Nickel	100	30	187	3.91	ER	3.76	ER	1.8	ER	1.79	ER	9.15		7.35		1.28	ER	3.96	ER	4.29	ER	7.86		7.5	
Potassium	NLE	NLE	137000	819	ER	858	ER	1130		1120		3000		3650		740	ER	1050		1090		1800		1850	
Selenium	40	7.80	29.6	<2.7		5.43	ER	<2.7		<2.7		8.64	ER	3.68	ER	32.1		<3.1		4.35	ER	21.1		28.8	
Silver	40	7.10	ND	<0.8		<0.8		<0.8		<0.8		<0.5		<0.5		<0.5		<0.5		<0.5		0.507	ER	<0.5	
Sodium	50000	NLE	21500	14500		16000		17800		15100		133000		44200		28900		42200		45300		82800		86400	
Thallium	0.5	0.02	5.50	<1.36		<1.36		<1.36		<1.36		<1.3		<1.3		<1.3		<1.3		<1.3		<1.3		<1.3	
Vanadium	NLE	6.30	108	<0.5		<0.63		<0.5		<0.5		0.892	ER	1.93	ER	0.21	ER	0.434	ER	0.517	ER	0.979	ER	<0.6	
Zinc	2000	470	233	<3.58		<3.58		<3.58		<3.58		137		81.4		20.1	ER	31.9		33.8		72.4		77.8	

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

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Shaded cells = concentration exceeds USEPA Tapwater RSLs

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Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW07																			
Round No.				53		53 Dup		54		54 Dup		LF1		LF2		LF3		LF4		LF5		LF6	
Date Collected:				11/4/2009		11/4/2009		1/6/2010		1/6/2010		4/6/2010		7/21/2010		10/6/2010		2/8/2011		4/6/2011		7/6/2011	
ANALYTE / Lab ID:				9043603		9043602		1000503		1000502		1012404		1031606		1043005		1104105		1113308		1128005	
Metals (µg/L)																							
Aluminum	200	1600	121000	833		861		457		496		<7.6		5000		1510		1170		349		2550	
Antimony	6	0.60	20.7	<4.8		<4.8		<4.8		7.58	ER	8.16		10.3	ER	<6.0		<6.0		<6.0		<6.0	
Arsenic	3	0.05	89.3	0.68	ER	<0.62		<0.62		<0.62		<0.62		<0.62		<3.0		<3.0		<3.0		<3.0	
Barium	6,000	290	699	54.8		54.1		23.4		24.1		34.2		199		<200		<200		<200		<200	
Beryllium	1	1.60	2.1	0.29	ER	0.285	ER	0.117	ER	0.108	ER	<0.04		1.28		<1.0		<1.0		<1.0		<1.0	
Cadmium	4	0.69	9.50	<0.5		<0.5		<0.5		<0.5		<0.5		1.51	ER	<3.0		<3.0		<3.0		<3.0	
Calcium	NLE	NLE	45400	20600		20300		11000		11200		37900		68600		25000		21200		10800		42900	
Chromium	70	0.03	191	<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<10		<10		<10		<10	
Cobalt	NLE	0.47	18.30	5.05		4.96		2.3		2.14		<0.4		10.8		<50		<50		<50		<50	
Copper	1300	62	65.6	<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<10		<10		<10		<10	
Iron	300	1,100	431000	2000		2580		332	ER	121		560		484	ER	1130		295		124		1510	
Lead	5	NLE	22.7	<2.4		<2.4		<2.4		<2.4		<2.4		<2.4		<3.0		<3.0		<3.0		<3.0	
Magnesium	NLE	NLE	62700	7420		7360		3500		3540		6110		25600		12500		7230		<5000		13800	
Manganese	50	32	331	84.3		84		33.5		34.8		5.03		282		138		92.3		31.3		188	
Mercury	2	0.06	0.26	<0.05		<0.05		<0.05		<0.05		<0.05		0.13	ER	NA		<0.20		<0.20		<0.20	
Nickel	100	30	187	8.44		8.44		5.17		5.45		0.672	ER	19.2		<10		<10		<10		15.9	
Potassium	NLE	NLE	137000	2040		2020		1540		1550		7400		3250		<10000		<10000		<10000		<10000	
Selenium	40	7.80	29.6	8.37	ER	<7.0		<7.0		<7.0		NR		83.4		<10		<10		<10		<10	
Silver	40	7.10	ND	<0.5		<0.5		1.25	ER	1.21	ER	3.01	ER	<0.5		<10		<10		<10		<10	
Sodium	50000	NLE	21500	90200		88800		39700		39400		6520		263000		36600		100000		23000		112000	
Thallium	0.5	0.02	5.50	<0.53		<0.53		<0.53		<0.53		<0.53		<0.53		<2.0		<2.0		<2.0		<2.0	
Vanadium	NLE	6.30	108	1.31	ER	3.06	ER	1.16	ER	1.07	ER	1.15	ER	1.01	ER	<50		<50		<50		<50	
Zinc	2000	470	233	84		82		10.8	ER	10.4	ER	2.48	ER	315		130		93.9		20.9		239	

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

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Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

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TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW08																	
Round No.				46		47		48		48 Dup		49		49 Dup		50		51		52	
Date Collected:				1/8/2008		4/3/2008		7/10/2008		7/10/2008		10/10/2008		10/10/2008		3/12/2009		5/20/2009		7/20/2009	
ANALYTE / Lab ID:				8001004		8011004		8022804		8022802		8036104		8036102		9010504		9020704		9030304	
Metals (µg/L)																					
Aluminum	200	1600	121000	<52		<52		<9.9		<9.9		259		784		<9.9		<9.9		8.15	ER
Antimony	6	0.60	20.7	48.8		20.7		1.73	ER	2.58	ER	4.1	ER	10.2		18.7		2.28	ER	<4.8	
Arsenic	3	0.05	89.3	<2.7		<2.7		<2.4		4.05	ER	<2.4		<2.4		109		20.2		24.8	
Barium	6,000	290	699	81.1		65.6		150		130		98		207		90.7		77.8		79.6	
Beryllium	1	1.60	2.1	0.171	ER	<0.1		<0.1		0.101	ER	0.272	ER	0.591		<0.1		<0.1		<0.04	
Cadmium	4	0.69	9.50	0.508	ER	0.917	ER	1.78	ER	1.26	ER	<0.2		0.204	ER	<0.2		<0.2		0.914	ER
Calcium	NLE	NLE	45400	79100		79400		72000		71500		50600		50600		75100		54300		63400	
Chromium	70	0.03	191	<0.2		<0.2		<0.3		<0.3		1.54	ER	5.56		0.32	ER	<0.3		<1.0	
Cobalt	NLE	0.47	18.30	<0.2		<0.2		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.4	
Copper	1300	62	65.6	<0.5		<0.5		<0.7		<0.7		<0.7		3.16	ER	<0.7		<0.7		<1.0	
Iron	300	1,100	431000	12400		9390		12200		8870		26800		41500		16300		18700		18000	
Lead	5	NLE	22.7	<0.7		<0.7		<1.3		<1.3		<1.3		<1.3		3.62	ER	2.58	ER	<2.4	
Magnesium	NLE	NLE	62700	10400		12000		18900		19200		8750		8600		10700		9020		15900	
Manganese	50	32	331	129		122		147		143		153		163		141		139		151	
Mercury	2	0.06	0.26	<0.13		<0.13		<0.073		<0.073		<0.073		<0.073		<0.073		<0.073		0.07	ER
Nickel	100	30	187	<0.3		<0.3		<0.5		<0.5		<0.5		<0.5		<0.5		<0.5		1.32	ER
Potassium	NLE	NLE	137000	7130		6900		10300		10600		8420		9140		6890		7030		8930	
Selenium	40	7.80	29.6	<2.7		<2.7		<7.43		<7.38		<3.1		<3.1		84.5		3.55	ER	13.3	
Silver	40	7.10	ND	<0.8		1.46	ER	1.62	ER	<1.21		<0.5		<0.5		<0.5		0.715	ER	2.45	ER
Sodium	50000	NLE	21500	25800		44700		128000		131000		20400		19300		35100		26300		88800	
Thallium	0.5	0.02	5.50	<1.36		<1.36		<1.3		<1.3		<1.3		<1.3		<1.3		<1.3		<1.3	
Vanadium	NLE	6.30	108	0.902	ER	0.821	ER	2	ER	1.67	ER	0.834	ER	3.19	ER	2	ER	0.654	ER	2.85	ER
Zinc	2000	470	233	<3.58		<3.58		<1.3		<1.3		8.44	ER	17.5	ER	5.25	ER	<1.3		<1.2	

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

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Detections are bolded

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Shaded cells = concentration exceeds USEPA Tapwater RSLs

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TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW08																	
Round No.				53		54		LF1		LF2		LF3		LF4		LF4 Dup	LF5		LF6		LF6 Dup
Date Collected:				11/4/2009		1/6/2010		4/6/2010		7/21/2010		10/6/2010		2/8/2011		2/8/2011	4/6/2011		7/6/2011		7/6/2011
ANALYTE / Lab ID:				9043604		1000504		1012405		1031604		1043003		1104103		1104102	1113306		1128003		1128002
Metals (µg/L)																					
Aluminum	200	1600	121000	3460		425		50.4		47.5		<200	<200	<200	<200	303	597				
Antimony	6	0.60	20.7	<4.8		4.94	ER	11.6		6.51	ER	<6.0	<6.0	<6.0	11.3	<6.0	<6.0				
Arsenic	3	0.05	89.3	4.36	ER	1.09	ER	3.61	ER	1.23	ER	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0				
Barium	6,000	290	699	883		42.3		18.8		34.7		<200	<200	<200	<200	<200	<200				
Beryllium	1	1.60	2.1	0.151	ER	<0.04		<0.04		<0.04		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0				
Cadmium	4	0.69	9.50	9.23		<0.5		<0.5		1.56	ER	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0				
Calcium	NLE	NLE	45400	117000		90600		76400		51500		69800	68500	67800	81400	44500	46000				
Chromium	70	0.03	191	20.5		<1.0		<1.0		<1.0		<10	<10	<10	<10	<10	<10				
Cobalt	NLE	0.47	18.30	<0.4		0.613		<0.4		<0.4		<50	<50	<50	<50	<50	<50				
Copper	1300	62	65.6	<1.0		<1.0		2.3	ER	<1.0		<10	<10	<10	<10	<10	<10				
Iron	300	1,100	431000	419000		4830		498		18900		15100	1020	1100	2850	20100	28300				
Lead	5	NLE	22.7	31.1		<2.4		<2.4		<2.4		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0				
Magnesium	NLE	NLE	62700	12000		11300		6230		7530		7650	6440	6390	9560	6320	6780				
Manganese	50	32	331	938		94.8		27.4		163		336	37.1	35.7	95.4	146	163				
Mercury	2	0.06	0.26	<0.05		<0.05		<0.05		0.16	ER	NA	<0.20	<0.20	<0.20	<0.20	<0.20				
Nickel	100	30	187	<0.4		3.05	ER	1.71	ER	<0.4		<10	<10	<10	<10	<10	<10				
Potassium	NLE	NLE	137000	8820		8390	ER	6060		8220		10300	<10000	<10000	<10000	<10000	<10000				
Selenium	40	7.80	29.6	<7.0		<7.0		NR		65.1		<10	<10	<10	<10	<10	<10				
Silver	40	7.10	ND	<0.5		4.02	ER	5.12		1.99	ER	<10	<10	<10	<10	<10	<10				
Sodium	50000	NLE	21500	22900		40400		40200		11500		48900	43500	42700	62500	1300	13700				
Thallium	0.5	0.02	5.50	<0.53		<0.53		<0.53		<0.53		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0				
Vanadium	NLE	6.30	108	63.6		2.72	ER	1.62	ER	<0.6		<50	<50	<50	<50	<50	<50				
Zinc	2000	470	233	69.9		<1.2		11	ER	3.08		<20	<20	<20	<20	<20	<20				

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

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Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Round No.	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW09															
				46		47		48		49		50		50 Dup		51		52	
				1/8/2008		4/3/2008		7/10/2008		10/10/2008		3/12/2009		3/12/2009		5/20/2009		7/20/2009	
ANALYTE / Lab ID:				8001005		8011005		8022805		8036105		9010505		9010502		9020705		9030305	
Metals (µg/L)																			
Aluminum	200	1600	121000	<52		<52		<9.9		12.8		<9.9		<9.9		<9.9		<7.6	
Antimony	6	0.60	20.7	<0.7		<0.7		<1.2		<1.2		15		12		3.71	ER	<4.8	
Arsenic	3	0.05	89.3	<2.7		<2.7		<2.4		<2.4		96		92		18.9		20.8	
Barium	6,000	290	699	62.4		50.7		37.2		65.9		63.5		67.3		44.4		63	
Beryllium	1	1.60	2.1	0.196	ER	<0.1		<0.1		0.188	ER	<0.1		<0.1		<0.1		<0.04	
Cadmium	4	0.69	9.50	0.343	ER	<0.2		0.27	ER	<0.2		<0.2		<0.2		<0.2		<0.5	
Calcium	NLE	NLE	45400	52300		51400		41100		46000		56700		55200		44300		51300	
Chromium	70	0.03	191	<0.2		<0.2		<0.3		0.561	ER	0.9	ER	<0.3		<0.3		<1.0	
Cobalt	NLE	0.47	18.30	<0.2		<0.2		<0.1		<0.1		<0.1		<0.1		<0.1		<0.4	
Copper	1300	62	65.6	<0.5		<0.5		<0.7		<0.7		<0.7		<0.7		<0.7		<1.0	
Iron	300	1,100	431000	9280		2880		904		7000		7280		8820		3790		7040	
Lead	5	NLE	22.7	<0.7		<0.7		<1.3		1.3		5	ER	6.81		2.02	ER	<2.4	
Magnesium	NLE	NLE	62700	7080		7560		6390		6800		8120		7890		6660		7130	
Manganese	50	32	331	68.6		41.8		6.82		22.1		90.8		106		75.7		38.4	
Mercury	2	0.06	0.26	<0.13		<0.13		<0.073		<0.073		<0.073		<0.073		<0.073		<0.05	
Nickel	100	30	187	<0.3		<0.3		<0.5		<0.5		<0.5		<0.5		0.993	ER	2.75	ER
Potassium	NLE	NLE	137000	8420		8350		7440		8340		9240		8930		7710		9270	
Selenium	40	7.80	29.6	<2.7		<2.7		7.62	ER	<3.1		87		73.3		4.73	ER	26.2	
Silver	40	7.10	ND	<0.8		<0.8		<0.5		<0.5		<0.5		<0.5		<0.5		1.22	ER
Sodium	50000	NLE	21500	12100		9240		6090		7660		11900		11100		6340		10000	
Thallium	0.5	0.02	5.50	<1.36		<1.36		<1.3		<1.3		<1.3		<1.3		2.02	ER	<1.3	
Vanadium	NLE	6.30	108	<0.5		0.542	ER	0.289	ER	<0.2		1.9	ER	1.39	ER	0.37	ER	0.84	ER
Zinc	2000	470	233	<3.58		<3.58		<1.3		3.59	ER	<1.3		2.77	ER	<1.3		<1.2	

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

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µg/L = micrograms per liter.

Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

Shaded cells = concentration exceeds USEPA Tapwater RSLs

Shaded cells = concentration exceeds the NJDEP GWQS and USEPA Tapwater RSLs.

Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW09																				
Round No.				53		54		LF1		LF1 Dup		LF2		LF2 Dup		LF3		LF3 Dup		LF4	LF5	LF6		
Date Collected:				11/4/2009		1/6/2010		4/6/2010		4/6/2010		7/21/2010		7/21/2010		10/6/2010		10/6/2010		2/7/2011	4/6/2011	7/5/2011		
ANALYTE / Lab ID:				9043605		1000505		1012403		1012402		1031603		1031602		1043002		1043001		1103703	1113305	1127805		
Metals (µg/L)																								
Aluminum	200	1600	121000	<7.6		<7.6		<7.6		<7.6		<7.6		<7.6		<200	<200	<200	<200	<200				
Antimony	6	0.60	20.7	<4.8		<4.8		11.6		8.16	ER	7.78	ER	9.64	ER	<6.0	<6.0	<6.0	<6.0	<6.0				
Arsenic	3	0.05	89.3	<0.62		<0.62		<0.62		<0.62		<0.62		0.98	ER	<3.0	<3.0	<3.0	<3.0	<3.0				
Barium	6,000	290	699	44		60.2		32		34.2		44.2		44.1		<200	<200	<200	<200	<200				
Beryllium	1	1.60	2.1	<0.04		<0.04		<0.04		<0.04		<0.04		<0.04		<1.0	<1.0	<1.0	<1.0	<1.0				
Cadmium	4	0.69	9.50	<0.5		<0.5		<0.5		<0.5		<0.5		<0.5		<3.0	<3.0	<3.0	<3.0	<3.0				
Calcium	NLE	NLE	45400	49800		59500		35800		37900		47500		48100		50200		51300		45200		53100		53600
Chromium	70	0.03	191	<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<10	<10	<10	<10	<10				
Cobalt	NLE	0.47	18.30	<0.4		<0.4		<0.4		<0.4		<0.4		<0.4		<50	<50	<50	<50	<50				
Copper	1300	62	65.6	<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<10	<10	<10	<10	<10				
Iron	300	1,100	431000	2430		7590		384		560		2290		2320		5940	6140	3480	7760	14700				
Lead	5	NLE	22.7	<2.4		<2.4		<2.4		<2.4		<2.4		<2.4		<3.0	<3.0	<3.0	<3.0	<3.0				
Magnesium	NLE	NLE	62700	7200		8360		5860		6110		7210		7350		6520	6710	6390	7210	7050				
Manganese	50	32	331	10.3		68.5		4.69	ER	5.03		18.4		18.2		43.2	44.9	<15	98.6	60.2				
Mercury	2	0.06	0.26	<0.05		<0.05		<0.05		<0.05		0.22	ER	0.47	ER	NA	NA	<0.20	<0.20	<0.20				
Nickel	100	30	187	0.524	ER	1.21	ER	<0.4		0.672	ER	<0.4		<0.4		<10	<10	<10	<10	<10				
Potassium	NLE	NLE	137000	8470		10200		6940		7400		7790		7940		<10000	<10000	<10000	<10000	<10000				
Selenium	40	7.80	29.6	17.7	ER	<7.0		NR		<7.0		62		72.7		<10	<10	<10	<10	<10				
Silver	40	7.10	ND	1.34		<0.5		3.01	ER	3.01	ER	<0.5		<0.5		<10	<10	<10	<10	<10				
Sodium	50000	NLE	21500	10100		11600		3950	ER	6520		6370		6760		<10000	<10000	<10000	10100	10100				
Thallium	0.5	0.02	5.50	<0.53		<0.53		<0.53		<0.53		<0.53		<0.53		<2.0	<2.0	<2.0	<2.0	<2.0				
Vanadium	NLE	6.30	108	1.03	ER	<0.6		0.718	ER	1.15	ER	<0.6		<0.6		<50	<50	<50	<50	<50				
Zinc	2000	470	233	<1.2		<1.2		1.26	ER	2.48	ER	<1.2		<1.2		<20	<20	<20	<20	<20				

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

NA = Not analyzed.

ND = Not detected.

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Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

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Shaded cells = concentration exceeds the NJDEP GWQS and USEPA Tapwater RSLs.

Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Round No.	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW10															
				46		47		48		49		50		51		52		53	
				1/8/2008		4/3/2008		7/10/2008		10/10/2008		3/12/2009		5/20/2009		7/21/2009		11/4/2009	
ANALYTE / Lab ID:				8001006		8011006		8022806		8036106		9010506		9020706		9030306		9043606	
Metals (µg/L)																			
Aluminum	200	1600	121000	122		<52		<9.9		<9.9		<9.9		<9.9		<7.6		<7.6	
Antimony	6	0.60	20.7	<0.7		<0.7		<1.2		2.52	ER	15.4		2	ER	<4.8		<4.8	
Arsenic	3	0.05	89.3	<2.7		5.11		<2.4		<2.4		61.5		17.6		17.7		<0.62	
Barium	6,000	290	699	1330		346		129		88.7		410		190		112		109	
Beryllium	1	1.60	2.1	2.65		0.472	ER	0.398	ER	0.342	ER	0.433	ER	0.32	ER	0.096	ER	<0.04	
Cadmium	4	0.69	9.50	5.74		5.9		2.9		<0.2		<0.2		<0.2		1.22	ER	<0.5	
Calcium	NLE	NLE	45400	32300		40100		29000		29000		45800		32400		33400		32300	
Chromium	70	0.03	191	0.529	ER	<0.2		<0.3		<0.3		0.833	ER	<0.3		<1.0		<1.0	
Cobalt	NLE	0.47	18.30	<0.2		<0.2		<0.1		<0.1		<0.1		<0.1		<0.4		<0.4	
Copper	1300	62	65.6	<0.5		<0.5		<0.7		<0.7		<0.7		<0.7		<1.0		<1.0	
Iron	300	1,100	431000	146000		54400		25600		22900		43500		36200		27900		27900	
Lead	5	NLE	22.7	<0.7		4.53	ER	2.13	ER	<1.3		11.6		1.78	ER	<2.4		<2.4	
Magnesium	NLE	NLE	62700	3720		6780		4050		4010		7740		4800		4680		4570	
Manganese	50	32	331	137		130		112		112		149		112		122		116	
Mercury	2	0.06	0.26	<0.13		<0.13		<0.073		<0.073		<0.073		<0.073		<0.05		<0.05	
Nickel	100	30	187	<0.3		0.309	ER	<0.5		<0.5		<0.5		<0.5		1.27	ER	<0.4	
Potassium	NLE	NLE	137000	8100		6680		7990		8430		6410		7060		8950		8740	
Selenium	40	7.80	29.6	<2.7		<2.7		<3.1		<3.1		52.7		4.61	ER	<7.0		<7.0	
Silver	40	7.10	ND	<0.8		8.31		3.72	ER	<0.5		<0.5		<0.5		4.14	ER	<0.5	
Sodium	50000	NLE	21500	10700		30800		10900		11200		38100		13200		12100		12800	
Thallium	0.5	0.02	5.50	<1.36		<1.36		<1.3		<1.3		<1.3		<1.3		<1.3		<0.53	
Vanadium	NLE	6.30	108	1.16	ER	<0.5		0.294	ER	<0.2		3.97	ER	0.36	ER	3.81	ER	3.77	ER
Zinc	2000	470	233	<3.58		<3.58		<1.3		3.22	ER	5.03	ER	<1.3		<1.2		1.45	ER

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

NA = Not analyzed.

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µg/L = micrograms per liter.

Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

Shaded cells = concentration exceeds USEPA Tapwater RSLs

Shaded cells = concentration exceeds the NJDEP GWQS and USEPA Tapwater RSLs.

Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.4
GROUNDWATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Round No.	NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSL ⁽²⁾	Background Concentration ⁽³⁾	M4MW10									
				54		LF1		LF2		LF3	LF4	LF5	LF6
				1/6/2010		4/6/2010		7/21/2010		10/6/2010	2/8/2011	4/6/2011	7/6/2011
ANALYTE / Lab ID:				1000506		1012406		1031605		1043004	1104104	1113307	1128004
Metals (µg/L)													
Aluminum	200	1600	121000	24.5	ER	<7.6		26.3		<200	<200	233	<200
Antimony	6	0.60	20.7	<4.8		7.3	ER	9.23	ER	<6.0	<6.0	<6.0	<6.0
Arsenic	3	0.05	89.3	1.4	ER	0.83	ER	1.12	ER	<3.0	<3.0	<3.0	<3.0
Barium	6,000	290	699	114		41.8		53.6		<200	<200	202	<200
Beryllium	1	1.60	2.1	<0.04		<0.04		<0.04		<1.0	<1.0	<1.0	<1.0
Cadmium	4	0.69	9.50	<0.5		<0.5		1.26	ER	<3.0	<3.0	<3.0	<3.0
Calcium	NLE	NLE	45400	74900		56400		40800		64300	72100	72800	44500
Chromium	70	0.03	191	<1.0		<1.0		<1.0		<10	<10	<10	<10
Cobalt	NLE	0.47	18.30	1.27	ER	0.559	ER	<0.4		<50	<50	<50	<50
Copper	1300	62	65.6	<1.0		1.34	ER	<1.0		<10	<10	<10	<10
Iron	300	1,100	431000	14800		<43.0		12000		15800	3270	46000	27600
Lead	5	NLE	22.7	<2.4		<2.40		<2.40		<3.0	<3.0	<3.0	<3.0
Magnesium	NLE	NLE	62700	15200		8610		6060		7720	13500	10100	5940
Manganese	50	32	331	248		70.7		128		159	223	152	148
Mercury	2	0.06	0.26	<0.05		<0.05		0.4	ER	NA	<0.20	<0.20	<0.20
Nickel	100	30	187	4.32	ER	3.54	ER	0.959	ER	<10	<10	<10	<10
Potassium	NLE	NLE	137000	5650		3220		6010		<10000	<10000	<10000	<10000
Selenium	40	7.80	29.6	<7.0		NR		59.8		<10	<10	<10	<10
Silver	40	7.10	ND	<0.5		3.13	ER	1.01	ER	<10	<10	<10	<10
Sodium	50000	NLE	21500	93500		79800		13500		26500	87200	91200	30300
Thallium	0.5	0.02	5.50	<0.53		<0.53		<0.53		<2.0	<2.0	<2.0	<2.0
Vanadium	NLE	6.30	108	0.882	ER	0.743	ER	<0.6		<50	<50	<50	<50
Zinc	2000	470	233	8.18	ER	27.6	ER	7.94		<20	45.4	70.1	<20

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs).

(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

NA = Not analyzed.

ND = Not detected.

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< = analyte not detected above method detection limit (MDL).

µg/L = micrograms per liter.

Detections are bolded

Shaded cells = concentration exceeds NJDEP GWQS

Shaded cells = concentration exceeds USEPA Tapwater RSLs

Shaded cells = concentration exceeds the NJDEP GWQS and USEPA Tapwater RSLs.

Shaded cells = concentration exceeds Weston (1995) background

TABLE 4.5
GROUNDWATER SAMPLING RESULTS FOR AUGUST 2013
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

WELL ID:					M4MW05		M4MW06		M4MW07		M4MW08		M4MW09		M4MW10	
DATE SAMPLED:		NJDEP GWQS ⁽¹⁾	USEPA Tapwater RSLs ⁽²⁾	 Background ⁽³⁾	20-Aug-2013		20-Aug-2013		20-Aug-2013		20-Aug-2013		20-Aug-2013		20-Aug-2013	
Interval (ft bgs):					5-20		5-20		6-16		4-19		7-22		3-18	
	Unit															
Volatile Organics - SW8260C																
Acetone	µg/L	6000	1,200		5.0	UJ	5.0	UJ	1.40	UJ	5.0	UJ	5.0	UJ	5.0	UJ
Napthalene	µg/L	300	0.14		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	0.28	BJ
Metals (Total) - SW6010C/SW7470A																
Aluminum	µg/L	200	1600	121000	90.5	J	31.3	J	125		25	U	25	U	25	U
Antimony	µg/L	6	0.60	20.70	4.0	U	2.9	BJ	2.5	BJ	4.4	BJ	4.1	BJ	4.0	U
Barium	µg/L	6000	290	699	22.2		18.4	J	16.9	J	27.7		48.9		60.7	
Beryllium	µg/L	1	1.60	2.10	0.399	BJ	0.29	BJ	0.30	U	0.30	U	0.30	U	0.30	U
Calcium	µg/L	NLE	NLE	45400	3,010		2,760		7,040		52,200		43,900		45500	
Chromium	µg/L	1300	0.03	191	1.4		1.1		0.348	J	0.195	J	1.0	U	1.0	U
Cobalt	µg/L	300	0.47	18.30	3.9		3.5		2.0	J	1.0	U	1.0	U	0.866	J
Iron	µg/L	NLE	1100	431000	201		18.1	J	3,260		19,800		5,600		9,160	
Magnesium	µg/L	NLE	NLE	62700	3,380		2,880		2,340		7,180		6,720		8,950	
Manganese	µg/L	50	NLE	331	12.3		7.8	J	32.5		272		50.6		163	
Nickel	µg/L	100	30	187	8.0		7.2		5.0	U	5.0	U	5.0	U	5.0	U
Potassium	µg/L	NLE	NLE	137000	2,400		2,580		1,480	J	7,510		7,520		4,220	
Selenium	µg/L	40	7.80	29.60	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	2.1	J
Silver	µg/L	40	7.10	ND	0.408	BJ	0.373	BJ	0.363	BJ	0.766	BJ	0.53	BJ	0.734	BJ
Sodium	µg/L	50000	NLE	21500	4,720		3,630		78,100		22000		5,860		58500	
Vanadium	µg/L	NLE	6.30	108	0.564	J	0.60	U	0.518	J	0.822	J	0.425	J	0.665	J
Zinc	µg/L	2000	470	233	33.7	B	40.5	B	46.6	B	4.0	U	4.0	U	3.7	BJ

Notes:

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards Specific Ground Water Quality Standards (GWQS) - Class IIA and Practical Quantitation Levels.

(http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(2) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(3) Background data from Weston. 1995. Site Investigation Report - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

B = The analyte was found in an associated blank at concentration above one half the LOQ, as well as in the sample.

BJ = Analyte detected, estimated concentration. Analyte also found in an associated blank at concentration above one half the LOQ.

ft bgs = feet below ground surface.

J = Analyte detected, estimated concentration.

NLE = No screening level established.

U = Analyte was not detected above the indicated limit of detection (LOD).

Detections are bolded.

Shaded cells = concentration exceeds NJDEP GWQS.

Shaded cells = concentration exceeds USEPA Tapwater RSL.

Shaded cells = concentration exceeds Weston (1995) background.

TABLE 4.6
GROUNDWATER SAMPLING SUMMARY OF EXCEEDANCES,
NOVEMBER 2009 – AUGUST 2013
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

						Number of Exceedances			Identification of COPCs		
Analyte	Maximum Concentration		Location of Maximum Concentration	Date of Maximum Concentration	Number of Samples ⁽¹⁾	Number of Detections	NJDEP GWQS ⁽²⁾	USEPA Tapwater RSL ⁽³⁾	Maximum Background (Weston, 1995) ⁽⁴⁾	Evaluated as COPC in Risk Assessment?	Rationale
Volatile Organic Compounds (µg/L)											
Acetone	1.40	UJ	M4MW07	8/20/2013	6	1	0	0	--	No	Less than tapwater RSL
Napthalene	0.28	BJ ⁽⁵⁾	M4MW10	8/20/2013	6	1	0	1	--	No	See footnote (5)
Metals (µg/L)											
Aluminum	5,000		M4MW07	7/21/2010	58	27	19	3	0	No	Less than maximum background
Antimony	11.6		M4MW08	4/6/2010	58	17	12	17	0	No	Less than maximum background
Arsenic	4.36	ER	M4MW08	11/4/2009	58	9	2	9	0	No	Less than maximum background
Barium	883		M4MW08	11/4/2009	58	29	0	1	1	No	Single exceedance of background is anomalous and not representative
Beryllium	1.28		M4MW07	7/21/2010	58	10	1	0	0	No	Less than tapwater RSL
Cadmium	9.23		M4MW08	11/4/2009	58	4	1	4	0	No	Less than maximum background
Calcium ⁽⁶⁾	117,000		M4MW08	11/4/2009	58	48	NLE ⁽⁷⁾	NLE	25	No	Essential nutrient
Chromium	20.5		M4MW08	11/4/2009	58	7	0	7	0	No	Less than maximum background
Cobalt	10.8		M4MW07	7/21/2010	58	13	0	13	0	No	Less than maximum background
Copper	2.30	ER	M4MW08	4/6/2010	58	2	0	0	0	No	Less than tapwater RSL
Iron ⁽⁶⁾	419,000		M4MW08	11/4/2009	58	NLE	45	32	0	No	Essential nutrient
Lead	31.10		M4MW08	11/4/2009	58	1	1	NLE	1	No	Single exceedance of background is anomalous and not representative
Magnesium ⁽⁶⁾	25,600		M4MW07	7/21/2010	58	46	NLE	NLE	0	No	Essential nutrient
Manganese	938		M4MW08	11/4/2009	58	48	27	33	2	No	Exceedances of background are anomalous and not representative
Mercury	0.47	ER	M4MW09	7/21/2010	58	5	0	5	2	No	Exceedances of background are anomalous and not representative
Nickel	19.20		M4MW07	7/21/2010	58	28	0	0	0	No	Less than tapwater RSL
Potassium ⁽⁶⁾	10,300		M4MW08	10/6/2010	58	28	NLE	NLE	0	No	Essential nutrient
Selenium	83.4		M4MW07	7/21/2010	58	9	5	8	5	No	Exceedances of background are anomalous and not representative
Silver	5.12		M4MW08	4/6/2010	58	18	0	0	18	No	Less than tapwater RSL
Sodium ⁽⁶⁾	263,000		M4MW07	7/21/2010	58	43	12	NLE	25	No	Essential nutrient
Thallium	n/a		n/a	n/a	58	0	0	0	0	No	All concentrations were <MDL or <LOQ
Vanadium	63.6		M4MW08	11/4/2009	58	20	NLE	1	0	No	Less than maximum background
Zinc	315		M4MW07	7/21/2010	58	37	0	0	2	No	Less than tapwater RSL

Notes:

(1) Data from the most recent 8 quarters of groundwater sampling are included here, plus data from August 2013. August 2013 data includes 6 primary samples.

(2) New Jersey Department of Environmental Protection Ground Water Quality Standards, Specific Ground Water Quality Criteria - Class IIA and Practical Quantitation Levels. (http://www.state.nj.us/dep/wms/bwqsa/Appendix_Table_1.htm)

(3) U.S. Environmental Protection Agency, Regional Screening Levels (RSLs). Residential Tapwaters (TR=1E-06, THQ = 0.1). (http://www.epa.gov/reg3hwm/risk/human/rb-concentration_table/Generic_Tables/index.htm). Revised November 2013.

(4) Weston, 1995. Final Site Investigation - Main Post and Charles Wood Areas, Fort Monmouth, New Jersey, December.

(5) B and BJ qualified data were treated as nondetected chemicals and are not considered COPCs.

(6) Essential nutrients (calcium, iron, magnesium, potassium, and sodium) are not considered COPCs.

(7) If there is NLE for an analyte, it is considered a COPC. Essential nutrients (calcium, iron, magnesium, potassium, and sodium) are not considered COPCs.

µg/L = micrograms/liter.

COPC = contaminant of potential concern.

Dash (--) = only background concentrations for metals are being used as comparison criteria.

BJ = Analyte detected, estimated concentration. Analyte also found in an associated blank at concentration above one half the LOQ.

ER = Estimated Result.

UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.

n/a = not applicable.

NLE = No limit established.

TABLE 4.7
SURFACE WATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP Saline Water (SE) criteria ⁽¹⁾	USEPA National Recommended Water Quality Criteria ⁽²⁾	SS-5																						
Date Collected			3/13/2007	6/26/2007	9/13/2007	12/19/2007	3/25/2008	6/26/2008	9/30/2008	12/29/2008	3/24/2009	6/29/2009	9/25/2009	12/7/2009	3/28/2010	6/22/2010	9/21/2010								
Round Number			42	43	44	45	46	47	48	49	50	51	52	53	54	55	56								
Analyte/Lab ID			70093.15	70234.04	70339.15	70541.15	80094.05	80213.15	80346.06	80478.06	90119.06	90268.06	90398.06	90472.06	10110.05	10277.06	10402.06								
Volatile Organic Compounds (µg/L)																									
Acetone	NLE	NLE	1.31	J	7.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
cis -1,2-Dichloroethene	NLE	NLE	0.79	J	ND	0.67	J	ND	0.79	J	1.5	J	0.6	J	0.58	J	ND	1.02	J	ND	0.41	J	0.79	0.91	0.95
Methyl tert -butyl ether	NLE	NLE	0.44	J	ND	0.33	J	ND	0.66	J	0.34	J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
tert -Butyl alcohol	NLE	NLE	ND	ND	8.65	J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Tetrachloroethene	1.6	3.3	1.86	J	ND	0.29	0.84	J	1.4	J	1.15	J	ND	0.97	J	0.47	J	1.24	J	ND	0.61	2.19	1	0.42	J
Trichloroethene	12	30	0.58	J	ND	ND	ND	0.6	J	0.55	J	ND	ND	ND	0.5	J	ND	ND	0.64	0.37	J	0.24	J	0.24	J
TICs	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	0	ND	ND	ND	ND	ND	ND	ND	
Metals (µg/L)																									
Antimony	640	640	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	0.061	0.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Barium	NLE	1000	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Beryllium	42.0	NLE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cadmium	16	NLE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chromium	750	NLE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Copper	NLE	1300	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lead	NLE	NLE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mercury	0.051	NLE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nickel	1,700	4600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Selenium	4200	4200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0.47	0.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Wet Chemistry																									
Ammonia (mg/L)	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fecal Coliform (cfu/100mL)	NLE	NLE	NA	4500	3200	50	20	100	300	120	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrates (mg/L)	NLE	10	*	ND	ND	ND	NA	4.02	5.92	ND	ND	ND	0.689	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Oxygen (dissolved; mg/L)	NLE	NLE	7.73	6.46	6.54	4.74	8.58	8.07	8.44	7.38	7.73	6.51	6.73	3.84	4.3	6.24	3.91								
pH	NLE	NLE	7.37	6.52	7.59	7.36	7.76	8.54	6.94	7.22	7.6	7.94	6.26	6.78	6.59	6.54	6.57								
Phosphate (mg/L)	NLE	NLE	ND	ND	ND	NA	0.09	ND	ND	ND	0.02	ND	NA	NA	NA	NA	NA								
Sulfate (mg/L)	NLE	NLE	26.6	19	226	NA	22.9	64.4	43	29.4	93.2	23.7	NA	NA	NA	NA	NA								
Temperature (°C)	NLE	NLE	11.56	27.3	20.9	5.89	10	23.25	19.22	7.78	8.46	23.16	20.32	4.26	6.85	23.79	21.62								
Total Coliform (cfu/100mL)	NLE	NLE	500	37500	12400	700	100	5760	1450	500	160	NA	NA	NA	NA	NA	NA								

Notes:

(1) New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (N.J.A.C. 7:9B), Human Health standards for Saline Waters of estuaries (SE).

(2) United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria (Human Health Criteria, Organism Only).

B = Compound detected in the sample and its associated blank sample.

ER = Estimated result.

J = Estimated concentration exceeds the MDL and is less than the RL.

mg/L = milligrams/liter; µg/L = micrograms/liter; cfu/100 mL = colony-forming units/100 milliliters.

NA = Not analyzed.

ND = Not detected.

NLE = No limit established.

* = Water + Organism.

Detections are Bolded.

Shaded cells = concentration exceeds NJDEP Saline Criterion.

Shaded cells = concentration exceeds USEPA National Recommended Water Quality Criteria.

Shaded cells = concentration exceeds NJDEP and USEPA criteria.

TABLE 4.7
SURFACE WATER SAMPLING RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	NJDEP Saline Water (SE) criteria ⁽¹⁾	USEPA National Recommended Water Quality Criteria ⁽²⁾	SS-15																													
Date Collected			3/13/2007	6/26/2007	9/13/2007	12/19/2007	3/25/2008	6/26/2008	9/30/2008	12/29/2008	3/24/2009	6/29/2009	9/25/2009	12/7/2009	3/28/2010	6/22/2010	9/21/2010															
Round Number			42	43	44	45	46	47	48	49	50	51	52	53	54	55	55															
Analyte/Lab ID			70093.06	70230.06	70339.06	70541.06	80094.11	80213.06	80346.12	80478.12	90119.12	90268.12	90398.12	90472.12	10110.11	10277.12	10402.12															
Volatile Organic Compounds (µg/L)																																
Acetone	NLE	NLE	0.92	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
cis -1,2-Dichloroethene	NLE	NLE	0.81	J	2.14		2.81		ND		1.35	J	2.89		0.88	J	0.94	J	0.96	J	1.33	J	1.92		0.7		1.04		1.96		2.81	
Methyl tert -butyl ether	NLE	NLE	0.47	J	ND		1	J	ND		0.88	J	0.63	J	ND		ND		ND		ND		0.18	J	0.24	J	ND		ND		ND	
tert -Butyl alcohol	NLE	NLE	ND		ND		20.81		14.52		ND		ND		ND		ND		ND		ND		9.16		ND		ND		ND		ND	
Tetrachloroethene	1.6	3.3	2.21		ND		1.54	J	0.93	J	2.42		2.28		ND		1.55	J	3.03		2.02		1.87		1.11		3.01		1.99		1.03	
Trichloroethene	12	30	0.65	J	ND		ND		ND		1.02	J	1.01	J	ND		ND		1.26	J	0.77	J	0.96		0.44	J	0.88		0.75		0.61	
TICs	NLE	NLE	ND		ND		ND		7		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Metals (µg/L)																																
Antimony	640	640	ND		ND		ND		ND		ND		ND		ND		17.8	ER	5.52		6.06		ND		6.44	ER	6.18	ER	10.8	ER		
Arsenic	0.061	0.14	ND		3.12	ER	ND		ND		3.37	ER	3.5	ER	ND		66.6		14.1		19.6		ND		1.45	ER	ND		1.13	ER		
Barium	NLE	1000	* 58.8		52.6		52.5		50.6		57.4		61.5		58.4		58.3		60.1		58.3		61.2		47.5		59.6		61.4		49.8	
Beryllium	42.0	NLE	0.156		ND		ND		0.106		ND		ND		0.247	ER	0.336	ER	ND		ND		ND		0.0702	ER	0.082	ER	ND		ND	
Cadmium	16	NLE	0.857	ER	0.435	ER	ND		0.879	ER	0.298	ER	ND		1.08	ER	0.471	ER	ND		ND		ND		0.608	ER	ND		ND		0.512	ER
Chromium	750	NLE	0.692	ER	0.432	ER	0.906	ER	1.44	ER	0.433	ER	0.758	ER	3.66	ER	3.37	ER	0.838	ER	0.628		ND		3.85	ER	1.07	ER	ND		ND	
Copper	NLE	1300	* ND		1.84	ER	0.801	ER	2.5	ER	2	ER	ND		ND		ND		1.45	ER	2.49		4.6		ND		ND		2.49	ER	1.4	ER
Lead	NLE	NLE	ND		ND		ND		ND		1.49	ER	ND		5.74		2.59	ER	ND		ND		ND		ND		ND		ND		ND	
Mercury	0.051	NLE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.18	ER	ND		ND		ND	
Nickel	1,700	4600	9.76		6.09		6.44		14.4		13		6.15		10.6		11.9		11.2		12		9.18		8.05		16		8.07		8.88	
Selenium	4200	4200	7.29	ER	6.39	ER	ND		ND		ND		6.62	ER	8.61	ER	ND		104		24.3		24.5		ND		NR		NR		NR	
Thallium	0.47	0.47	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Wet Chemistry																																
Ammonia (mg/L)	NLE	NLE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NA		NA		NA		NA		NA	
Fecal Coliform (cfu/100mL)	NLE	NLE	NA		100		2000		50		ND		ND		50		20		ND		NA		NA		NA		NA		NA		NA	
Nitrates (mg/L)	NLE	10	* 1.05		ND		ND		NA		2.76		5.97		ND		ND		ND		ND		NA		NA		NA		NA		NA	
Oxygen (dissolved; mg/L)	NLE	NLE	8.41		6.94		6.54		3.01		9.47		8.28		7.55		6.99		7.85		8.08		8.61		4.65		4.45		7.86		4.67	
pH	NLE	NLE	6.87		6.86		7.81		6.63		7.87		8.22		6.97		7.09		7.11		7.42		7.05		7.21		6.96		7.34		5.92	
Phosphate (mg/L)	NLE	NLE	ND		ND		ND		NA		0.07		ND		ND		ND		0.03		ND		NA		NA		NA		NA		NA	
Sulfate (mg/L)	NLE	NLE	30		20.9		22.8		NA		21.2		17.63		18.4		19.1		29		18.9		NA		NA		NA		NA		NA	
Temperature (°C)	NLE	NLE	8.21		22.3		18.7		4.82		8.62		23.47		17.6		8.33		6.59		23.58		18.31		4.79		7.5		22.74		16.01	
Total Coliform (cfu/100mL)	NLE	NLE	600		2450		11400		800		120		4080		2650		600		1460		NA		NA		NA		NA		NA		NA	

Notes:

(1) New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (N.J.A.C. 7:9B), Human Health standards for Saline Waters of estuaries (SE).

(2) United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria (Human Health Criteria, Organism Only).

B = Compound detected in the sample and its associated blank sample.

ER = Estimated result.

J = Estimated concentration exceeds the MDL and is less than the RL.

mg/L = milligrams/liter; µg/L = micrograms/liter; cfu/100 mL = colony-forming units/100 milliliters.

NA = Not analyzed.

ND = Not detected.

NLE = No limit established.

* = Water + Organism.

Detections are Bolded.

Shaded cells = concentration exceeds NJDEP Saline Criterion.

Shaded cells = concentration exceeds USEPA National Recommended Water Quality Criteria.

Shaded cells = concentration exceeds NJDEP and USEPA criteria.

TABLE 4.8
SURFACE WATER SAMPLING SUMMARY OF EXCEEDANCES, DECEMBER 2008 - SEPTEMBER 2010
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

	Maximum Concentration	Location of Maximum Concentra- tion	Date of Maximum Concentration	Number of Samples ⁽¹⁾	Number of Detections	Number of Exceedances		Identification of COPCs
						NJDEP Saline Water (SE) Criteria ⁽²⁾	USEPA National Recommended Water Quality Criteria ⁽³⁾	
Volatile Organic Compounds (µg/L)								
Acetone	n/a		n/a	n/a	16	0	0	No
cis-1,2-Dichloroethene	2.81		SS-15	9/21/2010	16	14	0	No
Methyl tert-butyl ether	0.24	J	SS-15	3/28/2010	16	2	0	No
tert-Butyl alcohol	9.16		SS-15	12/7/2009	16	1	0	No
Tetrachloroethene	3.03		SS-15	3/24/2009	16	15	6	No
Trichloroethene	1.26	J	SS-15	3/24/2009	16	11	0	No
TICs	8		SS-5	9/28/2009	16	2	0	No
Metals (µg/L)								
Antimony	17.8	ER	SS-15	3/24/2009	8	6	0	No
Arsenic	66.6		SS-15	3/24/2009	8	5	5	No
Barium	61.4		SS-15	6/22/2010	8	8	0	No
Beryllium	0.336	ER	SS-15	12/29/2008	8	3	0	No
Cadmium	0.608	ER	SS-15	12/7/2009	8	3	0	No
Chromium	3.85	ER	SS-15	12/7/2009	8	5	0	No
Copper	4.6		SS-15	9/25/2009	8	5	0	No
Lead	5.74		SS-15	12/9/2008	8	2	0	No
Mercury	0.18	ER	SS-15	12/7/2009	8	1	1	No
Nickel	16		SS-15	3/28/2010	8	8	0	No
Selenium	104		SS-15	3/24/2009	8	3	0	No
Thallium	n/a		n/a	n/a	8	0	0	No
Wet Chemistry								
Ammonia (mg/L)	n/a		n/a	n/a	16	0	0	No
Fecal Coliform (cfu/100mL)	120		SS-5	12/29/2008	16	2	0	No
Nitrates (mg/L)	0.689		SS-5	6/29/2009	16	1	0	No
Oxygen (dissolved; mg/L)	8.61		SS-15	9/25/2009	16	16	0	No
pH	7.94		SS-5	6/29/2009	16	16	0	No
Phosphate (mg/L)	0.03		SS-15	3/24/2009	16	2	0	No
Sulfate (mg/L)	93.2		SS-5	3/24/2009	16	6	0	No
Temperature (°C)	23.79		SS-5	6/22/2010	16	16	0	No
Total Coliform (cfu/100mL)	1460		SS-15	3/24/2009	16	4	0	No

Notes:

(1) The samples from the most recent eight quarters of surface water sampling are included in this summary.

(2) New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (N.J.A.C. 7:9B), Human Health standards for Saline Waters of estuaries (SE).

(3) U.S. Environmental Protection Agency, National Recommended Water Quality Criteria (NRWQC) Consumption of Water Plus Organisms, (<http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#hhtable>).

cfu/100 mL = colony-forming units/100 milliliters.

COPC = contaminant of potential concern.

ER = estimated result.

J = Estimated concentration exceeds the method detection limit (MDL) and is less than the reporting limit (RL).

mg/L = milligrams/liter.

µg/L = micrograms/liter.

n/a = all concentrations were less than the detection limit, therefore, no location of maximum value identified.

NLE = no limit established.

TABLE 4.9
SEDIMENT PCB RESULTS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Boring ID	Sample Depth (bgs)	Date Collected	Total PCBs (mg/kg)	Aroclor 1254 (mg/kg)
B-1	0-6"	4/13/2000	< 0.0124	< 0.007
	6"-12"	4/13/2000	< 0.0127	< 0.007
B-2	0-6"	4/13/2000	< 0.0128	< 0.007
	6"-12"	4/13/2000	< 0.0128	< 0.007
B-3	0-6"	4/13/2000	< 0.0128	< 0.007
	6"-12"	4/13/2000	< 0.0124	< 0.007
B-4	0-6"	4/13/2000	< 0.0109	< 0.006
	6"-12"	4/13/2000	< 0.0114	< 0.006
B-5	0-6"	4/13/2000	< 0.0139	< 0.007
	6"-12"	4/13/2000	0.051	0.051
	18"-24"	4/13/2000	< 0.0134	< 0.007
B-6	0-6"	4/13/2000	< 0.0123	< 0.006
	6"-12"	4/13/2000	< 0.0125	< 0.007

NJDEP RDCSRS	0.2	NLE
NJDEP NRDCSRS	1	NLE
USEPA RSL -Residential Soil	NLE	0.11
USEPA RSL - Non-Residential Soil	NLE	0.74

Notes:

PCBs = polychlorinated biphenyls

bgs = below ground surface

mg/kg = milligram per kilogram

NLE = No limit established

NJDEP = New Jersey Department of Environmental Protection

NRDCSRS = Non-Residential Direct Contact Soil Remediation Standards

RDCSRS = Residential Direct Contact Soil Remediation Standards

RSL = Regional Screening Level

USEPA = United States Environmental Protection Agency

TABLE 6.1
RISK RATIO CALCULATIONS FOR POTENTIAL EXPOSURE TO COPC IN SOIL
BY A FUTURE OUTDOOR WORKER
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

CAS No.	Compound	Exposure Point Concentration (units) (EPC)				USEPA Commercial Industrial Soil (HQ = 1.0) (units) ⁽¹⁾			Carcinogenic?	Industrial Non-Carcinogenic Risk Ratio (EPC/USEPA RSL)	Industrial Carcinogenic Risk Ratio (EPC/USEPA RSL)
						noncarcinogenic	carcinogenic				
	Semi-Volatile Organic Compounds										
208-96-8	Acenaphthylene	0.11	J	mg/kg	Max	--	NLE	mg/kg	--	--	--
56-55-3	Benzo(a)anthracene	3.7		mg/kg	Max	--	2.1	mg/kg	yes	--	2E-06
50-32-8	Benzo(a)pyrene	3.5		mg/kg	Max	--	0.21	mg/kg	yes	--	2E-05
205-99-2	Benzo(b)fluoranthene	4.0		mg/kg	Max	--	2.1	mg/kg	yes	--	2E-06
191-24-2	Benzo(g,h,i)perylene	1.6		mg/kg	Max	--	NLE	mg/kg	--	--	--
207-08-9	Benzo(k)fluoranthene	2.1		mg/kg	Max	--	21	mg/kg	yes	--	1E-07
53-70-3	Dibenz(a,h)anthracene	0.69		mg/kg	Max	--	0.13	mg/kg	yes	--	5E-06
193-39-5	Indeno(1,2,3-cd)pyrene	1.9		mg/kg	Max	--	2.1	mg/kg	yes	--	9E-07
85-01-8	Phenanthrene	6.3		mg/kg	Max	--	NLE	mg/kg	--	--	--
	PESTICIDES										
72-54-8	4,4'-DDD	3.056		mg/kg	Max	--	7.2	mg/kg	yes	--	4E-07
72-55-9	4,4'-DDE	3.263		mg/kg	Max	--	5.1	mg/kg	yes	--	6E-07
	METALS										
7429-90-5	Aluminum	75,543		mg/kg	Max	990,000	410	mg/kg	no	0.08	--
7440-36-0	Antimony	25		mg/kg	Max	410	410	mg/kg	no	0.06	--
7440-38-2	Arsenic	35		mg/kg	UCL	380	2.4	mg/kg	both	0.09	1E-05
7440-41-7	Beryllium	47		mg/kg	Max	2,000	6,900	mg/kg	both	0.02	7E-09
7440-48-4	Cobalt	65		mg/kg	Max	300	1,900	mg/kg	both	0.22	3.4E-08
7782-49-2	Selenium	244		mg/kg	Max	5,100	--	mg/kg	no	0.05	--
7440-28-0	Thallium	242		mg/kg	Max	10	--	mg/kg	no	24	--
7440-62-2	Vanadium	133		mg/kg	Max	5,100	--	mg/kg	no	0.03	--

Cumulative Risk Ratio (including Thallium)
Cumulative Risk Ratio (excluding Thallium)

25
1

4E-05

Notes:

⁽¹⁾ USEPA Regional Screening Level, Industrial Soil, (TR = 1E-06; THQ = 1.0), November 2013
(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/docs/composite_sl_table_run_NOV2013.pdf).

mg/kg - milligrams per kilogram

-- Not applicable

Max = Maximum detected concentration

UCL = 95% upper confidence limit on the mean.

TABLE 6.2
RISK RATIO CALCULATIONS FOR POTENTIAL EXPOSURE TO COPC IN SOIL
BY CURRENT AND FUTURE RECREATIONAL USERS
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

CAS No.	Compound	Exposure Point Concentration (units) (EPC)				USEPA Recreational User Soil (HQ = 1.0) (units) ⁽¹⁾			Carcinogenic?	Industrial Non-Carcinogenic Risk Ratio (EPC/USEPA rec user)	Industrial Carcinogenic Risk Ratio (EPC/USEPA rec user)
						noncarcinogenic	carcinogenic				
	Semi-Volatile Organic Compounds										
208-96-8	Acenaphthylene	0.11	J	mg/kg	Max	--	NLE	mg/kg	--	--	--
56-55-3	Benzo(a)anthracene	3.7		mg/kg	Max	--	8.41	mg/kg	yes	--	4E-07
50-32-8	Benzo(a)pyrene	3.5		mg/kg	Max	--	0.841	mg/kg	yes	--	4E-06
205-99-2	Benzo(b)fluoranthene	4.0		mg/kg	Max	--	8.41	mg/kg	yes	--	5E-07
191-24-2	Benzo(g,h,i)perylene	1.6		mg/kg	Max	--	NLE	mg/kg	--	--	--
207-08-9	Benzo(k)fluoranthene	2.1		mg/kg	Max	--	84.1	mg/kg	yes	--	2E-08
53-70-3	Dibenz(a,h)anthracene	0.69		mg/kg	Max	--	0.841	mg/kg	yes	--	8E-07
193-39-5	Indeno(1,2,3-cd)pyrene	1.9		mg/kg	Max	--	8.32	mg/kg	yes	--	2E-07
85-01-8	Phenanthrene	6.3		mg/kg	Max	--	NLE	mg/kg	--	--	--
	PESTICIDES										
72-54-8	4,4'-DDD	3.056		mg/kg	Max	--	61.6	mg/kg	yes	--	5E-08
72-55-9	4,4'-DDE	3.263		mg/kg	Max	--	43.5	mg/kg	yes	--	8E-08
	METALS										
7429-90-5	Aluminum	75,543		mg/kg	Max	6590000	--	mg/kg	no	0.01	--
7440-36-0	Antimony	25		mg/kg	Max	2650	--	mg/kg	no	0.01	--
7440-38-2	Arsenic	35		mg/kg	UCL	2870	18.6	mg/kg	both	0.01	2E-06
7440-41-7	Beryllium	47		mg/kg	Max	13200	344000	mg/kg	both	0.00	1E-10
7440-48-4	Cobalt	65		mg/kg	Max	1980	91800	mg/kg	both	0.03	7.1E-10
7782-49-2	Selenium	244		mg/kg	Max	33100	--	mg/kg	no	0.01	--
7440-28-0	Thallium	242		mg/kg	Max	66.2	--	mg/kg	no	4	--
7440-62-2	Vanadium	133		mg/kg	Max	33300	--	mg/kg	no	0.0040	--

Cumulative Risk Ratio (including Thallium)
Cumulative Risk Ratio (excluding Thallium)

4
0.1

8E-06

Notes:

⁽¹⁾ USEPA Regional Screening Level, Calculator for recreational user, site-specific exposure parameters, November 2013 (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

mg/kg - milligrams per kilogram

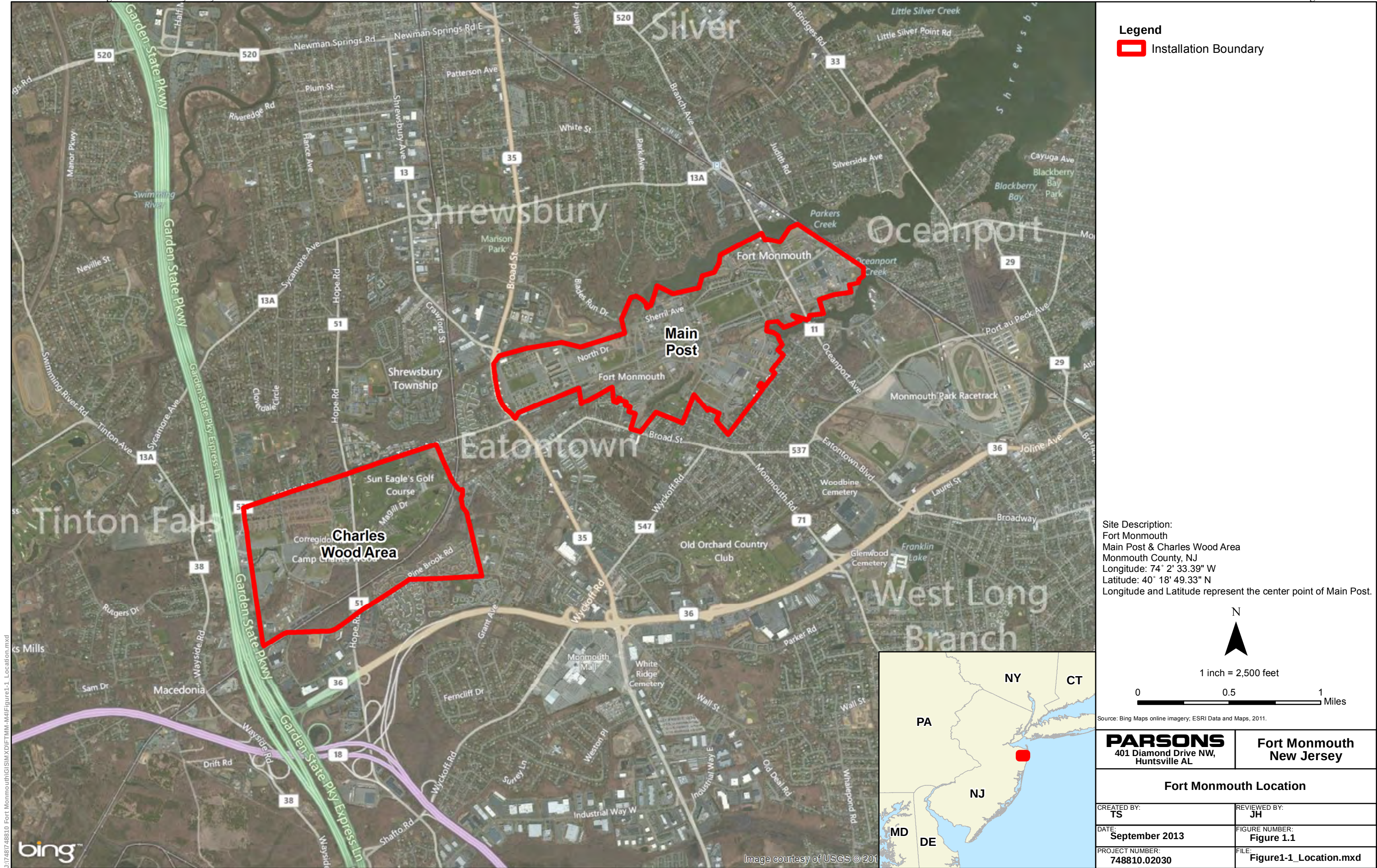
-- Not applicable

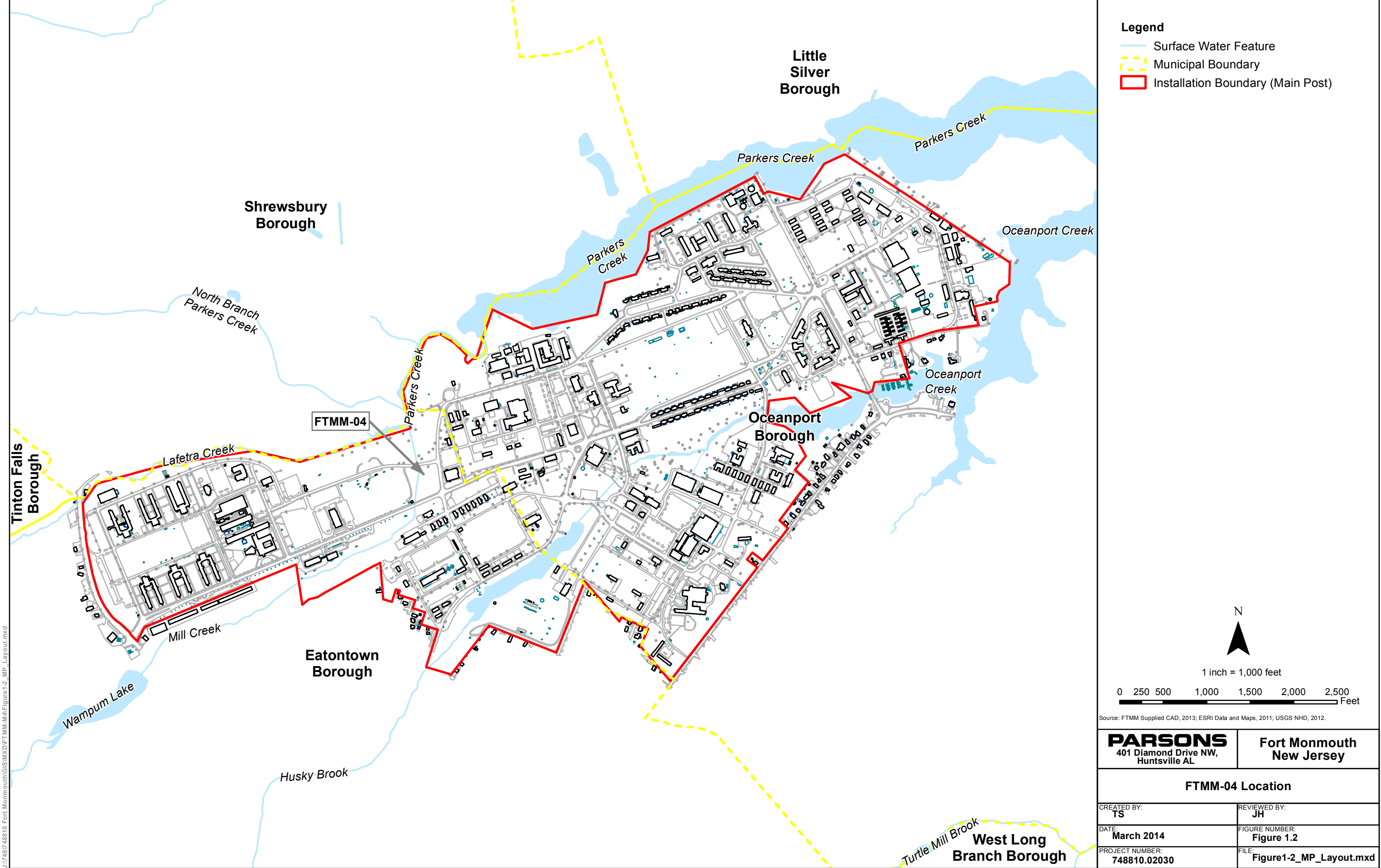
Max = Maximum detected concentration

UCL = 95% upper confidence limit on the mean.

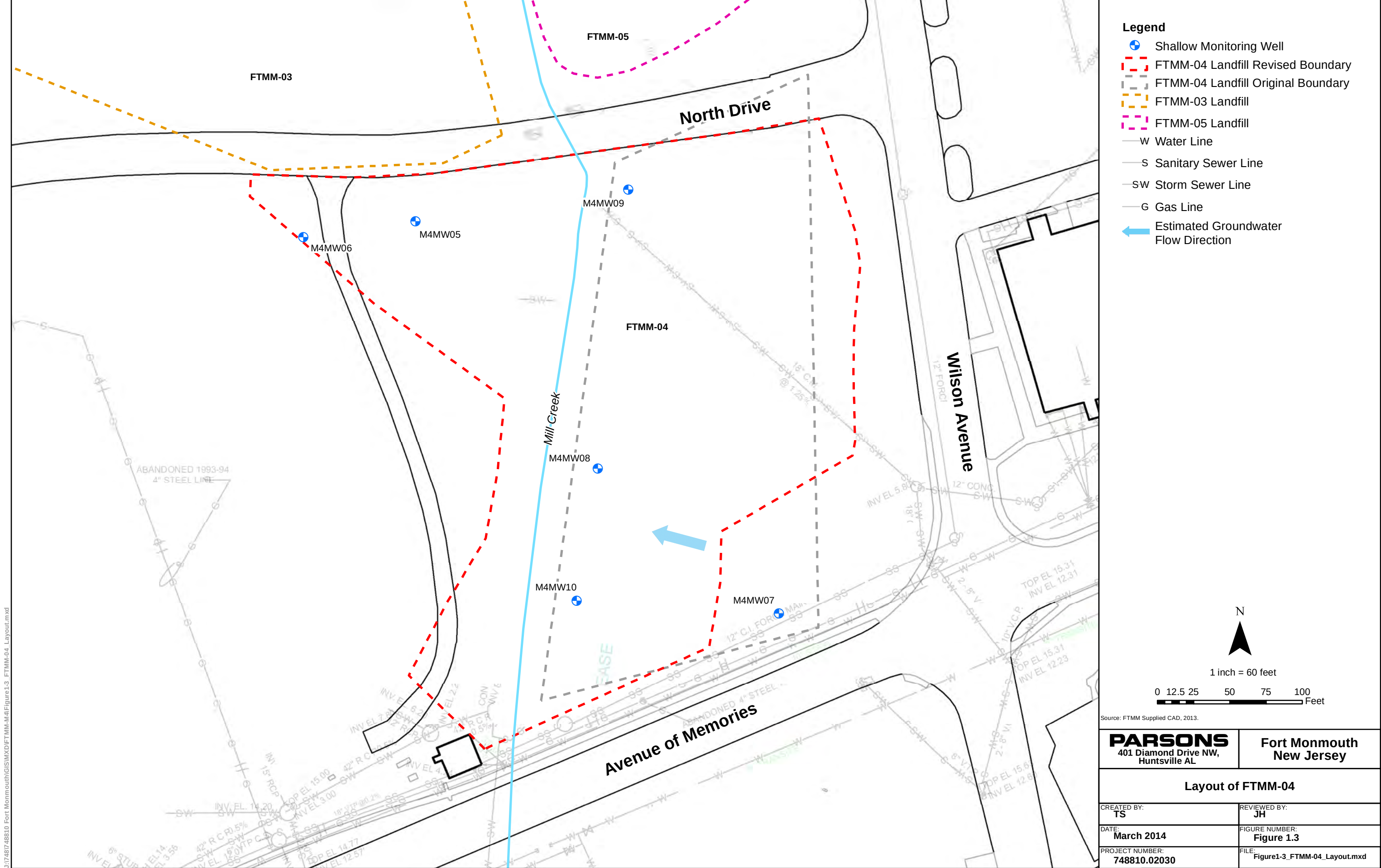
FIGURES

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3	Figure 1.1	Fort Monmouth Location
4	Figure 1.2	FTMM-04 Location
5	Figure 1.3	Layout of FTMM-04
6	Figure 2.1	FTMM-04 Soil Sample Locations
7	Figure 2.2	FTMM-04 Surface Water and Sediment Sample Locations
8	Figure 4.1	Determination of COPCs
9	Figure 6.1	Evaluation of Risk to Human Receptors
10	Figure 6.2	Human Health Conceptual Site Model

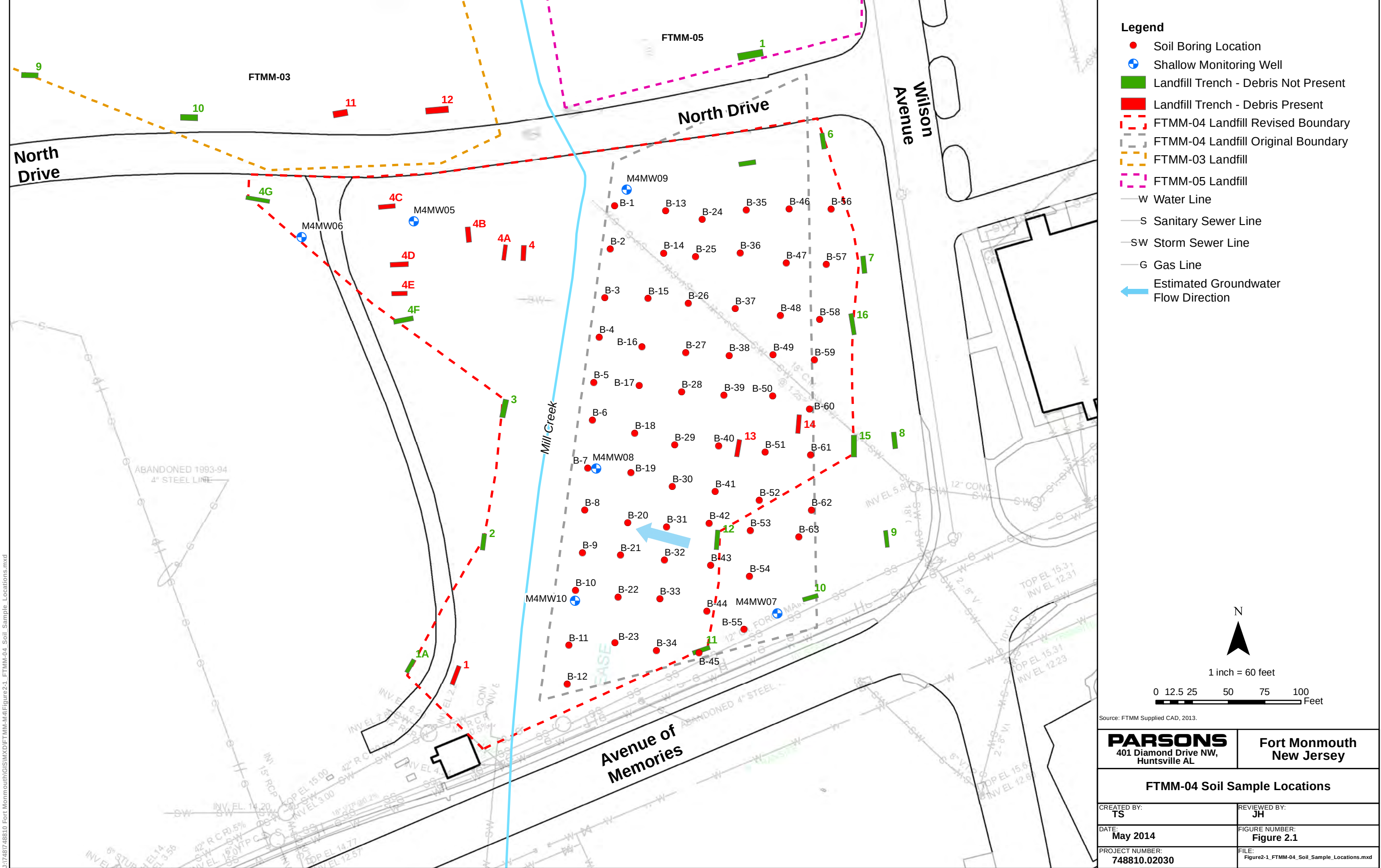




J:\174810\Fort Monmouth\GIS\MXD\FTMM-MA\Figure1-2_MP_Layout.mxd



3:17481748810 Fort MonmouthGIS\MXD\FTMM-MA\Figure1-3 FTMM-04_Layout.mxd



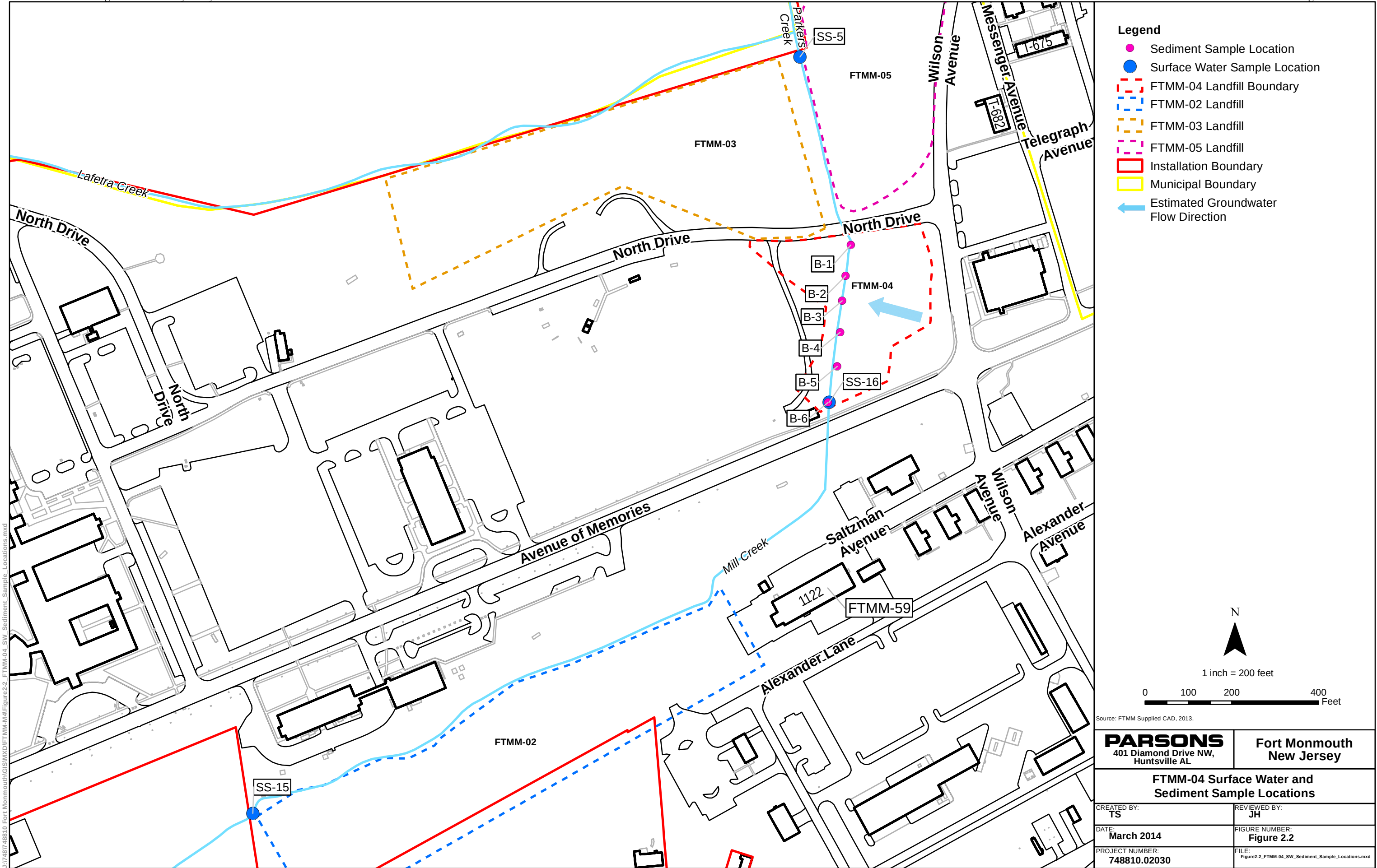


Figure 4.1
Determination of COPCs

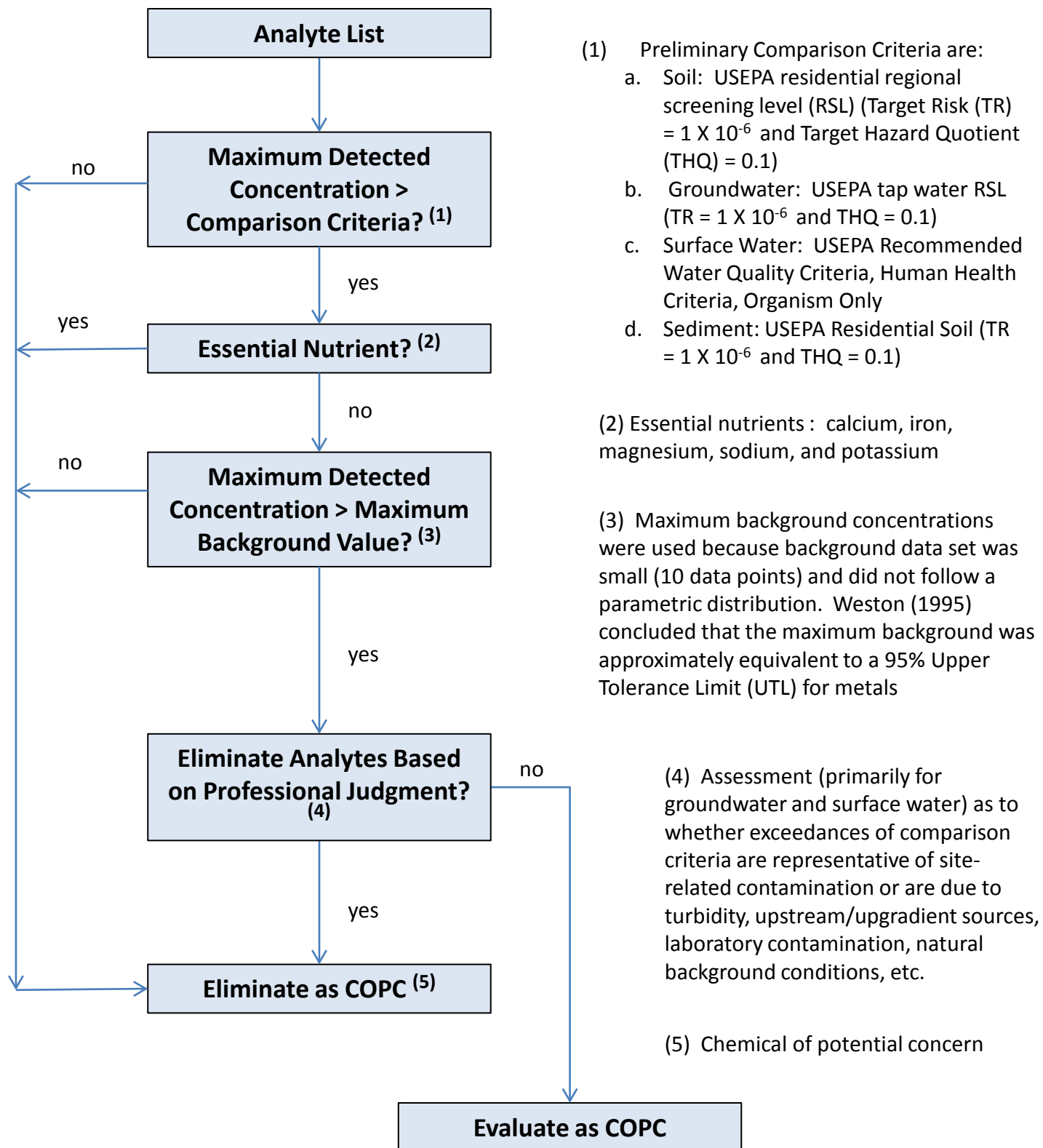


Figure 6.1
Evaluation of Risk to Human Receptors

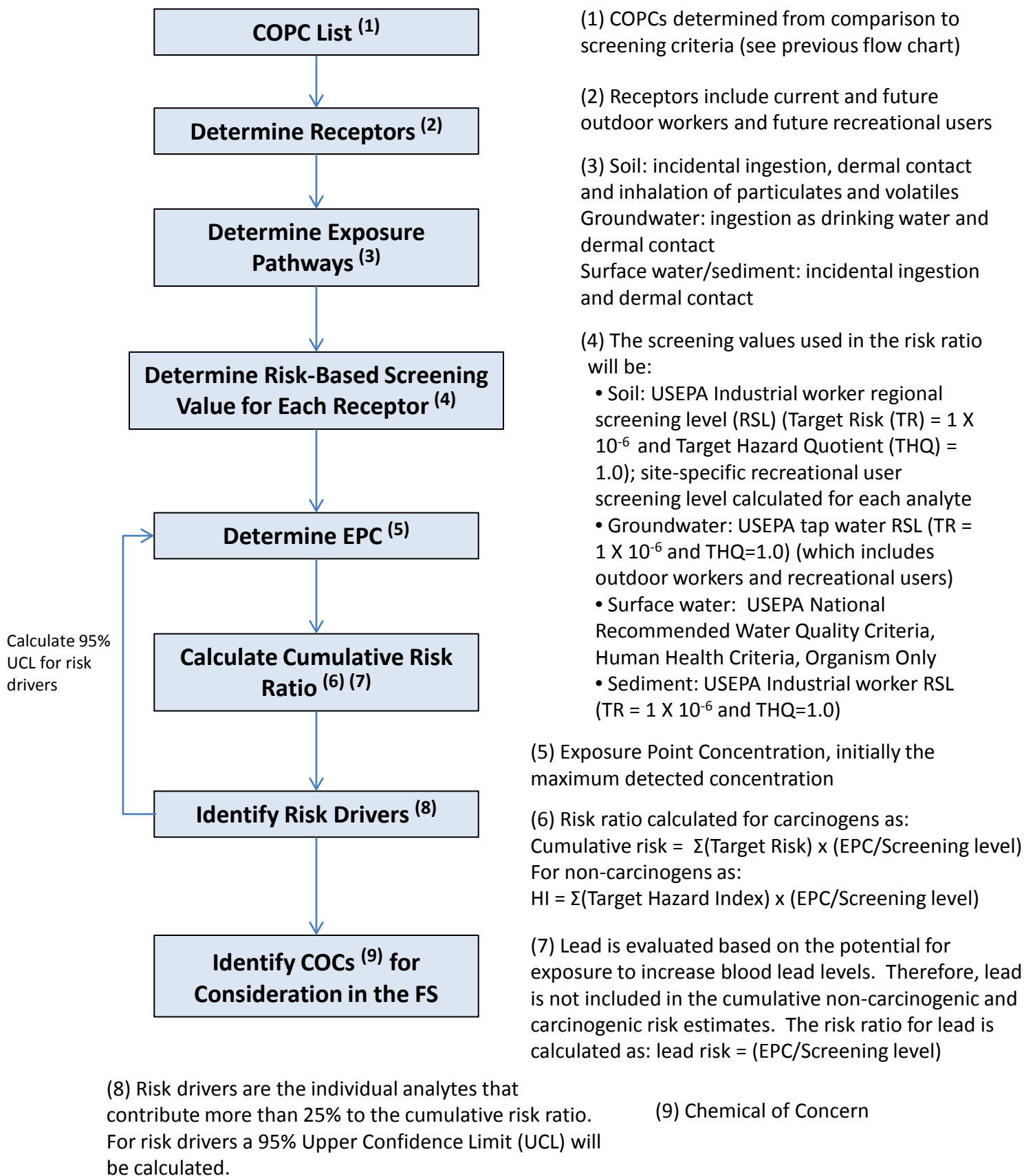


Figure 6.2
Human Health Conceptual Site Model
Site FTMM-04
Fort Monmouth, New Jersey

Potential Medium of Concern	Potential Route of Exposure	Potentially Exposed Population	Pathway Completeness and Assumptions
Soil	- Incidental ingestion of soil - Inhalation of volatiles and particulates from soil - Dermal contact with soil	- Current industrial receptor (outdoor worker) - Future industrial receptor (outdoor worker) - Future industrial receptor (indoor worker) - Current recreational user - Future recreational user	- FTMM-04 is a landfill that was used for building demolition debris disposal and has been inactive since 1956. It is currently vacant and unused with a stable vegetative cover established. FTMM-04 is undeveloped and there are no new development activities occurring. The Fort Monmouth Economic Redevelopment Planning Authority reuse plan calls for the Fort Monmouth landfills, including FTMM -04, to be designated as passive open space. - Current outdoor worker has a complete exposure pathway to soil via incidental ingestion, inhalation of volatiles and particulates, and dermal contact. An exposure frequency of 250 days per year and an exposure duration of 25 years are assumed for this scenario. Thus, it is a very conservative evaluation for a potential current outdoor industrial worker who would have much less exposure (<i>e.g.</i>, current worker that visits the site to perform mowing and landscaping activities). - Future outdoor worker has a complete exposure pathway to soil via incidental ingestion, inhalation of volatiles and particulates, and dermal contact. This pathway is not included in the risk ratio analysis because it is assumed to be conservatively evaluated under the current outdoor industrial worker scenario (based on the exposure frequency and exposure duration). - Future indoor worker has a complete exposure pathway to soil via incidental ingestion, inhalation of volatiles and particulates, and dermal contact. This pathway is not included in the risk ratio analysis because it is assumed to be conservatively evaluated under the current outdoor industrial worker scenario (future indoor industrial workers would have much less exposure to soil).

Figure 6.2
Human Health Conceptual Site Model
Site FTMM-04
Fort Monmouth, New Jersey

Potential Medium of Concern	Potential Route of Exposure	Potentially Exposed Population	Pathway Completeness and Assumptions
Soil (continued)			• Current recreational user has a complete exposure pathway to soil via incidental ingestion, inhalation of volatiles and particulates, and dermal contact. An exposure frequency of 50 days per year and an exposure duration of 24 years are assumed for this scenario. This potentially exposed population also includes persons who may be trespassing at the site, as they are expected to be on-site no more frequently than recreational users. • Future recreational user has a complete exposure pathway to soil via incidental ingestion, inhalation of volatiles and particulates, and dermal contact. This pathway is not included in the risk ratio analysis because it is assumed to be conservatively evaluated under the current recreational user scenario. • The site is not residential and is not planned for residential use. Therefore, residential exposure pathways are incomplete.

Figure 6.2
Human Health Conceptual Site Model
Site FTMM-04
Fort Monmouth, New Jersey

Potential Medium of Concern	Potential Route of Exposure	Potentially Exposed Population	Pathway Completeness and Assumptions
Groundwater	• Ingestion of groundwater as drinking water • Inhalation of volatiles in groundwater from use of groundwater in the home (<i>e.g.</i>, showering, laundering, and dish washing) • Inhalation of volatiles due to vapor intrusion of VOCs from shallow groundwater into indoor air	• Current industrial receptor (outdoor worker) • Future industrial receptor (outdoor worker) • Future industrial receptor (indoor worker)	• FTMM-04 is a landfill that was used for building demolition debris disposal and has been inactive since 1956. It is currently vacant and unused with a stable vegetative cover established. FTMM-04 is undeveloped and there are no new development activities occurring. The Fort Monmouth Economic Redevelopment Planning Authority reuse plan calls for the Fort Monmouth landfills, including FTMM-04, to be designated as passive open space. • No COPCs were identified in groundwater. Therefore, all groundwater exposure pathways are incomplete.

Figure 6.2
Human Health Conceptual Site Model
Site FTMM-04
Fort Monmouth, New Jersey

Potential Medium of Concern	Potential Route of Exposure	Potentially Exposed Population	Pathway Completeness and Assumptions
Surface Water/Sediment	• Ingestion of aquatic organisms (e.g., fish and shellfish) • Incidental ingestion of surface water/sediment • Inhalation of volatiles from surface water • Dermal contact with surface water/sediment	• Current industrial receptor (outdoor worker) • Future industrial receptor (outdoor worker) • Future recreational user	• Mill Creek flows north along the western boundary of FTMM-04. This creek is considered saline near the location of surface water sample SS5, located approximately 100 feet downgradient of FTMM-04. The surface water is not used as a drinking water resource. • No COPCs were identified in surface water or sediment. Therefore, all surface water and sediment exposure pathways are incomplete. • The site is not residential and is not planned for residential use. Therefore, residential exposure pathways are incomplete.

APPENDICES

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- 2
- 3 Appendix A Key Historical Reports and Background Information
- 4 Appendix B Recreational User Screening Level Calculations, Exposure Assumptions, and
- 5 ProUCL Output
- 6 Appendix C Cost Estimate

APPENDIX A
KEY HISTORICAL REPORTS AND BACKGROUND INFORMATION

- Groundwater Sampling Result Tables from May 1997 to October 2005, January 2006 to July 2007, October 2007 to July 2010, and August 2010
- Figure 2-6 Geologic Cross Section M-4 Landfill Site, Fort Monmouth NJ
- Figure 6-1 Regional Geologic Cross Section Site 1122 Main Post, Fort Monmouth NJ
- Fort Monmouth Concept Diagram: Land Use Plan in 2018 (10 Year Plan)
- M-4 Landfill (FTMM-04) Remedial Investigation Report Addendum (2nd Quarter 2001 through 3rd Quarter 2010), US Army, February 2012 (provided electronically on the report CD)

Table 5-1
Groundwater Sampling Results
Site M4MW06 (Aug10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	1	2
WELL ID				M4MW06	M4MW06
Date Collected				8/6/2010	8/20/2010
ANALYTE / Lab ID				10333.01	10356.01
Metals					
Antimony	6	µg/L	N/A	ND	ND
Arsenic	3	µg/L	N/A	ND	0.830 ER
Barium	6000	µg/L	699	23.2	22.3
Beryllium	1	µg/L	2.1	0.198 ER	0.170 ER
Cadmium	4	µg/L	N/A	ND	ND
Chromium	70	µg/L	191	1.19 ER	ND
Copper	1300	µg/L	65.6	ND	ND
Lead	5	µg/L	N/A	ND	ND
Mercury	2	µg/L	0.26	ND	ND
Nickel	100	µg/L	N/A	7.51	8.67
Selenium	40	µg/L	N/A	NR	NR

Notes:

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

ND - Analyte not detected in sample

NR - Not reported

Table 5-2
Groundwater Sampling Results
Site M4MW07 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	1	2	3	4	5	5	6	6	7	8	9
WELL ID				M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	MW07 Duplicate	M4MW07	MW07 Duplicate	M4MW07	M4MW07	M4MW07
Date Collected				5/6/1997	8/15/1997	10/24/1997	2/18/1998	5/6/1998	5/6/1998	7/9/1998	7/9/1998	10/29/1998	2/4/1999	4/23/1999
ANALYTE / Lab ID				2509.03	2906.04	3107.04	3347.03	3551.03	3551.06	3711.03	3711.06	4017.07	4245.03	4438.03
VOCs														
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	10.16	8.46	ND	7.39
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	4.0	12.0	10.0	11.0	ND	ND	ND	ND	ND	ND	ND
SVOCs														
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	5.96	60.77	2.28	8.18 B	ND	ND	ND	ND	ND	ND	ND
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	NLE	µg/L	N/A	0.34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	175.0	22.0	31.0	35.0	760.0	620.0	ND	ND	83.0	ND	18.0
Pesticides/PCBs														
4,4-DDE	0.1	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	0.0014	ND	ND	ND
4,4'-DDT	0.1	µg/L	N/A	ND	ND	ND	ND	ND	ND	0.0015	0.002	ND	ND	ND
Gamma-chlordane	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals														
Antimony	20	µg/L	N/A	ND	1.1	ND	ND	ND	2.8	5.45	3.54	3.96	ND	ND
Arsenic	8	µg/L	N/A	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	65.5	100.0	83.6	32.4	18.5	19.0	28.1	28.7	94.7	29.5	26.6
Beryllium	20	µg/L	2.1	0.32	0.52	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	0.6	0.6	0.73	ND	ND	ND	2.59
Chromium	100	µg/L	191	0.7	89.0	1.8	ND	1.4	1.1	ND	ND	1.22	4.28	2.7
Copper	1000	µg/L	65.6	23.0	6.0	12.0	12.0	ND	3.9	4.71	ND	ND	108.0	4.63
Lead	10	µg/L	N/A	ND	0.5	20.0	ND	ND	ND	7.96	4.85	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	7.8	7.8	5.4	5.9	4.31	4.89	6.09	14.6	5.79
Selenium	50	µg/L	N/A	3.0	ND	ND	ND	ND	ND	ND	4.61	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 ppb for

VOCs and SVOCs. No individual compound can exceed 100 ppb.

**NJDEP Groundwater Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Groundwater Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-2
Groundwater Sampling Results
Site M4MW07 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	10	11	12	13	14	14	15	16	17	18	19
WELL ID				M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	1W07 Duplicat	LF1 ⁽¹⁾	M4MW07	LF2 ⁽¹⁾	M4MW07	M4MW07
Date Collected				7/6/1999	10/5/1999	1/11/2000	5/1/2000	8/1/2000	8/1/2000	8/15/2000	10/12/2000	10/16/2000	1/3/2001	4/3/2001
ANALYTE / Lab ID				4591.01	4841.01	5088.01	5388.01	5584.04	5584.03	5631.02	5783.01	5970.06	12	16028.01
VOCs														
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	4.87	NA	ND	ND
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
SVOCs														
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	4.99 B	ND	ND	ND	NA	ND	NA	ND	ND
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
Naphthalene	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
TICs*	500	µg/L	N/A	ND	ND	11.0	8.0	95.0	21.0	NA	5.0	NA	ND	8.0
Pesticides/PCBs														
4,4-DDE	0.1	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
4,4'-DDT	0.1	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
Gamma-chlordane	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	ND
Metals														
Antimony	20	µg/L	N/A	ND	3.27	ND	ND	ND	4.19	4.35	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	44.6	52.7	35.0	27.8	39.0	38.6	35.6	35.3	41.3	53.7	33.1
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	0.655	1.65	0.969	1.38	0.754	0.77	ND	0.611	0.778	0.92	0.6
Chromium	100	µg/L	191	2.78	3.11	ND	5.78	ND	ND	ND	1.82	ND	ND	1.5
Copper	1000	µg/L	65.6	47.7	22.6	ND	431.0	ND	ND	ND	ND	ND	ND	ND
Lead	10	µg/L	N/A	ND	ND	ND	57.8	1.33	2.87	3.57	ND	ND	ND	2.0
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.12
Nickel	100	µg/L	N/A	6.77	9.81	4.57	23.7	6.94	7.65	3.82	4.59	5.33	3.72	6.0
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 ppb for

VOCs and SVOCs. No individual compound can exceed 100 ppb.

**NJDEP Groundwater Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Groundwater Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-2
Groundwater Sampling Results
Site M4MW07 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	20	21	21	22	23	24	25	26	26	27	28
WELL ID				M4MW07	M4MW07	MW07 Duplicate	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	MW07 Duplicate	M4MW07	M4MW07
Date Collected				7/19/2001	10/18/2001	10/18/2001	1/8/2002	4/9/2002	7/11/2002	10/8/2002	1/8/2003	1/8/2003	4/17/2003	7/11/2003
ANALYTE / Lab ID				16279.06	16522.04	16522.03	20016.01	20190.01	20439.01	20716.01	30008.04	30008.03	30176.01	30358.01
VOCs														
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs														
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	ND	12.0	5.0	9.0	5.0	15.0	35.0	10.0	11.0	10.0	11.0
Pesticides/PCBs														
4,4-DDE	0.1	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	0.1	µg/L	N/A	ND	0.006	0.007	ND	ND	ND	ND	ND	ND	ND	ND
Gamma-chlordane	NLE	µg/L	N/A	ND	0.002	0.001	ND	ND	ND	ND	ND	ND	ND	ND
Metals														
Antimony	20	µg/L	N/A	ND	ND	ND	ND	2.8	ND	ND	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	92.2	106.0	104.0	87.5	50.4	50.5	45.9	20.6	20.7	27.8	29.3
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.259 ER	0.294 ER
Cadmium	4	µg/L	N/A	1.72	0.605	ND	0.751	0.957	ND	ND	ND	ND	0.476 ER	0.638 ER
Chromium	100	µg/L	191	ND	2.46	2.31	7.97	3.61	2.01	1.07	0.628 ER	0.679 ER	ND	ND
Copper	1000	µg/L	65.6	ND	4.07	5.49	4.55	7.66	6.33	ND	ND	ND	0.546 ER	ND
Lead	10	µg/L	N/A	ND	ND	1.62	ND	1.61	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	5.75	5.88	4.7	4.93	4.54	3.49	3.24 ER	3.17 ER	3.65 ER	4.25 ER
Selenium	50	µg/L	N/A	3.09	ND	ND	7.97	ND	7.96	7.31	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 ppb for

VOCs and SVOCs. No individual compound can exceed 100 ppb.

**NJDEP Groundwater Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Groundwater Quality Criteria are shaded and bold

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ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-2
Groundwater Sampling Results
Site M4MW07 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	29	30	31	32	33	34	35	36	37	
WELL ID				M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07
Date Collected				10/2/2003	1/6/2004	5/5/2004	7/16/2004	10/7/2004	1/5/2005	4/5/2005	7/7/2005	10/18/2005	
ANALYTE / Lab ID				30624.01	40009.01	40336.01	40525.01	40702.01	50005.03	50185.03	50338.03	50534.03	
VOCs													
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
SVOCs													
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	2.02 J	NA	NA	NA	NA	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
Naphthalene	NLE	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
TICs*	500	µg/L	N/A	ND	6.0	ND	ND	ND	NA	NA	NA	NA	
Pesticides/PCBs													
4,4-DDE	0.1	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
4,4'-DDT	0.1	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
Gamma-chlordane	NLE	µg/L	N/A	ND	ND	ND	ND	ND	NA	NA	NA	NA	
Metals													
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Barium	2000	µg/L	699	93.7	27.9	30.0	63.5	65.0	38.2	14.3	106.0	25.3	
Beryllium	20	µg/L	2.1	0.706 ER	ND	ND	ND	0.594	ND	ND	0.7	ND	
Cadmium	4	µg/L	N/A	1.18 ER	ND	ND	ND	ND	ND	ND	ND	ND	
Chromium	100	µg/L	191	2.45 ER	ND	ND	ND	ND	ND	ND	ND	ND	
Copper	1000	µg/L	65.6	1.77 ER	ND	ND	ND	ND	ND	ND	ND	ND	
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	9.35	ND	15.8	6.14	ND	5.38	ND	13	ND	
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 ppb for VOCs and SVOCs. No individual compound can exceed 100 ppb.

**NJDEP Groundwater Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

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ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-2
Groundwater Sampling Results
Site M4MW07 (Jan06-July07)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	38	39	40	41	42	43	44
WELL ID				M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07	M4MW07
Date Collected				1/5/2006	4/5/2006	7/7/2006	10/11/2006	1/4/2007	4/3/2007	7/10/2007
ANALYTE / Lab ID				60011.03	60139.03	60302.03	60444.03	70003.03	70122.03	70249.03
Metals										
Antimony	6	µg/L	N/A	ND	ND	3.54 ER	ND	ND	ND	ND
Arsenic	3	µg/L	N/A	ND	ND	2.87 ER	ND	ND	ND	ND
Barium	2000	µg/L	699	23.9	24.3	81.6	57.5	20	10.4	45.7
Beryllium	1	µg/L	2.1	ND	0.214 ER	0.501	0.353 ER	0.160 ER	0.146 ER	0.183 ER
Cadmium	4	µg/L	N/A	ND	0.665 ER	1.60 ER	1.02 ER	ND	0.346 ER	0.664 ER
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	0.335 ER	ND
Copper	1300	µg/L	65.6	ND	ND	1.12 ER	1.50 ER	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	4.05 ER	10.5	8.76	2.49 ER	1.89 ER	4.69 ER
Selenium	40	µg/L	N/A	ND	ND	ND	5.13 ER	ND	4.71 ER	4.73 ER

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (November 7, 2005)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

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N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-2
Groundwater Sampling Results
Site M4MW07 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	45	46	46	47	47	48	49	50	51
WELL ID				M4MW07	M4MW07	MW07 Duplicate	M4MW07	MW07 Duplicate	M4MW07	M4MW07	M4MW07	M4MW07
Date Collected				10/3/2007	1/8/2008	1/8/2008	4/3/2008	4/3/2008	7/10/2008	10/10/2008	3/12/2009	5/20/2009
ANALYTE / Lab ID				70369.03	80010.03	80010.02	80110.03	80110.02	80228.03	80361.03	90105.03	90207.03
Metals												
Antimony	6	µg/L	N/A	3.96 ER	ND	ND	ND	ND	ND	ND	5.24 ER	2.88 ER
Arsenic	3	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	9.05	7.36
Barium	6000	µg/L	699	87.4	19.5	20.9	12.4	11.4	79.9	68.5	15.7	27.2
Beryllium	1	µg/L	2.1	0.673	0.326 ER	0.329 ER	0.134 ER	0.122 ER	0.604	0.597	ND	0.150 ER
Cadmium	4	µg/L	N/A	0.903 ER	0.471 ER	0.678 ER	ND	ND	1.30 ER	0.278 ER	ND	ND
Chromium	70	µg/L	191	0.407 ER	ND	ND	ND	ND	0.521 ER	2.56 ER	0.495 ER	1.79 ER
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	4.46 ER	2.50 ER
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	10.1	3.91 ER	3.76 ER	1.80 ER	1.79 ER	9.15	7.35	1.28 ER	3.96 ER
Selenium	40	µg/L	N/A	ND	ND	5.43 ER	ND	ND	8.64 ER	3.68 ER	32.1	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

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Table 5-2
Groundwater Sampling Results
Site M4MW07 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	51	52	52	53	53	54	54	55	56
WELL ID				MW07 Duplicate	M4MW07	MW07 Duplicate	M4MW07	MW07 Duplicate	M4MW07	MW07 Duplicate	LF3 ⁽¹⁾	LF4 ⁽¹⁾
Date Collected				5/20/2009	7/20/2009	7/20/2009	11/4/2009	11/4/2009	1/6/2010	1/6/2010	4/6/2010	7/21/2010
ANALYTE / Lab ID				90207.02	90303.03	90303.02	90436.03	90436.02	10005.03	10005.02	10124.04	10316.06
Metals												
Antimony	6	µg/L	N/A	1.30 ER	5.21 ER	ND	ND	ND	ND	7.58 ER	11.6	10.3 ER
Arsenic	3	µg/L	N/A	5.37	5.28	14.8	0.68 ER	ND	ND	ND	ND	ND
Barium	6000	µg/L	699	29.1	48.4	50.9	54.8	54.1	23.4	24.1	32.0	199
Beryllium	1	µg/L	2.1	0.154 ER	0.377 ER	0.350 ER	0.290 ER	0.285 ER	0.117 ER	0.108 ER	ND	1.28
Cadmium	4	µg/L	N/A	ND	0.906 ER	0.519 ER	ND	ND	ND	ND	ND	1.51 ER
Chromium	70	µg/L	191	1.26 ER	ND	ND	ND	ND	ND	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	5	µg/L	N/A	2.39 ER	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	0.06 ER	0.08 ER	ND	ND	ND	ND	ND	0.130 ER
Nickel	100	µg/L	N/A	4.29 ER	7.86	7.50	8.44	8.44	5.17	5.45	ND	19.2
Selenium	40	µg/L	N/A	4.35 ER	21.1	28.8	8.37 ER	ND	NR	NR	NR	NR

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

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NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	1	2	3	4	5	6	7	8	9	10	11	
WELL ID				M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08
Date Collected				5/6/1997	8/15/1997	10/24/1997	2/18/1998	5/6/1998	7/9/1998	10/29/1998	2/4/1999	4/23/1999	7/6/1999	10/5/1999	
ANALYTE / Lab ID				2509.04	2906.05	3107.05	3347.04	3551.04	3711.04	4017.06	4245.04	4438.04	4591.02	4841.02	
VOCs															
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	16.68	13.01	ND	8.64	ND	ND	
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.2	ND	
TICs*	500	µg/L	N/A	ND	7.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SVOCs															
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	1.34	ND	1.6	ND	ND	15.08	1.18	ND	ND	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	11.67	56.16	6.42	10.8 B	ND	ND	ND	ND	ND	ND	ND	
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	
TICs*	500	µg/L	N/A	238.0	28.0	53.0	55.0	680.0	ND	102.0	ND	18.0	ND	19.0	
Metals															
Antimony	20	µg/L	N/A	ND	1.3	ND	ND	ND	4.72	5.36	2.9	7.05	ND	ND	
Arsenic	8	µg/L	N/A	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Barium	2000	µg/L	699	34.2	70.0	29.5	36.0	74.0	81.1	40.9	176.0	990.0	405.0	54.9	
Beryllium	20	µg/L	2.1	0.23	ND	ND	ND	ND	ND	ND	0.58	2.13	1.06	ND	
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	0.697	ND	2.17	1.91	
Chromium	100	µg/L	191	ND	90.0	1.2	ND	ND	ND	ND	9.36	22.3	8.89	4.16	
Copper	1000	µg/L	65.6	44.0	6.0	11.0	9.0	ND	3.71	ND	17.8	11.1	24.4	19.5	
Lead	10	µg/L	N/A	ND	1.0	18.0	ND	ND	2.7	ND	ND	8.35	3.46	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.29	0.1	
Nickel	100	µg/L	N/A	ND	ND	ND	3.4	2.1	ND	ND	5.3	ND	4.27	2.77	
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	6.19	5.27	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

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N/A - Not applicable

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ND - Analyte not detected in sample.

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after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	12	13	14	15	16	17	18	19	20	20	21
WELL ID				M4MW08	M4MW08	M4MW08	LE1 ⁽¹⁾	M4MW08	LE2 ⁽¹⁾	M4MW08	M4MW08	M4MW08	MW08 Duplicate	M4MW08
Date Collected				1/11/2000	5/1/2000	8/1/2000	8/15/2000	10/12/2000	10/16/2000	1/3/2001	4/3/2001	7/19/2001	7/19/2001	10/18/2001
ANALYTE / Lab ID				5088.02	5388.02	5584.05	5631.03	5783.02	5790.04	13	16028.02	16279.04	16279.03	16522.05
VOCs														
Acetone	700	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
2-Butanone	300	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
SVOCs														
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	2.2 B	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	6.0	22.0	88.0	NA	65.0	NA	ND	8.0	ND	ND	14.0
Metals														
Antimony	20	µg/L	N/A	ND	ND	5.5	4.44	ND	ND	ND	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	2.1	ND	ND
Barium	2000	µg/L	699	173.0	217.0	41.2	33.3	32.0	33.2	86.5	216.0	59.5	73.6	47.3
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	5.4	0.762	0.863	0.57
Chromium	100	µg/L	191	2.77	3.34	1.09	ND	0.653	1.05	ND	ND	ND	ND	1.36
Copper	1000	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.88	ND
Lead	10	µg/L	N/A	ND	ND	2.27	1.56	ND	ND	ND	10.0	ND	ND	2.17
Mercury	2	µg/L	0.26	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND	0.1
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	4.18	10.3	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

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NA - Not analyzed

ND - Analyte not detected in sample.

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after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	22	23	24	25	26	27	28	29	30	31	32	
WELL ID				M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	M4MW08
Date Collected				1/8/2002	4/9/2002	7/11/2002	10/8/2002	1/8/2003	4/17/2003	7/11/2003	10/2/2003	1/6/2004	5/5/2004	7/16/2004	
ANALYTE / Lab ID				20016.02	20190.02	20439.02	20716.02	30008.05	30176.02	30358.02	30624.02	40009.02	40336.02	40525.02	
VOCs															
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SVOCs															
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	12.0	ND	12.0	31.0	13.0	12.0	11.0	21.0	11.0	ND	ND	
Metals															
Antimony	20	µg/L	N/A	ND	ND	ND	ND	2.89	ND	ND	ND	ND	ND	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	2.92 ER	ND	ND	ND	
Barium	2000	µg/L	699	112.0	70.0	36.2	79.3	39.2	99.8	64.4	57.1	84.5	372.0	64.5	
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	0.112 ER	0.145 ER	0.092 ER	ND	ND	ND	
Cadmium	4	µg/L	N/A	0.714	ND	ND	ND	ND	ND	0.444 ER	0.791 ER	ND	ND	ND	
Chromium	100	µg/L	191	2.13	1.8	ND	ND	0.965 ER	4.49 ER	ND	ND	ND	ND	ND	
Copper	1000	µg/L	65.6	3.0	5.3	ND	ND	ND	4.10 ER	ND	0.737 ER	ND	ND	ND	
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	1.04 ER	ND	ND	ND	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.7	ND	
Selenium	50	µg/L	N/A	7.99	ND	7.28	8.61	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample.

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	33	34	35	35	36	37	37
WELL ID				M4MW08	M4MW08	M4MW08	MW08 Duplicate	M4MW08	M4MW08	MW08 Duplicate
Date Collected				10/7/2004	1/5/2005	4/5/2005	4/5/2005	7/7/2005	10/18/2005	10/18/2005
ANALYTE / Lab ID				40702.02	50005.06	50185.04	50185.02	50338.04	50534.04	50534.02
VOCs										
Acetone	700	µg/L	N/A	ND	NA	NA	NA	NA	NA	NA
2-Butanone	300	µg/L	N/A	ND	NA	NA	NA	NA	NA	NA
TICs*	500	µg/L	N/A	ND	NA	NA	NA	NA	NA	NA
SVOCs										
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	1.70 J	NA	NA	NA	NA	NA	NA
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	NA	NA	NA	NA	NA	NA
Di- <i>n</i> -octyl phthalate	100	µg/L	N/A	ND	NA	NA	NA	NA	NA	NA
TICs*	500	µg/L	N/A	14.0	NA	NA	NA	NA	NA	NA
Metals										
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	47.0	56.4	58.6	81.9	55.7	51.3	57.1
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Chromium	100	µg/L	191	ND	ND	ND	ND	ND	ND	ND
Copper	1000	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample.

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (Jan06-July07)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽¹⁾	38	39	39	40	40	41
WELL ID				M4MW08	M4MW08	MW08 Duplicate	M4MW08	MW08 Duplicate	M4MW08
Date Collected				1/5/2006	4/5/2006	4/5/2006	7/7/2006	7/7/2006	10/11/2006
ANALYTE / Lab ID				60011.04	60139.04	60139.02	60302.04	60302.02	60444.04
Metals									
Antimony	6	µg/L	N/A	ND	5.85 ER	5.16 ER	6.76 ER	5.68 ER	ND
Arsenic	3	µg/L	N/A	ND	ND	ND	ND	ND	2.79 ER
Barium	2000	µg/L	699	63.4	116.0	72.8	62.6	66.5	59.2
Beryllium	1	µg/L	2.1	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	0.331 ER	0.329 ER	ND	ND	2.06
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	1.44 ER	1.51 ER	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND
Selenium	40	µg/L	N/A	ND	ND	ND	ND	ND	8.48 ER

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (November 7, 2005)

⁽¹⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (Jan06-July07)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽¹⁾	42	42	43	43	44	44
WELL ID				M4MW08	MW08 Duplicate	M4MW08	MW08 Duplicate	M4MW08	MW08 Duplicate
Date Collected				1/4/2007	1/4/2007	4/3/2007	4/3/2007	7/10/2007	7/10/2007
ANALYTE / Lab ID				70003.04	70003.04	70122.04	70122.04	70249.04	70249.02
Metals									
Antimony	6	µg/L	N/A	7.76 ER	9.38 ER	ND	1.73 ER	ND	ND
Arsenic	3	µg/L	N/A	4.89 ER	5.44	6.4	5.75	6.4	9.9
Barium	2000	µg/L	699	106.0	121.0	726.0	419.0	689.0	1120.0
Beryllium	1	µg/L	2.1	ND	ND	0.979	0.519	0.666	1.0
Cadmium	4	µg/L	N/A	8.24	8.72	15.9	7.98	10.8	14.8
Chromium	70	µg/L	191	ND	ND	0.550 ER	0.381 ER	ND	1.39 ER
Copper	1300	µg/L	65.6	ND	ND	1.61 ER	ND	ND	1.84 ER
Lead	5	µg/L	N/A	ND	ND	10.2	4.50 ER	7.06	28.7
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	1.13 ER	ND	3.16 ER	ND	1.29 ER	0.459 ER
Selenium	40	µg/L	N/A	8.85 ER	7.88	8.21 ER	9.20 ER	13.2	8.98 ER

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (November 7, 2005)

⁽¹⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	45	45	46	47	48	49	49
WELL ID				M4MW08	MW08 Duplicate	M4MW08	M4MW08	M4MW08	M4MW08	MW08 Duplicate
Date Collected				10/3/2007	10/3/2007	1/8/2008	4/3/2008	7/10/2008	10/10/2008	10/10/2008
ANALYTE / Lab ID				70369.04	70369.04	80010.04	80110.04	80228.04	80361.04	80361.02
Metals										
Antimony	6	µg/L	N/A	10.3	10.9	48.8	20.7	1.73 ER	4.10 ER	10.2
Arsenic	3	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Barium	6000	µg/L	699	92.7	93.2	81.1	65.6	150.0	98.0	207.0
Beryllium	1	µg/L	2.1	ND	ND	0.171 ER	ND	ND	0.272 ER	0.591
Cadmium	4	µg/L	N/A	ND	ND	0.508 ER	0.917 ER	1.78 ER	ND	0.204 ER
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	1.54 ER	5.56
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	ND	3.16 ER
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Selenium	40	µg/L	N/A	ND	ND	ND	ND	7.43 ER	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-3
Groundwater Sampling Results
Site M4MW08 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	50	51	52	53	54	55	56
WELL ID				M4MW08	M4MW08	M4MW08	M4MW08	M4MW08	LF3 ⁽¹⁾	LF4 ⁽¹⁾
Date Collected				3/12/2009	5/20/2009	7/20/2009	11/4/2009	1/6/2010	4/6/2010	7/21/2010
ANALYTE / Lab ID				90105.04	90207.04	90303.04	90436.04	10005.04	10124.05	10316.04
Metals										
Antimony	6	µg/L	N/A	18.7	2.28 ER	ND	ND	4.94 ER	ND	6.51 ER
Arsenic	3	µg/L	N/A	109.0	20.2	24.8	4.36 ER	1.09 ER	1.11 ER	1.23 ER
Barium	6000	µg/L	699	90.7	77.8	79.6	883	42.3	12.4	34.7
Beryllium	1	µg/L	2.1	ND	ND	ND	0.151 ER	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	0.914 ER	9.23	ND	ND	1.56 ER
Chromium	70	µg/L	191	0.320 ER	ND	ND	20.5	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	1.07 ER	ND
Lead	5	µg/L	N/A	3.62 ER	2.58 ER	ND	31.1	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	0.07 ER	ND	ND	ND	0.160 ER
Nickel	100	µg/L	N/A	ND	ND	1.32 ER	ND	3.05 ER	2.19 ER	ND
Selenium	40	µg/L	N/A	84.5	3.55 ER	13.3	ND	ND	ND	65.1

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	1	2	3	4	5	6	7	7	8
WELL ID				M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	MW09 Duplicate	M4MW09
Date Collected				5/6/1997	8/15/1997	10/24/1997	2/18/1998	5/6/1998	7/9/1998	10/29/1998	10/29/1998	2/4/1999
ANALYTE / Lab ID				2509.05	2906.03	3107.03	3347.05	3551.05	3711.05	4017.05	4017.06	4245.05
VOCs												
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	16.17	11.38	ND
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	5.72	3.8	ND
TICs*	500	µg/L	N/A	ND	ND	14.0	36.0	ND	ND	ND	ND	ND
SVOCs												
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	2.36
Diethyl phthalate	5000	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	3.04	50.51	11.15	5.14 B	ND	ND	ND	ND	ND
Naphthalene	NLE	µg/L	N/A	0.26	ND	ND	ND	ND	ND	ND	ND	ND
TICs*	500	µg/L	N/A	178.0	29.0	34.0	24.0	840.0	ND	106.0	190.0	ND
Pesticides/PCBs												
4,4'-DDD	0.10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals												
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	6.52	6.52	3.8	ND
Arsenic	8	µg/L	N/A	3.0	ND	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	109.1	130.0	46.7	42.0	80.0	278.0	72.4	72.9	66.7
Beryllium	20	µg/L	2.1	0.25	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	100	µg/L	191	ND	68.0	1.4	ND	ND	ND	ND	ND	ND
Copper	1000	µg/L	65.6	32.0	8.0	11.0	10.0	ND	26.5	5.21	ND	ND
Lead	10	µg/L	N/A	0.5	ND	9.0	ND	ND	12.2	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	1.5	3.5	1.9	0.847	ND	ND	2.45
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	4.5
Thallium	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

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Table 5-4
Groundwater Sampling Results
Site M4MW09 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	8	9	10	11	12	13	14	15	16	
WELL ID				MW09 Duplicate	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	LF ⁽¹⁾	M4MW09
Date Collected				2/4/1999	4/23/1999	7/6/1999	10/5/1999	1/11/2000	5/1/2000	8/1/2000	8/15/2000	10/12/2000	
ANALYTE / Lab ID				4245.06	4438.05	4591.03	4841.03	5088.03	5388.03	5584.06	5631.04	5783.03	
VOCs													
Acetone	700	µg/L	N/A	ND	7.59	5.92	ND	ND	ND	ND	NA	ND	
2-Butanone	300	µg/L	N/A	ND	ND	6.32	ND	ND	ND	ND	NA	ND	
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	NA	ND	
SVOCs													
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	1.58	ND	ND	ND	ND	ND	ND	NA	ND	
Diethyl phthalate	5000	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	NA	ND	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	NA	ND	
Naphthalene	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	NA	ND	
TICs*	500	µg/L	N/A	ND	66.0	ND	5.0	13.0	10.0	16.0	NA	70.0	
Pesticides/PCBs													
4,4'-DDD	0.10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	NA	ND	
Metals													
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	3.65	5.48	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Barium	2000	µg/L	699	78.4	62.5	72.2	58.7	49.0	59.9	47.6	50.7	41.4	
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Cadmium	4	µg/L	N/A	ND	1.65	0.75	0.904	ND	ND	ND	ND	ND	
Chromium	100	µg/L	191	2.68	2.15	2.18	2.16	ND	ND	ND	ND	ND	
Copper	1000	µg/L	65.6	126.0	4.08	15.6	12.6	ND	ND	22.6	ND	ND	
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	1.9	2.84	ND	
Mercury	2	µg/L	0.26	ND	0.11	0.34	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	2.58	0.971	ND	2.02	ND	ND	1.17	ND	ND	
Selenium	50	µg/L	N/A	4.64	ND	ND	ND	ND	ND	ND	ND	ND	
Thallium	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

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ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

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after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	17	17	18	18	19	20	21	22	23	
WELL ID				LF2 ⁽¹⁾	LF2 ⁽¹⁾ Duplicate	M4MW09	MW09 Duplicate	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09
Date Collected				10/16/2000	10/16/2000	1/3/2001	1/3/2001	4/3/2001	7/19/2001	10/18/2001	1/8/2002	4/9/2002	
ANALYTE / Lab ID				5790.03	5790.02	14	11	16028.03	16279.05	16522.06	20016.03	20190.03	
VOCs													
Acetone	700	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
2-Butanone	300	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
SVOCs													
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	NA	NA	ND	ND	ND	ND	1.95	ND	ND	
Diethyl phthalate	5000	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
Naphthalene	NLE	µg/L	N/A	NA	NA	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	NA	NA	ND	ND	6.0	ND	54.0	6.0	ND	
Pesticides/PCBs													
4,4'-DDD	0.10	µg/L	N/A	NA	NA	ND	ND	ND	ND	0.003	ND	ND	
Metals													
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Barium	2000	µg/L	699	45.3	50.1	50.8	55.3	52.7	65.5	65.4	56.2	81.3	
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	0.7	0.765	ND	0.978	ND	
Chromium	100	µg/L	191	0.741	ND	ND	ND	ND	ND	2.04	0.633	1.36	
Copper	1000	µg/L	65.6	ND	13.9	ND	ND	ND	ND	ND	2.33	10.0	
Lead	10	µg/L	N/A	ND	ND	ND	ND	3.0	ND	1.22	ND	1.78	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	0.11	0.32	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	1.5	
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	7.27	ND	6.02	ND	
Thallium	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	24	25	26	27	28	29	30	31	32	
WELL ID				M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09
Date Collected				7/11/2002	10/8/2002	1/8/2003	4/17/2003	7/11/2003	10/2/2003	1/6/2004	5/5/2004	7/16/2004	
ANALYTE / Lab ID				20439.03	20716.03	30008.06	30176.03	30358.03	30624.03	40009.03	40336.03	40525.03	
VOCs													
Acetone	700	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
2-Butanone	300	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SVOCs													
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Diethyl phthalate	5000	µg/L	N/A	ND	1.99	ND	ND	ND	ND	ND	ND	ND	
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Naphthalene	NLE	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
TICs*	500	µg/L	N/A	14.0	27.0	12.0	11.0	396.0	ND	5.0	ND	ND	
Pesticides/PCBs													
4,4'-DDD	0.10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Metals													
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	4.98 ER	ND	ND	ND	
Barium	2000	µg/L	699	78.7	47.2	43.7	50.7	57.4	59.6	62.0	22.0	50.5	
Beryllium	20	µg/L	2.1	ND	ND	ND	0.0788 ER	0.0471 ER	0.061 ER	2.62	ND	ND	
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Chromium	100	µg/L	191	ND	1.77	ND	ND	ND	ND	ND	ND	ND	
Copper	1000	µg/L	65.6	ND	ND	ND	ND	ND	1.38	ND	ND	ND	
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	12.8	ND	
Selenium	50	µg/L	N/A	4.99	6.54	ND	ND	5.04 ER	ND	ND	ND	ND	
Thallium	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (May97-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	33	34	35	36	36	37
WELL ID				M4MW09	M4MW09	M4MW09	M4MW09	MW09 Duplicate	M4MW09
Date Collected				10/7/2004	1/5/2005	4/5/2005	7/7/2005	7/7/2005	10/18/2005
ANALYTE / Lab ID				40702.03	50005.05	50185.05	50338.05	50338.02	50534.05
VOCs									
Acetone	700	µg/L	N/A	ND	NA	NA	NA	NA	NA
2-Butanone	300	µg/L	N/A	ND	NA	NA	NA	NA	NA
TICs*	500	µg/L	N/A	ND	NA	NA	NA	NA	NA
SVOCs									
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	NA	NA	NA	NA	NA
Diethyl phthalate	5000	µg/L	N/A	ND	NA	NA	NA	NA	NA
Di- <i>n</i> -butyl phthalate	900	µg/L	N/A	ND	NA	NA	NA	NA	NA
Naphthalene	NLE	µg/L	N/A	ND	NA	NA	NA	NA	NA
TICs*	500	µg/L	N/A	ND	NA	NA	NA	NA	NA
Pesticides/PCBs									
4,4'-DDD	0.10	µg/L	N/A	ND	NA	NA	NA	NA	NA
Metals									
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	55.3	47.9	53.8	40.8	41.7	39.1
Beryllium	20	µg/L	2.1	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND
Chromium	100	µg/L	191	ND	ND	ND	ND	ND	ND
Copper	1000	µg/L	65.6	ND	ND	ND	ND	ND	ND
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND
Thallium	10	µg/L	N/A	ND	ND	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

B - Compound detected in the sample and its associated blank sample

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NLE - No limit established

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (Jan06-July07)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽¹⁾	38	38	39	40	41	42	43	44	
WELL ID				M4MW09	MW09 Duplicate	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09
Date Collected				1/5/2006	1/5/2006	4/5/2006	7/7/2006	10/11/2006	1/4/2007	4/3/2007	7/10/2007	
ANALYTE / Lab ID				60011.05	60011.02	60139.05	60302.05	60444.05	70003.05	70122.05	70249.05	
Metals												
Antimony	6	µg/L	N/A	ND	ND	2.55 ER	3.92 ER	ND	ND	ND	ND	
Arsenic	3	µg/L	N/A	ND	ND	ND	2.67 ER	ND	ND	ND	ND	
Barium	2000	µg/L	699	50.6	52.8	56.4	40.3	56.9	55.6	49.3	37.3	
Beryllium	1	µg/L	2.1	ND	ND	ND	ND	ND	ND	0.250 ER	ND	
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	1.56 ER	1.09 ER	1.03 ER	0.740 ER	
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	ND	ND	ND	
Copper	1300	µg/L	65.6	ND	ND	ND	1.14 ER	ND	ND	ND	ND	
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	1.24 ER	1.22 ER	
Selenium	40	µg/L	N/A	ND	ND	ND	ND	6.80 ER	5.66 ER	10.6	11.0	
Thallium	2	µg/L	N/A	ND	ND	ND	ND	ND	ND	1.59 ER	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (November 7, 2005)

⁽¹⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	45	46	47	48	49	50	50	51
WELL ID				M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	M4MW09	MW09 Duplicate	M4MW09
Date Collected				10/3/2007	1/8/2008	4/3/2008	7/10/2008	10/10/2008	3/12/2009	3/12/2009	5/20/2009
ANALYTE / Lab ID				70369.05	80010.05	80110.05	80228.05	80361.05	90105.05	90105.02	90207.05
Metals											
Antimony	6	µg/L	N/A	2.69 ER	ND	ND	ND	ND	15.0	12.0	3.71 ER
Arsenic	3	µg/L	N/A	ND	ND	ND	ND	ND	96.0	92.0	18.9
Barium	6000	µg/L	699	40.9	62.4	50.7	37.2	65.9	63.5	67.3	44.4
Beryllium	1	µg/L	2.1	0.140 ER	0.196 ER	ND	ND	0.188 ER	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	0.343 ER	ND	0.270 ER	ND	ND	ND	ND
Chromium	70	µg/L	191	ND	ND	ND	ND	0.561 ER	0.90 ER	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	5.0 ER	6.81	2.02 ER
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	0.993 ER
Selenium	40	µg/L	N/A	ND	ND	ND	7.62 ER	ND	87.0	73.3	4.73 ER
Thallium	2	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	2.02 ER

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7-9-C (July 27, 2007)

⁽¹⁾ Low flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-4
Groundwater Sampling Results
Site M4MW09 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	52	53	54	55	55	56	56
WELL ID				M4MW09	M4MW09	M4MW09	LF3 ⁽¹⁾	LF3 ⁽¹⁾ Duplicate	LF4 ⁽¹⁾	LF4 ⁽¹⁾ Duplicat
Date Collected				7/20/2009	11/4/2009	1/6/2010	4/6/2010	4/6/2010	7/21/2010	7/21/2010
ANALYTE / Lab ID				90303.05	90436.05	10005.05	10124.03	10124.02	10316.03	10316.02
Metals										
Antimony	6	µg/L	N/A	ND	ND	ND	11.6	8.16 ER	7.78 ER	9.64 ER
Arsenic	3	µg/L	N/A	20.8	ND	ND	3.61 ER	ND	ND	0.980 ER
Barium	6000	µg/L	699	63.0	44.0	60.2	18.8	34.2	44.2	44.1
Beryllium	1	µg/L	2.1	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	2.30 ER	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	0.220 ER	0.470 ER
Nickel	100	µg/L	N/A	2.75 ER	0.524 ER	1.21 ER	1.71 ER	0.672 ER	ND	ND
Selenium	40	µg/L	N/A	26.2	17.7 ER	NR	NR	NR	NR	NR
Thallium	2	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Jan00-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	1	2	3	4	5	6	7	8	9
WELL ID				M4MW10	M4MW10	M4MW10	LF1 ⁽¹⁾	M4MW10	LF2 ⁽¹⁾	M4MW10	M4MW10	M4MW10
Date Collected				1/11/2000	5/1/2000	8/1/2000	8/15/2000	10/12/2000	10/16/2000	1/3/2001	4/3/2001	7/19/2001
ANALYTE / Lab ID				5088.04	5388.04	5584.07	5631.05	5783.04	5790.05	15	16028.04	16279.07
SVOCs												
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	NA	ND	NA	ND	ND	ND
TICs*	500	µg/L	N/A	38.0	8.0	51.0	NA	64.0	NA	112.0	12.0	ND
Metals												
Antimony	20	µg/L	N/A	ND	ND	5.07	4.13	ND	ND	ND	ND	ND
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	2000	µg/L	699	109.0	516.0	117.0	63.1	76.7	58.2	286.0	574.0	106.0
Beryllium	20	µg/L	2.1	ND	0.582	ND	ND	ND	ND	ND	ND	0.525
Cadmium	4	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	4.9	1.13
Chromium	100	µg/L	191	ND	2.28	0.895	ND	ND	ND	ND	ND	1.59
Copper	1000	µg/L	65.6	25.6	ND	ND	ND	2.34	ND	172	23.0	ND
Lead	10	µg/L	N/A	ND	ND	8.0	2.1	ND	ND	35.6	15.0	1.1
Mercury	2	µg/L	0.26	0.2	ND	ND	ND	ND	ND	ND	0.11	0.15
Nickel	100	µg/L	N/A	931.0	ND	1.16	ND	ND	ND	2.08	3.0	11.5
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	11.4

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Jan00-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	10	11	12	13	14	15	16	17	18	
WELL ID				M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10
Date Collected				10/18/2001	1/8/2002	4/9/2002	7/11/2002	10/8/2002	1/8/2003	4/17/2003	7/11/2003	10/2/2003	
ANALYTE / Lab ID				16522.07	20016.04	20190.04	20439.04	20716.04	30008.07	30176.04	30358.04	30624.04	
SVOCs													
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	ND	ND	2.63 J	ND	ND	ND	
TICs*	500	µg/L	N/A	ND	17.0	ND	13.0	16.0	10.0	8.0	11.0	ND	
Metals													
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	6.89 ER	ND	ND	
Arsenic	8	µg/L	N/A	ND	3.62	ND	ND	2.68	ND	ND	ND	2.31 ER	
Barium	2000	µg/L	699	154.0	962.0	1520.0	74.9	150.0	122.0	53.8	141.0	127.0	
Beryllium	20	µg/L	2.1	ND	1.34	2.73	ND	ND	ND	0.0799 ER	0.207 ER	0.288 ER	
Cadmium	4	µg/L	N/A	2.51	3.66	3.54	ND	1.06	ND	ND	0.781 ER	1.11 ER	
Chromium	100	µg/L	191	1.83	ND	ND	ND	ND	0.853 ER	416.0	ND	ND	
Copper	1000	µg/L	65.6	ND	3.18	4.11	ND	7.53	2.53 ER	3.51 ER	ND	ND	
Lead	10	µg/L	N/A	1.6	3.4	3.8	ND	ND	ND	1.07 ER	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	3.17 ER	40.6	ND	ND	
Selenium	50	µg/L	N/A	ND	11.3	ND	6.67	4.4	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Jan00-Oct05)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	19	20	21	22	23	24	25	26	
WELL ID				M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10
Date Collected				1/6/2009	5/5/2004	7/16/2004	10/7/2004	1/5/2005	4/5/2005	7/7/2005	10/18/2005	
ANALYTE / Lab ID				40009.04	40336.04	40525.04	40702.04	50005.04	50185.06	50338.06	50534.06	
SVOCs												
Bis(2-ethylhexyl) phthalate	30	µg/L	N/A	ND	ND	ND	1.80 J	NA	NA	NA	NA	
TICs*	500	µg/L	N/A	ND	ND	8.0	10.0	NA	NA	NA	NA	
Metals												
Antimony	20	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	
Arsenic	8	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	
Barium	2000	µg/L	699	364.0	423.0	123.0	81.2	147.0	49.5	87.1	47.8	
Beryllium	20	µg/L	2.1	0.676	ND	ND	ND	ND	ND	ND	ND	
Cadmium	4	µg/L	N/A	ND	ND	ND	2.01	ND	ND	2.5	ND	
Chromium	100	µg/L	191	ND	ND	ND	ND	ND	ND	ND	ND	
Copper	1000	µg/L	65.6	ND	ND	ND	ND	ND	ND	ND	ND	
Lead	10	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND	
Nickel	100	µg/L	N/A	ND	13.1	ND	ND	ND	ND	ND	ND	
Selenium	50	µg/L	N/A	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7-9-6 (January 7, 1993)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

J - Estimated concentration exceeds the MDL and is less than the RL

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Jan06-July07)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽¹⁾	27	28	29	30	30	31	32	33
WELL ID				M4MW10	M4MW10	M4MW10	M4MW10	MW10 Duplicate	M4MW10	M4MW10	M4MW10
Date Collected				1/5/2006	4/5/2006	7/7/2006	10/11/2006	10/11/2006	1/4/2007	4/3/2007	7/10/2007
ANALYTE / Lab ID				60011.06	60139.06	60302.06	60444.06	60444.02	70003.06	70122.06	70249.06
Metals											
Antimony	6	µg/L	N/A	ND	ND	3.99 ER	ND	ND	ND	ND	ND
Arsenic	3	µg/L	N/A	ND	ND	ND	2.55 ER	ND	4.51 ER	4.5	5.14
Barium	2000	µg/L	699	73.0	448.0	244.0	150.0	92.5	453.0	300.0	186.0
Beryllium	1	µg/L	2.1	ND	0.523	0.469 ER	0.261 ER	0.122 ER	0.571	0.549	0.345 ER
Cadmium	4	µg/L	N/A	ND	0.983 ER	ND	4.01	3.13	6.56	5.74	5.6
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	2.02 ER	ND	ND	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	ND	ND	ND	ND	5.35	2.23 ER
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	ND	ND	ND	ND	1.41 ER	0.923 ER
Selenium	40	µg/L	N/A	ND	ND	ND	3.17 ER	3.97 ER	ND	7.74 ER	12.5

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7-9-C (November 7, 2005)

⁽¹⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	34	35	36	37	38	39
WELL ID				M4MW10	M4MW10	M4MW10	M4MW10	M4MW10	M4MW10
Date Collected				10/3/2007	1/8/2008	4/3/2008	7/10/2008	10/10/2008	3/12/2009
ANALYTE / Lab ID				70369.06	80010.06	80110.06	80228.06	80361.06	90105.06
Metals									
Antimony	6	µg/L	N/A	ND	ND	ND	ND	2.52 ER	15.4
Arsenic	3	µg/L	N/A	ND	ND	5.11	ND	ND	61.5
Barium	6000	µg/L	699	113.0	1330.0	346.0	129.0	88.7	410.0
Beryllium	1	µg/L	2.1	0.239 ER	2.65	0.472 ER	0.398 ER	0.342 ER	0.433 ER
Cadmium	4	µg/L	N/A	ND	5.74	5.9	2.9	ND	ND
Chromium	70	µg/L	191	ND	0.529 ER	ND	ND	ND	0.833 ER
Copper	1300	µg/L	65.6	ND	ND	ND	ND	ND	ND
Lead	5	µg/L	N/A	ND	ND	4.53 ER	2.13 ER	ND	11.6
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	ND
Nickel	100	µg/L	N/A	ND	ND	0.309 ER	ND	ND	ND
Selenium	40	µg/L	N/A	ND	ND	ND	ND	ND	52.7

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Table 5-5
Groundwater Sampling Results
Site M4MW10 (Oct07-Jul10)
Fort Monmouth, New Jersey

Round No.	** NJDEP Criteria	Units	Site Specific MBC ⁽²⁾	40	52	53	54	55	56
WELL ID				M4MW10	M4MW10	M4MW10	M4MW10	LF3 ⁽¹⁾	LF4 ⁽¹⁾
Date Collected				5/20/2009	7/21/2009	11/4/2009	1/6/2010	4/6/2010	7/21/2010
ANALYTE / Lab ID				90207.06	90303.06	90436.06	10005.06	10124.06	10316.05
Metals									
Antimony	6	µg/L	N/A	2.00 ER	ND	ND	ND	7.30 ER	9.23 ER
Arsenic	3	µg/L	N/A	17.6	17.7	ND	1.40 ER	0.83 ER	1.12 ER
Barium	6000	µg/L	699	190.0	112	109	114	41.8	53.6
Beryllium	1	µg/L	2.1	0.320 ER	0.096 ER	ND	ND	ND	ND
Cadmium	4	µg/L	N/A	ND	1.22 ER	ND	ND	ND	1.26 ER
Chromium	70	µg/L	191	ND	ND	ND	ND	ND	ND
Copper	1300	µg/L	65.6	ND	ND	ND	ND	1.34 ER	ND
Lead	5	µg/L	N/A	1.78 ER	ND	ND	ND	ND	ND
Mercury	2	µg/L	0.26	ND	ND	ND	ND	ND	0.400 ER
Nickel	100	µg/L	N/A	ND	1.27 ER	ND	4.32 ER	3.54 ER	0.959 ER
Selenium	40	µg/L	N/A	4.61 ER	ND	ND	NR	NR	NR

Notes:

*TICs - Tentatively identified compounds, cannot exceed 500 µg/L for

VOCs and SVOCs. No individual compound can exceed 100 µg/L.

**NJDEP Ground Water Quality Criteria as per N.J.A.C. 7:9-C (July 27, 2007)

⁽¹⁾ Low Flow sampling method used to collect sample

⁽²⁾ MBC - Maximum Background Criteria for native metals (Weston, 1995)

Exceedances of NJDEP Ground Water Quality Criteria are shaded and bold

ER - Estimated result

N/A - Not applicable

NA - Not analyzed

ND - Analyte not detected in sample

NR - Not reported

Sampling for VOCs, SVOCs, and Pesticides/PCBs were discontinued

after the 10/7/04 sampling event as per NJDEP approval dated (November 2004)

Fort Monmouth

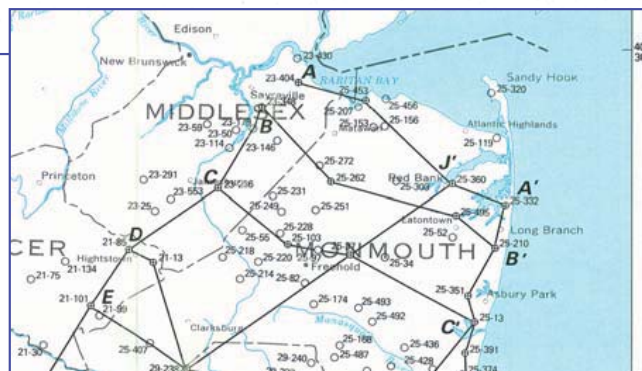
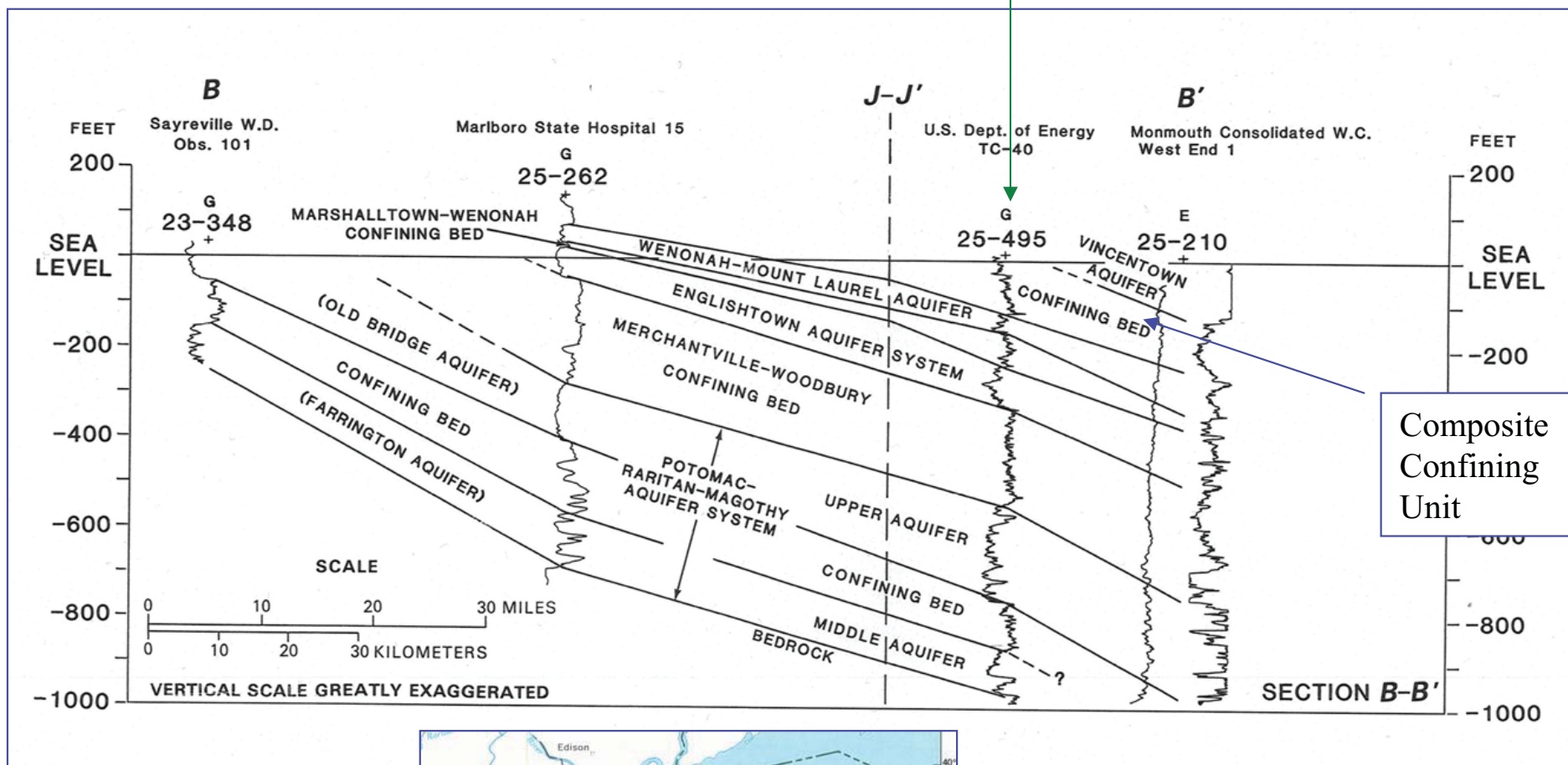


FIGURE 2-6

**Geologic Cross-Section
M-4 Landfill Site
Fort Monmouth, New Jersey**

Versar INC.

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

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

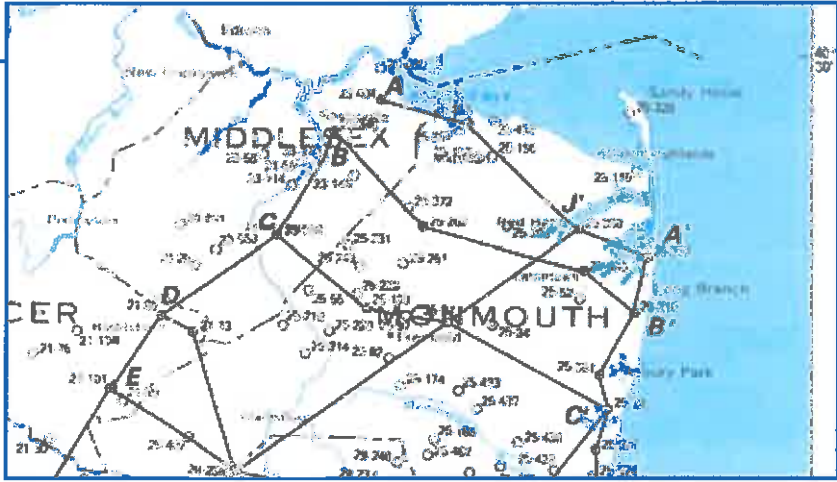
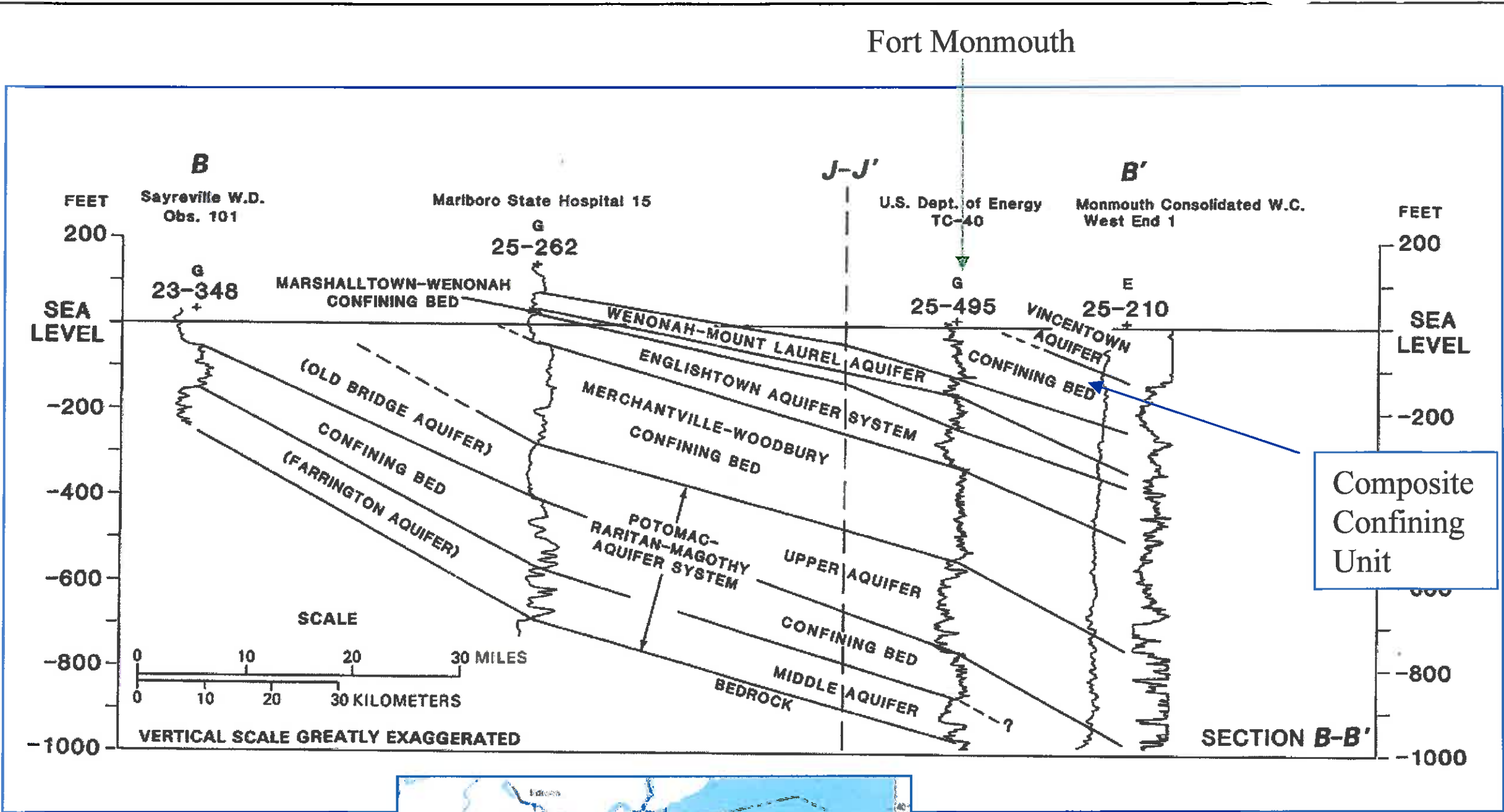


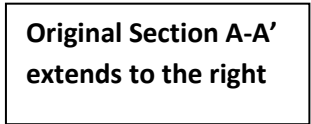
FIGURE 6-1

**Regional Geologic Cross-Section
Site 1122 – Main Post
Fort Monmouth, New Jersey**

Versar INC. 2558 Pearl Buck Road, Suite 1
Bristol, PA 19007
(215) 788-7844

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

Excerpt of Cross-Section A-A'



**Description of Geologic Units
Shown on Cross-Section A-A'**

Tvt **VINCENTOWN FORMATION**—Glaucconitic (5-20%) silty medium-to-coarse quartz sand, some fine-to-medium sand, some very coarse sand to very fine pebbles; yellow, reddish-yellow, olive-yellow, olive-brown; unstratified to weakly horizontally stratified. Coarse sands are locally iron-cemented into beds and masses as much as 10 feet thick. Lowermost 10-20 feet of the formation is silty fine-to-medium sand, with more glauconite than upsection. Total thickness of formation is 180 feet. Late Paleocene in age, based on foraminifera (Olsson and Wise, 1987; Miller and others, 2006) and calcareous nannofossils (Sugarman and others, 1991). Unconformably overlies the Hornerstown Formation.

Tht **HORNERSTOWN FORMATION**—Glaucconite (>50%) clay and silty clay; olive, dark green, black where unweathered, olive-brown with brown to reddish-brown mottles where weathered; unstratified. Glaucconite occurs primarily in soft grains of fine-to-medium sand size. Thickness is 25 to 30 feet. Early Paleocene in age, based on foraminifera (Olsson and others, 1997; Landman and others, 2004; Miller and others, 2006) and calcareous nannofossils (Sugarman and others, 1991; Miller and others, 2006). Unconformably overlies the Tinton Formation.

Kt **TINTON FORMATION**—Glaucconitic (5-30%) silty medium-to-coarse and fine-to-medium quartz sand; reddish-brown, reddish-yellow, yellowish-brown where weathered, grayish-brown, brown, olive-brown where unweathered; unstratified to weakly horizontally stratified. Commonly iron-cemented into beds and masses as much as 15 feet thick. Uppermost 4-6 feet, just below contact with Hornerstown Formation, is a brown to olive-gray glauconitic clayey-silty fine sand to fine-sandy silt-clay ("New Egypt Formation" of Landman and others, 2004). Total thickness of Tinton is 30 to 40 feet. Late Cretaceous (late Maestrichtian) in age based on foraminifera, nannofossils, and ammonites (Landman and others, 2004) and strontium-isotope ratios (Sugarman and others, 1995). Overlies the Shrewsbury Member of the Red Bank Formation. Contact with Shrewsbury is not exposed in the Long Branch quadrangle. It is gradational over several feet in the Sandy Hook quadrangle, north of the Long Branch quadrangle (Minard, 1969), but may be unconformable in the Marlboro quadrangle, west of the Long Branch quadrangle (Sugarman and Owens, 1996).

Krs **RED BANK FORMATION, SHREWSBURY MEMBER**—Fine-to-medium quartz sand, minor medium-to-coarse sand, slightly silty, glauconitic (<5%), and micaceous; reddish-yellow, yellow where weathered, light gray and gray where unweathered; unstratified to weakly horizontally bedded; locally iron-cemented. As much as 100 feet thick. Late Cretaceous (late Maestrichtian) in age based on fossils in the underlying Sandy Hook Member; the Shrewsbury Member is unfossiliferous. Grades downward within 2-3 feet to the Red Bank Formation, Sandy Hook Member. On geophysical well logs, transition to Sandy Hook Member is marked by increased gamma-ray intensity and decreased resistance.

Krsh **RED BANK FORMATION, SANDY HOOK MEMBER**—Fine-sandy clayey silt, micaceous, slightly glauconitic (<5%); brown to yellowish-brown where weathered, dark gray, olive-gray where unweathered; unstratified. Calcareous brachiopod, pelecypod, and gastropod fossils are common. As much as 20 feet thick. Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils (Sugarman and Owens, 1996), foraminifera (Olsson, 1964; Olsson and Wise, 1987; Owens and others, 1977), and strontium-isotope ratios (Sugarman and others, 1995). Grades downward within 2-3 feet into the Navesink Formation. On geophysical well logs, transition to Navesink is marked by increased gamma-ray intensity and slightly decreased resistance.

Kns **NAVESINK FORMATION**—Glaucconitic (20-50%) clayey-silty fine-to-medium quartz sand to fine-sandy clayey silt; dark gray, gray, grayish-brown, olive-gray where unweathered, brown to yellowish-brown where weathered; unstratified. Glaucconite occurs chiefly in soft grains of fine-to-medium sand size. Calcareous brachiopod, pelecypod, and gastropod fossils are common. Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils and foraminifera (Olsson, 1964; Miller and others, 2006), macrofossils (Sohl, 1977), and strontium-isotope ratios (Sugarman and others, 1995). Unconformably overlies the Mount Laurel Formation. Contact with Mount Laurel is commonly marked by a sharp peak in gamma-ray intensity on geophysical well logs, with reduced intensity in the Mount Laurel.

**Description of Geologic Units
Shown on Cross-Section A-A'
(cont.)**

Kml **MOUNT LAUREL FORMATION**—Glauconitic (3-15%) fine-to-medium quartz sand, minor medium-to-coarse sand, with thin interbeds of clay and silt; yellowish-brown where weathered, olive-gray to olive-brown where unweathered. Sand is unstratified to horizontally bedded to cross-bedded. As much as 50 feet thick in the southern part of the quadrangle; thins to 20 feet to the north. In subsurface only, covered by surficial deposits in the Navesink River estuary and by overlying Coastal Plain formations elsewhere. Late Cretaceous (late Campanian) in age, based on calcareous nannofossils and strontium-isotope ratios (Sugarman and others, 1991; Miller and others, 2006). Grades downward into the Wenonah Formation. On geophysical well logs, transition to Wenonah is generally marked by slightly decreased resistance and increased gamma-ray intensity.

Kw **WENONAH FORMATION**—Silty fine-to-very-fine quartz sand to fine-sandy clayey silt, micaceous, slightly glauconitic (<5%); yellow, very pale brown where weathered, gray to pale-olive where unweathered; unstratified. As much as 40 feet thick. In subsurface only, covered by surficial deposits in the Navesink River estuary and by overlying Coastal Plain formations elsewhere. Late Cretaceous (late Campanian) in age based on pollen (Wolfe, 1976) and ammonites (Kennedy and Cobban, 1994). Grades downward into the Marshalltown Formation. On geophysical well logs, transition to Marshalltown is marked by increased gamma-ray intensity.

Kmt **MARSHALLTOWN FORMATION**—Glauconitic (20-50%), slightly micaceous, silty-clayey fine-to-medium quartz sand, to fine-sandy clayey silt; olive-gray to olive-brown; unstratified. Thickness is 15 to 20 feet. In subsurface only. Late Cretaceous (middle Campanian) in age based on calcareous nannofossils, foraminifera, mollusks, and strontium-isotope ratios (Sugarman and others, 1995). Unconformably overlies the Englishtown Formation. On geophysical well logs, contact with Englishtown is marked by decreased gamma-ray intensity and slightly increased resistance.

Ket **ENGLISHTOWN FORMATION**—Fine-to-medium quartz sand, minor medium-to-coarse sand, with thin interbeds of clay and silt; micaceous and lignitic, with a trace (<1%) of glauconite; white and light gray where weathered, dark gray where unweathered. Sand is unstratified to horizontally bedded to cross-bedded. In subsurface only. As much as 140 feet thick in the eastern part of the quadrangle, thins to 110 feet thick in the west. In the Asbury Park quadrangle to the south of the Long Branch quadrangle, and farther southwest in northern Ocean County, the Englishtown is divided into an upper and lower member based on the presence of a clay-silt facies in the middle of the formation that is distinctive on gamma-ray logs (Nichols, 1977; Sugarman and Owens, 1994; Miller and others, 2006). This facies is not well marked on gamma-ray logs in the Long Branch quadrangle (wells 29-9335, 29-7941, 29-9465, 29-6173, 29-23948, and 29-48307) and so the members are not mapped here. Late Cretaceous (middle to late Campanian) in age, based on pollen (Wolfe, 1976), ostracodes (Gohn, 1992), calcareous nannofossils, and strontium-isotope ratios (Miller and others, 2006). Grades downward into the Woodbury Formation. On geophysical well logs, transition to Woodbury is marked by increased gamma-ray intensity and decreased resistance.

Kwb **WOODBURY FORMATION**—Clay, silty clay, with minor thin beds of very fine quartz sand, slightly micaceous and lignitic; dark gray and black where unweathered, yellowish-brown to brown where weathered; unstratified. In subsurface only. As much as 240 feet thick in the eastern part of the quadrangle, thins to 160 feet thick in the central and western parts of the quadrangle. Late Cretaceous (early to middle Campanian) based on pollen (Wolfe, 1976), ostracodes (Gohn, 1992), and calcareous nannofossils (Miller and others, 2006). Grades downward into the Merchantville Formation. On geophysical well logs, transition to the Merchantville is marked by slightly increased gamma-ray intensity.

Description of Geologic Units
Shown on Cross-Section A-A'
(cont.)

Kmv **MERCHANTVILLE FORMATION**—Glauconitic (20-50%) clayey silt to sandy clayey silt, slightly micaceous; olive, dark gray, black where unweathered, olive-brown to yellowish-brown where weathered; unstratified. Thickness is 40 to 60 feet. In subsurface only. Late Cretaceous (early Campanian to Santonian) in age based on ammonites (Owens and others, 1977) and calcareous nannofossils (Miller and others, 2006). The Cheesequake Formation, a glauconitic clayey silt underlying the Merchantville, is mapped in outcrop in northern Monmouth and eastern Middlesex counties (Sugarman and Owens, 1996; Sugarman and others, 2005; Stanford and Sugarman, 2008) and in the subsurface both west and south of the Long Branch quadrangle (Sugarman and Owens, 1994, 1996). Because it is lithically similar to the Merchantville and cannot be easily distinguished from it on geophysical logs, it is not mapped separately here. If present, it is included here within the Merchantville, or uppermost Magothy Formation.

Kmg **MAGOTHY FORMATION**—Fine-to-medium quartz sand, some very-fine-to-fine sand and minor medium-to-coarse sand, micaceous, lignitic, and pyrite-bearing in places, with thin interbeds of silt and clay; white to yellow where weathered, light gray to gray where unweathered. Sand is cross-bedded to laminated. As much as 220 feet thick. In subsurface only. Late Cretaceous (Turonian-Santonian) in age, based on pollen (Christopher, 1979, 1982; Miller and others, 2006). Unconformably overlies the Raritan Formation, Woodbridge Clay member. On geophysical well logs, contact with the Woodbridge is marked by increased gamma-ray intensity.

In its outcrop area in eastern Middlesex County the Magothy is divided into 5 members. From bottom to top they include: South Amboy Fire Clay, Old Bridge Sand, Amboy Stoneware Clay, Morgan beds, and Cliffwood beds (Sugarman and others, 2005). The Old Bridge is a thick sand, the other members are interbedded clay-silt and fine sand. These members may extend downdip in the subsurface (Miller and others, 2006). Geophysical well logs in the Long Branch quadrangle (wells 29-21612, 29-23948, 29-21510, 29-9335, 29-7941, 29-9465, and 29-6173) show generally higher gamma-ray intensity and lower resistivity in the uppermost 50 feet of the formation, and again in the lowermost 30-40 feet, than in the middle 100-120 feet. The upper fine-grained beds may correspond to the Amboy Stoneware Clay and Morgan and Cliffwood beds, and the lower fine-grained beds may correspond to the South Amboy Fire Clay. The middle sand may correspond to the Old Bridge Sand.

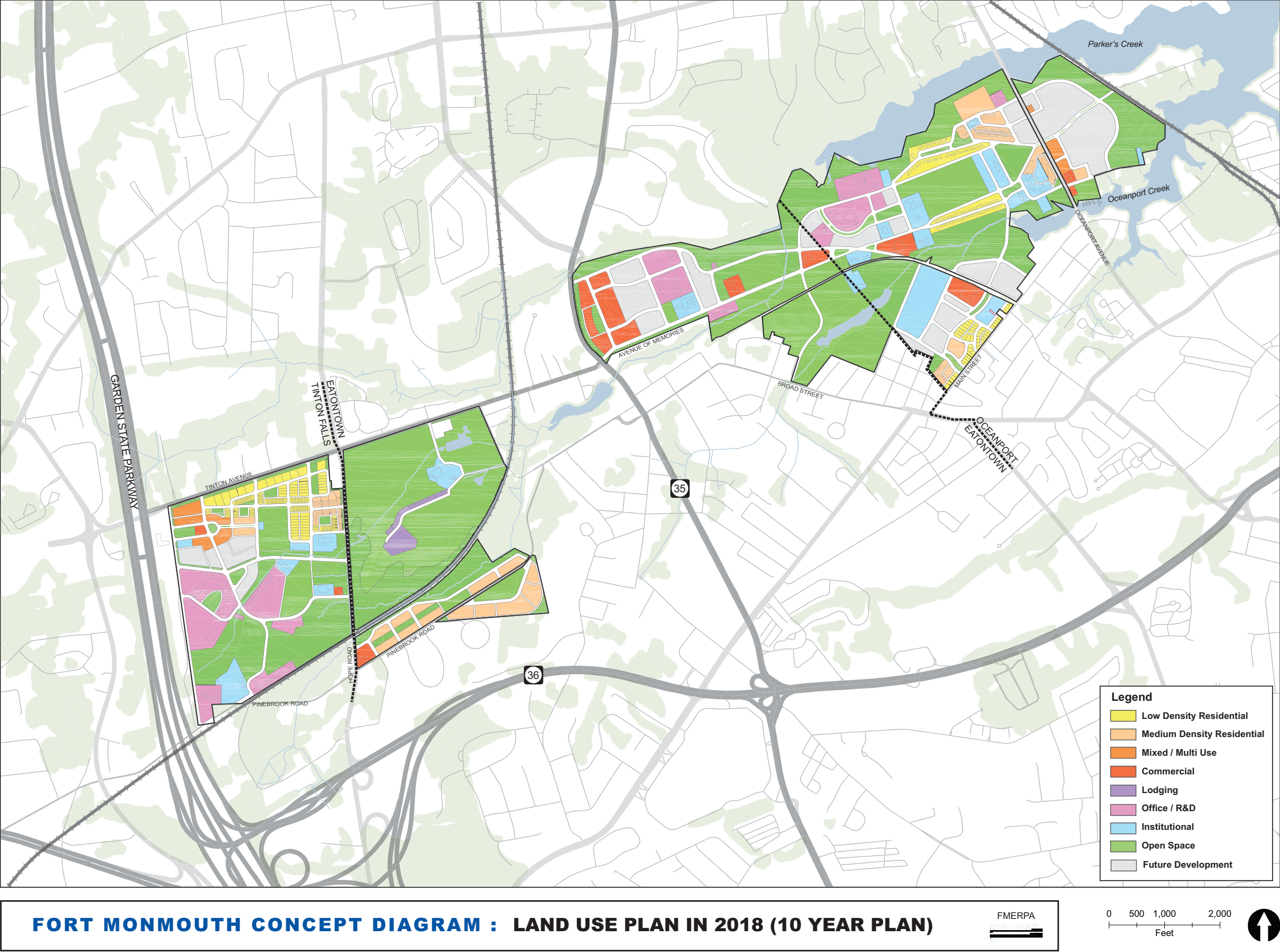
Krw **RARITAN FORMATION, WOODBRIDGE CLAY MEMBER**—Clay and silt, micaceous, lignitic, and pyrite-bearing; gray and black where unweathered, white to brown where weathered; with minor thin interbeds and laminae of white, yellow, and light gray very-fine-to-fine quartz sand. As much as 110 feet thick. In subsurface only, penetrated by wells 29-9465 and 29-1921. The driller's log for well 29-2366 in Eatontown reports "weathered bedrock", with no further information, beneath the Magothy Formation, at a depth of 875-891 feet. This depth is anomalously shallow for the basement surface, suggesting that the material may be weathered clay of either the Woodbridge or South Amboy Fire Clay member of the Magothy. The Woodbridge is Late Cretaceous (late Cenomanian) in age based on pollen (Christopher, 1979) and ammonites (Cobban and Kennedy, 1990). Grades downward into the Raritan Formation, Farrington Sand member. Transition to the Farrington is marked by decreased gamma-ray intensity on geophysical well logs.

Krf **RARITAN FORMATION, FARRINGTON SAND MEMBER**—Fine-to-coarse quartz sand, some coarse-to-very-coarse sand, minor beds of clay and silt; white and yellow where weathered, gray where unweathered. Sands are horizontally bedded to cross-bedded. As much as 60 feet thick. In subsurface only, penetrated in well 29-9465. Late Cretaceous (Cenomanian) in age based on pollen (Christopher, 1979). Unconformably overlies the Potomac Formation. Contact with Potomac is marked by increased gamma-ray intensity on geophysical well logs.

Kp

POTOMAC FORMATION—Fine-to-medium quartz sand, some coarse-to-very-coarse sand, with beds of clay and silt; white, red, yellow where weathered, gray where unweathered. Sands are horizontally bedded to cross-bedded, clays are in beds as much as 8 feet thick. More than 90 feet thick, full thickness not penetrated in the Long Branch quadrangle. In subsurface only, partially penetrated in well 29-9465. Late Cretaceous (Albian-Cenomanian) based on pollen (Sugarman and Owens, 1996; Miller and others, 2006), which indicates that the Potomac in this area corresponds to the Potomac Formation, unit 3, of Doyle and Robbins (1977).

**Description of Geologic Units
Shown on Cross-Section A-A'
(cont.)**



APPENDIX B

RECREATIONAL USER SCREENING LEVEL CALCULATIONS, EXPOSURE ASSUMPTIONS, AND PROUCL OUTPUT

Screening Level Exposure Assumptions for FTMM Receptors

Potential receptors at the site include outdoor workers and recreational users.

Soil screening levels are calculated as described below.

The following abbreviations are used:

- nc = noncarcinogenic
- ing = ingestion
- der = dermal
- inh = inhalation
- ca = carcinogenic
- mu = mutagenic
- adl = adolescent
- adjust = adjusted

SOIL:

Outdoor Worker. The outdoor worker would be exposed to surface soil through incidental ingestion of soil, dermal contact with soil, and inhalation of volatiles and particulates from soil.

The soil screening levels for the outdoor worker are calculated as:

Noncarcinogenic

Ingestion

$$SL_{nc-ing} = \frac{THQ \times AT \times ED \times BW_{adult}}{EF \times ED \times \frac{1}{RfD_o} \times IRS \times \left(\frac{10^{-6}kg}{1mg}\right)}$$

Dermal

$$SL_{nc-der} = \frac{THQ \times AT \times ED \times BW_{adult}}{EF \times ED \times \left(\frac{1}{RfD_o \times GIABS}\right) \times SA \times AF \times ABS_d \times \left(\frac{10^{-6}kg}{1mg}\right)}$$

Inhalation

$$SL_{nc-inh} = \frac{THQ \times AT \times ED}{EF \times ED \times ET \times \frac{1 day}{24 hours} \times \frac{1}{RfC} \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w}\right)}$$

Total

$$SL_{nc-total} = \frac{1}{\frac{1}{SL_{nc-ing}} + \frac{1}{SL_{nc-der}} + \frac{1}{SL_{nc-inh}}}$$

Carcinogenic

Ingestion

$$SL_{ca-ing} = \frac{TR \times AT \times LT \times BW_{adult}}{EF \times ED \times Cfs_o \times IRS \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Dermal

$$SL_{ca-der} = \frac{TR \times AT \times LT \times BW_{adult}}{EF \times ED \times \frac{CFS_o}{GIABS} \times SA \times AF \times ABS_d \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Inhalation

$$SL_{ca-inh} = \frac{TR \times AT \times LT}{EF \times ED \times ET \times \frac{1\ day}{24\ hours} \times IUR \times \left(\frac{1000\mu g}{mg}\right) \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w}\right)}$$

Total

$$SL_{ca-total} = \frac{1}{\frac{1}{SL_{ca-ing}} + \frac{1}{SL_{ca-der}} + \frac{1}{SL_{ca-inh}}}$$

Mutagenic

Ingestion

$$SL_{mu-ing} = \frac{TR \times AT_r \times LT}{EF_r \times CfS_o \times IFSM \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Where:

$$IFSM = \frac{ED \times IRS}{BW}$$

Dermal

$$SL_{mu-der} = \frac{TR \times AT_r \times LT}{EF_r \times \frac{CFS_o}{GIABS} \times DFSM \times ABS_d \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Where:

$$DFSM = \frac{ED \times SA}{BW}$$

Inhalation

$$SL_{mu-inh} = \frac{TR \times AT_r \times LT}{EF_r \times ED \times ET \times \frac{1\ day}{24\ hours} \times IUR \times \left(\frac{1000\mu g}{mg}\right) \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w}\right)}$$

Total

$$SL_{mu-total} = \frac{1}{\frac{1}{SL_{mu-ing}} + \frac{1}{SL_{mu-der}} + \frac{1}{SL_{mu-inh}}}$$

Recreational user: The recreational user would be exposed to surface soil through incidental ingestion of soil, dermal contact with soil, and inhalation of volatiles and particulates from soil, in part as an adolescent (aged 6-16 for noncarcinogens) and in part as an adult (aged 16-30 for noncarcinogens). For carcinogenic compounds the default age is 6-30 years.

The screening levels for the recreational user are calculated as:

Noncarcinogenic adolescent

Ingestion

$$SL_{nc-ing} = \frac{THQ \times AT \times ED_{adl} \times BW_{adl}}{EF \times ED \times \frac{1}{RfD_o} \times IRS_{adl} \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Dermal

$$SL_{nc-der} = \frac{THQ \times AT \times ED_{adl} \times BW_{adl}}{EF \times ED \times \left(\frac{1}{RfD_o \times GIABS} \right) \times SA_{adl} \times AF_{adl} \times ABS_d \times \left(\frac{10^{-6}kg}{1\ mg} \right)}$$

Inhalation

$$SL_{nc-inh} = \frac{THQ \times AT \times ED_{adl}}{EF \times ED_{adl} \times ET_{adl} \times \frac{1\ day}{24\ hours} \times \frac{1}{RfC} \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w} \right)}$$

Total

$$SL_{nc-total} = \frac{1}{\frac{1}{SL_{nc-ing}} + \frac{1}{SL_{nc-der}} + \frac{1}{SL_{nc-inh}}}$$

Noncarcinogenic adult

Ingestion

$$SL_{nc-ing} = \frac{THQ \times AT \times ED_{adult} \times BW_{adult}}{EF \times ED \times \frac{1}{RfD_o} \times IRS_{adult} \times \left(\frac{10^{-6}kg}{1\ mg} \right)}$$

Dermal

$$SL_{nc-der} = \frac{THQ \times AT \times ED_{adult} \times BW_{adult}}{EF \times ED \times \left(\frac{1}{RfD_o \times GIABS} \right) \times SA_{adult} \times AF_{adult} \times ABS_d \times \left(\frac{10^{-6}kg}{1\ mg} \right)}$$

Inhalation

$$SL_{nc-inh} = \frac{THQ \times AT \times ED_{adult}}{EF \times ED_{adult} \times ET_{adult} \times \frac{1\ day}{24\ hours} \times \frac{1}{RfC} \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w} \right)}$$

Total

$$SL_{nc-total} = \frac{1}{\frac{1}{SL_{nc-ing}} + \frac{1}{SL_{nc-der}} + \frac{1}{SL_{nc-inh}}}$$

Carcinogenic Ingestion

$$SL_{ca-ing} = \frac{TR \times AT \times LT}{CfS_o \times IFS_{adj} \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Where:

$$IFS_{adjust} = \frac{ED_{adl} \times EF_{adl} \times IRS_{adl}}{BW_{adl}} + \frac{ED_{adult} \times EF_{adult} \times IRS_{adult}}{BW_{adult}}$$

Dermal

$$SL_{ca-der} = \frac{TR \times AT \times LT}{\frac{CsF_o}{GIABS} \times DFS_{adj} \times ABS_d \times \left(\frac{10^{-6}kg}{1\ mg}\right)}$$

Where:

$$DFS_{adjust} = \frac{ED_{adl} \times EF_{adl} \times SA_{adl} \times AF_{adl}}{BW_{adl}} + \frac{ED_{adult} \times EF_{adult} \times SA_{adult} \times AF_{adult}}{BW_{adult}}$$

Inhalation

$$SL_{ca-inh} = \frac{TR \times AT \times LT}{EF_{rec} \times ED_{rec} \times ET_{rec} \times \left(\frac{1\ day}{24\ hours}\right) \times IUR \times \left(\frac{1000\mu g}{mg}\right) \times \left(\frac{1}{VF_s} + \frac{1}{PEF}\right)}$$

Total

$$SL_{ca-total} = \frac{1}{\frac{1}{SL_{ca-ing}} + \frac{1}{SL_{ca-der}} + \frac{1}{SL_{ca-inh}}}$$

Mutagenic

Ingestion

$$SL_{mu-ing} = \frac{TR \times AT_r \times LT}{EF_r \times CfS_o \times IFSM_{adjust} \times \left(\frac{10^{-6}kg}{1mg}\right)}$$

Where:

$$IFSM_{adjust} = \frac{ED_{adl} \times IRS_{adl} \times 3}{BW_{adl}} + \frac{ED_{adult} \times IRS_{adult} \times 1}{BW_{adult}}$$

Dermal

$$SL_{mu-der} = \frac{TR \times AT_r \times LT}{\frac{CFS_o}{GIABS} \times DFSM_{adjust} \times ABS_d \times \left(\frac{10^{-6}kg}{1mg}\right)}$$

Where:

$$DFSM_{adjust} = \frac{ED_{adl} \times EF_{adl} \times SA_{adl} \times 3}{BW_{adl}} + \frac{ED_{adult} \times EF_{adult} \times SA_{adult} \times 1}{BW_{adult}}$$

Inhalation

$$SL_{mu-inh} = \frac{TR \times AT_r \times LT}{ET \times \frac{1 \text{ day}}{24 \text{ hours}} \times ((ED_{adl} \times EF_{adl} \times ET_{adl} \times IUR_{adl} \times 3) + (ED_{adult} \times EF_{adult} \times ET_{adult} \times IUR_{adult} \times 1)) \times \left(\frac{1}{VF_s} + \frac{1}{PEF_w}\right)}$$

Total

$$SL_{mu-total} = \frac{1}{\frac{1}{SL_{mu-ing}} + \frac{1}{SL_{mu-der}} + \frac{1}{SL_{mu-inh}}}$$

Supporting Equations

Particulate Emission Factor

$$PEF = \frac{Q}{C} \times \frac{3,600 \text{ seconds/hour}}{0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times [F(x)]}$$

Volatilization Factor

$$VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times CF_{vol}}{(2 \times \rho_b \times D_A)}$$

Where:

$$\left(\theta_a^{10/3} \times D_i \times H' + \theta_w^{10/3} \times D_w \right) / n^2$$

$$D_A = \frac{(\rho_b \times K_d + \theta_w + \theta_a \times H')}{n^2}$$

Summary of Exposure Assumptions for Soil

Parameter (Abbreviation)	Units	Outdoor Worker	Sources	Rationale	Recreational User	Sources	Rationale
Target Hazard Quotient (THQ)	unitless	1	a, b	USEPA recommended	1	a, b	USEPA recommended
Averaging Time (AT)	days	9,125 (nc) 25,550 (c)	a, b	USEPA recommended	5,110 (nc-adult) 3,650 (nc-adl) 25,550 (c)	a, b	USEPA recommended
Exposure Duration-adult (ED _{adult})	year	25	c	USEPA standard default value for industrial worker.	14 (age 16-30)	b	Represents the number of years returning to the same location
Exposure Duration-adolescent (noncarcinogenic age 6-16) (ED _{adl})	year	--	--	--	10 (age 6-16)	b	Assumes adolescent recreational user 6 to 16 years of age.
Body Weight-adult (BW _{adult})	kg	70	a	Mean adult body weight	70	a	Mean adult body weight
Body Weight-adolescent (BW _{adl})	kg	--	--	--	56	c	Mean body weight for adolescent 6 to 16 years of age
Exposure Frequency-adult (EF _{adult})	days/year	250	c	USEPA recommended value for industrial worker. Site-specific value of 250 days per year for 50 weeks.	50	d	Assumes recreational user on site once per week every week of the year

Parameter (Abbreviation)	Units	Outdoor Worker	Sources	Rationale	Recreational User	Sources	Rationale
Exposure Frequency-adolescent (EF _{adl})	days/year	--	--		50	d	Assumes recreational user on site once per week every week of the year
Oral Reference Dose (RfD _o)	mg/kg-day	Chemical specific	b		Chemical specific	b	
Soil Ingestion Rate-adult (IRS _{adult})	mg/day	100	a, e	USEPA recommended value for outdoor industrial worker.	50	e	USEPA recommended values for recreational user.
Soil Ingestion Rate-adolescent (IRS _{adl})	mg/day	--	e	--	100	b	Used value for 6 to <21 years for adolescent.
Gastrointestinal Absorption Fraction (GIABS)	unitless	Chemical specific	c		Chemical specific	c	
Surface Area-adult (SA _{adult})	cm ² /day	3300	b,c	USEPA default value for industrial worker	3300	b,c	
Surface Area-adolescent (SA _{adl})	cm ² /day	--	--	--	2800	f	
Adherence Factor-adult (AF _{adult})	mg/cm ²	0.07	c, f	USEPA value for 95 th percentile for commercial/industrial landscaper	0.07	c, f	Geometric mean for activities equivalent to gardening
Adherence Factor-adolescent (AF _{adl})	mg/cm ²	--	--	--	0.07	b	Geometric mean for activities equivalent to gardening
Dermal Absorption Factor (ABS _d)	unitless	Chemical specific	c		Chemical specific	c	

Parameter (Abbreviation)	Units	Outdoor Worker	Sources	Rationale	Recreational User	Sources	Rationale
Exposure Time (ET)	hour/event	8	b	USEPA standard default value for workers.	2	d	Assumes recreational users on site for two hours each event
Chronic Inhalation Reference Concentration (RfC)	mg/m ³	Chemical specific	b		Chemical specific	b	
Mutagenic Soil Ingestion Rate (IFSM)	L-year/kg-day	Site specific	b		Site specific	b	
Mutagenic Soil Dermal Contact Factor (DFSM)	Mg-year/kg-day	Site specific	b		Site specific	b	
Volatilization Factor-soil (VF _s)	m ³ /kg	Chemical Specific	b	Chemical-specific volatilization factor	Chemical specific	b	Chemical-specific volatilization factor
Particulate Emission Factor (PEF)	m ³ /kg	3.23E-09	b (with inputs below)	Calculated using Q/C for Philadelphia, Pennsylvania, the nearest city for which USEPA has a Q/C term.	3.23E-09	b (with inputs below)	Calculated using Q/C for Philadelphia, Pennsylvania, the nearest city for which USEPA has a Q/C term.
Target Risk (TR)	unitless	1E-06	b		1E-06	b	
Lifetime (LT)	years	70	b	Conventional human lifespan of 70 years	70	b	Conventional human lifespan of 70 years
Cancer Slope Factor-oral (CSF _O)	(mg/kg-day) ⁻¹	Chemical specific	b		Chemical specific	b	
Inhalation Unit Rate IUR	(µg/m ³) ⁻¹	Chemical specific	b	Chemical-specific Inhalation Unit Rate	Chemical specific	b	Chemical-specific Inhalation Unit Rate

Sources:

- a. USEPA 1989. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A). EPA/540/1-89/002. December 1989. (<http://www.epa.gov/oswer/riskassessment/ragsa/>)
- b. USEPA 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Updated November 2013. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm).
- c. USEPA 2004. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. July 2004. EPA/540/R-99/005. OSWER 9285.7-02EP. (<http://www.epa.gov/swerrims/riskassessment/ragsa/>)
- d. Based on professional judgment; assumes the recreational user would be onsite one day per week (excluding 2 week vacation) for 2 hours per event.
- e. USEPA 1991. Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. March 1991. (http://www.epa.gov/oswer/riskassessment/pdf/oswer_directive_9285_6-03.pdf)
- f. USEPA 2011. Exposure Factors Handbook 2011 Edition (Final). Table 5.1. EPA/600/R-09/052F. September 2011. (<http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252#Download>).
- g. USEPA 2009. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). EPA-540-R-070-002. OSWER 9285.7-82. January 2009. (<http://www.epa.gov/swerrims/riskassessment/ragsf/>)

Summary of Exposure Parameters for VF/PEF

Parameter (Abbreviation)	Units	All Receptors	Sources
Areal extent of the site or contamination (A_s)	acres	0.5	a
Inverse of the ratio of the geometric mean (Q/C_w) for Philadelphia, Pennsylvania	g/m^2 -s per kg/m^3	87.36898	b
Fraction of vegetative cover (V)	unitless	0.5	a
mean annual wind speed (U_m)	m/s	4.29	b
Equivalent Threshold Value (U_t)	m/s	11.32	a
Function Dependent on U_m/U_t (F(x))	unitless	0.0993	b, c
Apparent diffusivity (D_A)	cm^2/s	Chemical specific	b
Exposure interval (T)	seconds	9.5E08	b
Conversion Factor-volatilization (CF_{vol})	m^2/cm^2	1.0E-04	b
Dry soil bulk density (ρ_b)	g/cm^3	1.5	a, b
Air-filled Soil Porosity (θ_a)	L_{air}/L_{soil}	0.28	a (calculated as $n - \theta_w$)
Total Soil Porosity (n)	L_{pore}/L_{soil}	0.43	a (calculated as $1 - (\rho_b / \rho_s)$). b
Water-filled Soil Porosity (θ_w)	L_{water}/L_{soil}	0.15	a, b
Soil particle density (ρ_s)	g/cm^3	2.65	a
Diffusivity in Air (D_i)	$cm^2/second$	Chemical specific	a
Henry's law constant (H')	Dimensionless	Chemical specific	a

Parameter (Abbreviation)	Units	All Receptors	Sources
Diffusivity in Water (D_w)	cm ² /second	Chemical specific	a
Soil-water Partition Coefficient (K_d)	L/kg	Chemical specific	b (calculated as $K_{OC} \times f_{OC}$)
Soil organic carbon-water Partition Coefficient (K_{OC})	L/kg	Chemical specific	a, b
Organic Carbon Content of Soil (f_{OC})	g/g	0.006	a, b

Sources

- USEPA 1996. Soil Screening Guidance: Technical Background document. EPA/540/R95/128. July 1996. (<http://www.epa.gov/superfund/health/conmedia/soil/introtbd.htm>).
- USEPA 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Updated November 2013. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm).
- Cowherd, C., G. Muleski, P. Engelhart, and D. Gillette. 1985. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. EPA/600/8-85/002. NTIS PB85-192212.

DATA USED FOR 95% UCL CALCULATIONS

Lab Sample ID	Field Sample Location	Sample Date	Arsenic	d_Arsenic	Thallium	d_Thallium
3396.01	B-1	03/09/98	12.96	1	0.359	0
3396.03	B-2	03/09/98	12.27	1	0.328	0
3396.05	B-3	03/09/98	22.31	1	0.299	0
3398.01	B-4	03/10/98	7.751	1	0.318	0
3398.03	B-5	03/10/98	9.701	1	0.315	0
3398.05	B-6	03/10/98	12.05	1	0.347	0
3398.07	B-7	03/10/98	80.95	1	0.342	0
3398.09	B-8	03/10/98	4.872	1	0.315	0
3398.11	B-9	03/10/98	15.67	1	0.315	0
3398.13	B-10	03/10/98	16.23	1	0.265	0
3398.15	B-11	03/10/98	9.697	1	0.354	0
3398.17	B-12	03/10/98	25.22	1	0.24	0
3399.01	B-13	03/11/98	20.03	1	0.308	0
3399.03	B-14	03/11/98	18.43	1	0.331	0
3399.05	B-15	03/11/98	11.68	1	0.274	0
3399.07	B-16	03/11/98	12.41	1	0.27	0
3399.09	B-17	03/11/98	12.59	1	0.342	0
3399.11	B-18	03/11/98	12.59	1	0.515	0
3399.13	B-19	03/11/98	10.61	1	0.365	0
3399.15	B-20	03/11/98	6.726	1	0.373	0
3399.17	B-21	03/11/98	11.04	1	0.323	0
3399.19	B-22	03/11/98	14	1	0.373	0
3399.21	B-23	03/11/98	9.005	1	0.264	0
3399.29	B-23 Duplicate	03/11/98	17.79	1	0.258	0
3399.23	B-24	03/11/98	9.278	1	0.376	0
3399.25	B-25	03/11/98	7.189	1	0.295	0
3399.27	B-26	03/11/98	7.951	1	0.358	0
3399.31	B-27	03/11/98	17.79	1	0.354	0
3399.33	B-28	03/11/98	16.85	1	0.399	0
3399.35	B-29	03/11/98	21.71	1	0.371	0
3403.01	B-30	03/12/98	20.51	1	0.32	0
3403.03	B-31	03/12/98	10.38	1	0.345	0
3403.05	B-32	03/12/98	6.695	1	0.368	0
3403.07	B-33	03/12/98	5.212	1	0.368	0
3403.09	B-34	03/12/98	266	1	242	1
3403.11	B-35	03/12/98	4.396	1	0.362	0
3403.13	B-36	03/12/98	9.209	1	0.331	0
3403.15	B-37	03/12/98	10.74	1	0.304	0
3403.17	B-38	03/12/98	12.98	1	0.349	0
3403.19	B-39	03/12/98	20.66	1	0.345	0
3403.21	B-40	03/12/98	17.72	1	0.361	0
3403.37	B-40 Duplicate	03/12/98	17.37	1	0.353	0
3403.23	B-41	03/12/98	19.16	1	0.344	0
3403.25	B-42	03/12/98	15.72	1	0.364	0
3403.27	B-43	03/12/98	15.77	1	0.353	0
3403.29	B-44	03/12/98	8.882	1	0.355	0
3403.31	B-45	03/12/98	10.24	1	0.354	0
3403.33	B-46	03/12/98	11.43	1	0.3	0
3403.35	B-47	03/12/98	5.398	1	0.309	0
3403.39	B-48	03/12/98	11.49	1	0.336	0
3403.41	B-49	03/12/98	10.09	1	0.337	0
3408.01	B-50	03/13/98	7.422	1	0.322	0
3408.03	B-51	03/13/98	8.636	1	0.33	0
3408.05	B-52	03/13/98	24.96	1	0.354	0
3408.07	B-53	03/13/98	7.025	1	0.332	0

Lab Sample ID	Field Sample Location	Sample Date	Arsenic	d_Arsenic	Thallium	d_Thallium
3408.09	B-54	03/13/98	13.65	1	0.338	0
3408.11	B-55	03/13/98	11.22	1	0.318	0
3408.13	B-56	03/13/98	10.14	1	0.34	0
3408.15	B-57	03/13/98	39.46	1	0.339	0
3408.17	B-58	03/13/98	7.415	1	0.325	0
3408.19	B-59	03/13/98	16.7	1	0.36	0
3408.21	B-60	03/13/98	12.48	1	0.337	0
3408.29	B-60 Duplicate	03/13/98	16.94	1	0.358	0
3408.23	B-61	03/13/98	18.4	1	0.353	0
3408.25	B-62	03/13/98	8.055	1	0.359	0
3408.27	B-63	03/13/98	3.938	1	0.323	0

PROUCL GENERATED QUANTILE PLOT



PROUCL GENERATED OUTLIER TEST

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation 3/20/2014 10:20

From File

Data for UCL_proUCL temp.xls

Full Precision

OFF

Rosner's Outlier Test for Arsenic

Mean 17.94
 Standard Deviation 32.67
 Number of data 66
 Number of suspected outliers 1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	17.94	32.42		266	35	7.651	3.236

For 5% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 266

For 1% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 266

	A	B	C	D	E	F	G	H	I	J	K	L	M		
1	PROUCL GENERATED OUTPUT FOR 95% UCL CALCULATION														
2								Recreational	User Screening Levels	and ProUCL	Output				
3	UCL Statistics for Uncensored Full Data Sets														
4															
5	User Selected Options														
6	Date/Time of Computation			3/20/2014 10:21:08 AM											
7	From File			Data for UCL_proUCL temp.xls											
8	Full Precision			OFF											
9	Confidence Coefficient			95%											
10	Number of Bootstrap Operations			2000											
11															
12															
13	Arsenic														
14															
15	General Statistics														
16	Total Number of Observations					66		Number of Distinct Observations					64		
17								Number of Missing Observations					0		
18	Minimum					3.938		Mean					17.94		
19	Maximum					266		Median					12.16		
20	SD					32.67		Std. Error of Mean					4.022		
21	Coefficient of Variation					1.822		Skewness					7.048		
22															
23	Normal GOF Test														
24	Shapiro Wilk Test Statistic					0.303		Shapiro Wilk GOF Test							
25	5% Shapiro Wilk P Value					0		Data Not Normal at 5% Significance Level							
26	Lilliefors Test Statistic					0.371		Lilliefors GOF Test							
27	5% Lilliefors Critical Value					0.109		Data Not Normal at 5% Significance Level							
28	Data Not Normal at 5% Significance Level														
29															
30	Assuming Normal Distribution														
31	95% Normal UCL							95% UCLs (Adjusted for Skewness)							
32	95% Student's-t UCL					24.65		95% Adjusted-CLT UCL (Chen-1995)					28.28		
33								95% Modified-t UCL (Johnson-1978)					25.23		
34															
35	Gamma GOF Test														
36	A-D Test Statistic					5.516		Anderson-Darling Gamma GOF Test							
37	5% A-D Critical Value					0.768		Data Not Gamma Distributed at 5% Significance Level							
38	K-S Test Statistic					0.222		Kolmogrov-Smirnoff Gamma GOF Test							
39	5% K-S Critical Value					0.112		Data Not Gamma Distributed at 5% Significance Level							
40	Data Not Gamma Distributed at 5% Significance Level														
41															
42	Gamma Statistics														
43	k hat (MLE)					1.613		k star (bias corrected MLE)					1.55		
44	Theta hat (MLE)					11.12		Theta star (bias corrected MLE)					11.58		
45	nu hat (MLE)					212.9		nu star (bias corrected)					204.5		
46	MLE Mean (bias corrected)					17.94		MLE Sd (bias corrected)					14.41		
47								Approximate Chi Square Value (0.05)					172.5		
48	Adjusted Level of Significance					0.0464		Adjusted Chi Square Value					171.8		
49															

	A	Final B	C	D	E	F	G	H	I	J	K	Appendix B	M
50	Remedial Investigation / Feasibility Study for Assessing Gamma Distribution, recreational User Screening Levels and ProUCL Output												
51	95% Approximate Gamma UCL (use when n>=50))					21.28	95% Adjusted Gamma UCL (use when n<50)					21.36	
52													
53	Lognormal GOF Test												
54	Shapiro Wilk Test Statistic					0.878	Shapiro Wilk Lognormal GOF Test						
55	5% Shapiro Wilk P Value					4.15E-07	Data Not Lognormal at 5% Significance Level						
56	Lilliefors Test Statistic					0.118	Lilliefors Lognormal GOF Test						
57	5% Lilliefors Critical Value					0.109	Data Not Lognormal at 5% Significance Level						
58	Data Not Lognormal at 5% Significance Level												
59													
60	Lognormal Statistics												
61	Minimum of Logged Data					1.371	Mean of logged Data					2.546	
62	Maximum of Logged Data					5.583	SD of logged Data					0.635	
63													
64	Assuming Lognormal Distribution												
65	95% H-UCL					18.22	90% Chebyshev (MVUE) UCL					19.5	
66	95% Chebyshev (MVUE) UCL					21.29	97.5% Chebyshev (MVUE) UCL					23.78	
67	99% Chebyshev (MVUE) UCL					28.66							
68													
69	Nonparametric Distribution Free UCL Statistics												
70	Data do not follow a Discernible Distribution (0.05)												
71													
72	Nonparametric Distribution Free UCLs												
73	95% CLT UCL					24.55	95% Jackknife UCL					24.65	
74	95% Standard Bootstrap UCL					24.66	95% Bootstrap-t UCL					47.72	
75	95% Hall's Bootstrap UCL					53.85	95% Percentile Bootstrap UCL					25.48	
76	95% BCA Bootstrap UCL					31.99							
77	90% Chebyshev(Mean, Sd) UCL					30	95% Chebyshev(Mean, Sd) UCL					35.47	
78	97.5% Chebyshev(Mean, Sd) UCL					43.05	99% Chebyshev(Mean, Sd) UCL					57.95	
79													
80	Suggested UCL to Use												
81	95% Chebyshev (Mean, Sd) UCL					35.47							
82													
83	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
84	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)												
85	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.												
86	For additional insight the user may want to consult a statistician.												
87													
88													
89													
90	General Statistics for Uncensored Data Sets												
91													
92	Variable		NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.67	Skewness	Kurtosis	CV
93	Arsenic		66	0	3.938	266	17.94	32.67	4.022	6.163	7.048	53.16	1.822
94	Thallium		66	0	0.24	242	3.998	29.75	3.662	0.0274	8.124	66	7.44
95													
96	Percentiles for Uncensored Data Sets												
97													
98	Variable		NumObs	# Missing	10%ile	20%ile	25%ile(Q1	50%ile(Q2	75%ile(Q3	80%ile	90%ile	95%ile	99%ile
99	Arsenic		66	0	6.876	8.055	9.056	12.16	17.26	17.79	21.19	25.16	145.7
100	Thallium		66	0	0.297	0.315	0.319	0.341	0.358	0.36	0.37	0.375	85.03

1
2

APPENDIX C

COST ESTIMATE

**APPENDIX C
LANDFILL COVER AND LAND USE CONTROLS COST ESTIMATE
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY**

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C.1B	Specific Response Action Summary
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C.3	Land Use Controls Present Value
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C.5	Attachments for LUC Implementation
C.5	Landfill Cover Cost Breakdown
C.7	Attachments for Landfill Cover Design and Installation

TABLE C.1A
COST ESTIMATE SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Remedial Alternative	Description	Capital Cost	Annual Operations and Maintenance Cost ^{a/}	Periodic Cost ^{b/}	Non-Discounted Constant Dollar Cost ^{c/}	TPV at 1.90% Discount Rate ^{d/}
1	No Action	\$0	\$0	\$0	\$0	\$0
2	Landfill Cover and Land Use Controls (LUCs)	\$435,157	\$4,000	\$0	\$553,157	\$520,000

NOTES

- ^{a/} Highest annual operations and maintenance (O&M) costs for remedial alternatives shown. Some costs decrease after a period of operation.
^{b/} Highest annual periodic costs for remedial alternatives shown. Periodic costs may be less during a specific year.
^{c/} Non-discounted constant dollar cost provided to show impact of discount rate on total present value (TPV).
^{d/} TPV cost estimates are considered accurate to within -30% to +50% of actual costs. Discount rate is shown below.

Other Notes/Assumptions

1. Design and construction contingencies have been added to capital and O&M costs based on USEPA (2000) and professional judgment.
USEPA. 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. USEPA 540-R-00-002. July.

Source

Discount Rate: 30-Year, Real Discount Rate from White House Office of Management and Budget, Circular A-94 Appendix C, Revised December 2013

TABLE C.1B
SPECIFIC RESPONSE ACTIONS COST SUMMARY
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Specific Response Action	Description	Capital Cost	Annual Operations and Maintenance Cost ^{a/}	Periodic Cost ^{b/}	Non-Discounted Constant Dollar Cost ^{c/}	TPV at 1.90% Discount Rate ^{d/}
1	No Action	\$0	\$0	\$0	\$0	\$0
2	Land Use Controls	\$62,000	\$4,000	\$0	\$180,000	\$150,000
3	Landfill Cover	\$373,157	\$0	\$0	\$373,157	\$370,000

NOTES

^{a/} Highest annual operations and maintenance (O&M) costs for remedial alternatives shown. Some costs decrease after a period of operation.

^{b/} Highest annual periodic costs for remedial alternatives shown. Periodic costs may be less during a specific year.

^{c/} Non-discounted constant dollar cost provided to show impact of discount rate on total present value (TPV).

^{d/} TPV cost estimates are considered accurate to within -30% to +50% of actual costs. Discount rate is shown below.

Other Notes/Assumptions

1. Design and construction contingencies have been added to capital and O&M costs based on USEPA (2000) and professional judgment.

Discount Rate:

1.90%

Source
30-Year, Real Discount Rate from White House Office of Management and Budget,
Circular A-94 Appendix C, Revised December 2013

TABLE C.2
LAND USE CONTROLS
COST BREAKDOWN
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Item	Units	Unit Cost	Extended
<i>Capital</i>			
Implementation of Land Use Controls (See Table C.11, Attachment 1)	1 Lump Sum	\$ 49,194	\$ 49,194
		<i>Sub-Total</i>	\$ 49,194
Contingency (design + construction)	25%		\$ 12,300
		<i>Capital Total</i>	\$ 61,494
<i>Annual Operation and Maintenance</i>			
Land Use Controls Inspection and Reporting (30 Years)	1 each	\$ 3,200	\$ 3,200
Contingency	25%		\$ 800
		<i>Annual Total</i>	\$ 4,000

Assumptions:

- 1) LUCs have a 30-year duration.

**TABLE C.3
LAND USE CONTROLS
PRESENT VALUE
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY**

Year	Capital Cost (\$)	Annual O&M (\$) (LUCs)	Periodic Costs (\$)	Total Cost	Discount Factor at 1.90%	Present Value at 1.90%
Annual Cost for Remedial Alternatives with Source Control - Cost shown for 30 years						
0	\$ 61,500	\$ -	\$ -	\$ 61,500	1.000	\$ 61,500
1	\$ -	\$ 4,000	\$ -	\$ 4,000	0.981	\$ 3,926
2	\$ -	\$ 4,000	\$ -	\$ 4,000	0.963	\$ 3,853
3	\$ -	\$ 4,000	\$ -	\$ 4,000	0.945	\$ 3,781
4	\$ -	\$ 4,000	\$ -	\$ 4,000	0.927	\$ 3,710
5	\$ -	\$ 4,000	\$ -	\$ 4,000	0.910	\$ 3,641
6	\$ -	\$ 4,000	\$ -	\$ 4,000	0.893	\$ 3,573
7	\$ -	\$ 4,000	\$ -	\$ 4,000	0.877	\$ 3,507
8	\$ -	\$ 4,000	\$ -	\$ 4,000	0.860	\$ 3,441
9	\$ -	\$ 4,000	\$ -	\$ 4,000	0.844	\$ 3,377
10	\$ -	\$ 4,000	\$ -	\$ 4,000	0.828	\$ 3,314
11	\$ -	\$ 4,000	\$ -	\$ 4,000	0.813	\$ 3,252
12	\$ -	\$ 4,000	\$ -	\$ 4,000	0.798	\$ 3,192
13	\$ -	\$ 4,000	\$ -	\$ 4,000	0.783	\$ 3,132
14	\$ -	\$ 4,000	\$ -	\$ 4,000	0.768	\$ 3,074
15	\$ -	\$ 4,000	\$ -	\$ 4,000	0.754	\$ 3,017
16	\$ -	\$ 4,000	\$ -	\$ 4,000	0.740	\$ 2,960
17	\$ -	\$ 4,000	\$ -	\$ 4,000	0.726	\$ 2,905
18	\$ -	\$ 4,000	\$ -	\$ 4,000	0.713	\$ 2,851
19	\$ -	\$ 4,000	\$ -	\$ 4,000	0.699	\$ 2,798
20	\$ -	\$ 4,000	\$ -	\$ 4,000	0.686	\$ 2,746
21	\$ -	\$ 4,000	\$ -	\$ 4,000	0.674	\$ 2,695
22	\$ -	\$ 4,000	\$ -	\$ 4,000	0.661	\$ 2,644
23	\$ -	\$ 4,000	\$ -	\$ 4,000	0.649	\$ 2,595
24	\$ -	\$ 4,000	\$ -	\$ 4,000	0.637	\$ 2,547
25	\$ -	\$ 4,000	\$ -	\$ 4,000	0.625	\$ 2,499
26	\$ -	\$ 4,000	\$ -	\$ 4,000	0.613	\$ 2,453
27	\$ -	\$ 4,000	\$ -	\$ 4,000	0.602	\$ 2,407
28	\$ -	\$ 4,000	\$ -	\$ 4,000	0.590	\$ 2,362
29	\$ -	\$ 4,000	\$ -	\$ 4,000	0.579	\$ 2,318
30	\$ -	\$ 4,000	\$ -	\$ 4,000	0.569	\$ 2,275
TOTALS	\$ 61,500	\$ 120,000	\$ -	\$ 181,500		\$ 152,400

TABLE C.4
LAND USE CONTROLS
PERIODIC COST BREAKDOWN
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Year	Annual O&M Cost Breakdown (\$)		Periodic Cost Breakdown (\$)		
	(LUCs)				
0	\$	-	\$	-	\$ -
1	\$	4,000	\$	-	\$ -
2	\$	4,000	\$	-	\$ -
3	\$	4,000	\$	-	\$ -
4	\$	4,000	\$	-	\$ -
5	\$	4,000	\$	-	\$ -
6	\$	4,000	\$	-	\$ -
7	\$	4,000	\$	-	\$ -
8	\$	4,000	\$	-	\$ -
9	\$	4,000	\$	-	\$ -
10	\$	4,000	\$	-	\$ -
11	\$	4,000	\$	-	\$ -
12	\$	4,000	\$	-	\$ -
13	\$	4,000	\$	-	\$ -
14	\$	4,000	\$	-	\$ -
15	\$	4,000	\$	-	\$ -
16	\$	4,000	\$	-	\$ -
17	\$	4,000	\$	-	\$ -
18	\$	4,000	\$	-	\$ -
19	\$	4,000	\$	-	\$ -
20	\$	4,000	\$	-	\$ -
21	\$	4,000	\$	-	\$ -
22	\$	4,000	\$	-	\$ -
23	\$	4,000	\$	-	\$ -
24	\$	4,000	\$	-	\$ -
25	\$	4,000	\$	-	\$ -
26	\$	4,000	\$	-	\$ -
27	\$	4,000	\$	-	\$ -
28	\$	4,000	\$	-	\$ -
29	\$	4,000	\$	-	\$ -
30	\$	4,000	\$	-	\$ -
TOTALS	\$	40,000	\$	-	

TABLE C.5
ATTACHMENTS FOR LUC IMPLEMENTATION
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Attachment 1 - Implementation of Land Use Controls					
<u>Subtask Description, Labor</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Cost</u>	<u>Source</u>
LUC Implementation Plan	1	Lump Sum	\$ 24,597	\$ 24,597	professional judgement
Delineate Area onto Master Planning Maps/GIS	1	Lump Sum	\$ 24,597	\$ 24,597	professional judgement
			Total	\$ 49,194	

**TABLE C.6
LANDFILL COVER
COST BREAKDOWN
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY**

Item	Units		Unit Cost		Extended
<i>Capital</i>					
Soil Cap Installation (see Table C.7 Attachment 1)	1	Lump Sum	\$	293,000	\$ 293,000
Geotechnical borings (see Table C.7 Attachment 2)	1	Lump Sum	\$	5,556	\$ 5,556
				<i>Sub-Total</i>	\$ 298,556
Contingency (design + construction)	25%				\$ 74,600
				<i>Capital Total</i>	\$ 373,157

TABLE C.7
ATTACHMENT FOR LANDFILL COVER DESIGN AND INSTALLATION
SITE FTMM-04
FORT MONMOUTH, NEW JERSEY

Attachment 1- Landfill Cover					
Item	Quantity	Units	Unit Cost	Extended	Comments
<i>Capital</i>					
<i>Landfill Soil Cap Installation</i>					
Mobilization and site preparation	1	Lump Sum	\$ 1,500.00	\$ 1,500	contractor bid
Clearing and grubbing	1.4	acre	\$ 2,900.00	\$ 4,060	contractor bid
Subgrad preparation and compaction	1.4	acre	\$ 4,250.00	\$ 5,950	contractor bid
Soil Cover material	1.4	acre	\$ 54,511	\$ 76,315	contractor bid
Placement of soil cover material	1.4	acre	\$ 10,865	\$ 15,211	contractor bid
Placement of vegetative layer material	1.4	acre	\$ 3,802	\$ 5,323	contractor bid
Seeding of soil caps	1.4	acre	\$ 4,845	\$ 6,783	contractor bid
Temporary erosion and sediment controls	166.0	LF	\$ 7	\$ 1,156	contractor bid
Permanent stormwater features	166	LF	\$ 31	\$ 5,193	contractor bid
Demobilization	1	Lump Sum	\$ 1,500	\$ 1,500	contractor bid
Subgrade material	2800	tons	\$ 14	\$ 39,900	contractor bid
Placement of Subgrade material	2800	tons	\$ 6	\$ 16,800	contractor bid
			Sub-Total	\$ 179,691	
<i>Design & Construction Oversight</i>					
<i>Labor</i>					
Engineer/Geologist	570	Hour	\$ 110	\$ 62,700	professional judgement
CSP	19	Hour	\$ 100	\$ 1,900	professional judgement
Administrative/home office	177	Hour	\$ 56	\$ 9,912	professional judgement
Scientist	39	Hour	\$ 77	\$ 3,003	professional judgement
Contract Specialist	11	Hour	\$ 77	\$ 847	professional judgement
Project Manager	269	Hour	\$ 130	\$ 34,970	professional judgement
				\$ 113,332	
			Subtotal: Landfill Soil Cap Installation	\$ 293,000	
Attachment 2 - Geotechnical Borings					
	Quantity	Unit	Unit Cost	Extended Cost	Notes
<i>Capital</i>					
<i>Geotechnical Borings -</i>					
Mobilization	1	LS	\$ 611.11	\$ 611	contractor bid
hand clearing	2	/boring	\$ 50.00	\$ 100	contractor bid
HAS Drilling	1	/rig/day	\$ 1,850.00	\$ 1,850	contractor bid
Geoprobe Drilling (Soil Boring)	1	/rig/day	\$ 1,850.00	\$ 1,850	contractor bid
Boring Abandonment	100	per foot	\$ 3.00	\$ 300	contractor bid
Drums	13	/drum	\$ 65.00	\$ 845	contractor bid
shelby tube	2	each	100	\$ 200	contractor bid
			Subtotal - Geotechnical borings:	\$5,556	

Assumptions:

- 1) Areal extent of impacted material is 1.4 acres
- 2) Area to reseed is 1.4 acres
- 3) Two geotechnical borings will be advanced at the site