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

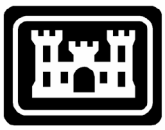
# Remedial Investigation Report Addendum

# Building 290

## *Fort Monmouth, New Jersey*

**January 20, 2011**
**Revised June 2011**

# REMEDIAL INVESTIGATION REPORT ADDENDUM
# FOR THE BUILDING 290
# FORT MONMOUTH, NEW JERSEY



**PREPARED FOR:**

**U.S. ARMY FORT MONMOUTH**
**DIRECTORATE OF PUBLIC WORKS**
**BUILDING 167**
**FORT MONMOUTH, NJ 07703**

**PREPARED BY:**

**January 20, 2011**
**Revised June 2011**

**TETRA TECH PROJECT NO. 103G1058223**

# TABLE OF CONTENTS

## TABLES



## FIGURES



## APPENDICES

# EXECUTIVE SUMMARY

Tetra Tech EM Inc. (Tetra Tech) has been contracted by the U.S. Army Installation Fort Monmouth Directorate of Public Works (DPW) in Fort Monmouth, New Jersey, to prepare a Remedial Investigation Report Addendum (RIRA) for the Building 290 site (Building 290) located in the Fort Monmouth Main Post area. This report addresses the remedial investigation activities conducted at Building 290 from August 2001 to September 2010.

Building 290 is located in the northern portion of the Main Post (**Figure 2-1**), between Parkers Creek to the north and Sherrill Avenue to the south. Building 290 is an inactive military vehicle repair and maintenance facility. Four underground storage tank (UST) closures have been performed at Building 290 as part of DPW's UST management program. Two monitoring wells (290MW01 and 290MW02) were installed in August 1994 at the site as part of the ground water monitoring program. Regarding soils at Building 290, NJDEP has provided NFA approvals for most of the soils associated with underground storage tank (UST) removals at the site.

This report is an addendum to the Remedial Investigation Report (RIR), M-18 Landfill, (Versar, Inc. [Versar] 2003), which described remedial investigation activities conducted from October 1996 through March 2001 at the M-18 Landfill. The remedial investigation presented in the 2003 RIR included former UST areas originally intended to be investigated as separate sites, including Building 290.

Fort Monmouth DPW conducted the additional investigation activities described in this RIRA, including quarterly ground water sampling. The purpose of this investigation was to define the areal extent of potential pollutants and evaluate potential impacts to ground water and surface water near Building 290.

A total of 38 quarterly ground water sampling events were conducted from April 2001 through September 2010. From April 2001 to November 2004, ground water samples collected from Building 290 were analyzed for volatile organic compounds (VOC) plus 15 Tentatively Identified Compounds (TICs), semivolatile organic compounds (SVOC) plus 25 TICs, pesticides, polychlorinated biphenyls (PCB) and target analyte list (TAL) metals. In November 2004, New Jersey Department of Environmental Protection (NJDEP) approved DPW's request to reduce the analytical parameters for ground water monitoring program, and subsequent ground water samples collected at Building 290 were analyzed for VOCs plus 15 TICs and TAL metals only.

To define the current ground water quality beneath Building 290 and identify potential contaminants of concern (COC), analytical results from the eight most recent rounds of quarterly sampling were evaluated in this RIRA. Ground water analytical data was compared with NJDEP Ground Water Quality Standard (GWQS) and the maximum background concentrations (MBC) established for the site. If concentrations exceeded NJDEP GWQS, the analytical results were then compared to the MBC. Those compounds that exceeded both the NJDEP GWQS and established background levels were classified as potential COCs. Additional factors used to eliminate or identify analytes detected in ground water samples as potential COCs included the magnitude and frequency of analyte exceedences. Metals data was also compared to low-flow

sampling results to assess potential biases in metals concentrations due to elevated sample turbidity.

During the eight most recent quarterly sampling events, four metals (antimony, arsenic, cadmium, and lead) exceeded the NJDEP GWQS.

Based on the factors noted above used to eliminate or identify COCs, no potential ground water COCs were identified at Building 290. Therefore, No Further Action (NFA) is recommended for ground water at Building 290.

DPW recommends continued quarterly ground water monitoring of well 290MW01 to provide data to support the monitored natural attenuation (MNA) remedy for the Building 290. Monitoring well 290MW02 should be located and inspected. If the well is too damaged to sample or well integrity cannot be confirmed, the well should be properly abandoned in accordance with NJDEP requirements.

# 1.0 INTRODUCTION

Tetra Tech EM Inc. (Tetra Tech) has been contracted by the U.S. Army Installation Directorate of Public Works (DPW) to prepare a Remedial Investigation Report Addendum (RIRA) to document remedial investigation activities performed at the Building 290 site (Building 290) located in the Fort Monmouth Main Post area in Fort Monmouth, New Jersey. This report addresses the remedial investigation activities conducted at the site between April 2001 and September 2010.

This report is an addendum to the Remedial Investigation Report (RIR), M-18 Landfill, (Versar, Inc. [Versar] 2003), which described remedial investigation activities conducted between October 1996 through March 2001 at the M-18 Landfill. The remedial investigation presented in the 2003 RIR included former UST areas originally intended to be investigated as separate sites, including Building 290. Details regarding subsequent remedial investigation activities at the M-18 Landfill will be addressed in a separate RIRA.

This section describes the objectives and organization of this RIRA.

## 1.1 OBJECTIVES

The objectives of this RIRA are to further define aquifer, chemical, and physical characteristics and to determine the requirement for further remedial activities at Building 290. The additional remedial investigation activities performed from April 2001 to September 2010 at Building 290 were conducted in accordance with the New Jersey Department of Environmental Protection (NJDEP) Technical Requirements for Site Remediation (New Jersey Administrative Code [N.J.A.C.] 7:26E, et seq.) that were current at the time sampling was conducted (NJDEP 1999).

The additional remedial investigation and subsequent preparation of the RIRA included:

- Characterization of ground water quality at Building 290 through quarterly ground water sampling events conducted from April 2001 through September 2010
- Comparison of ground water sampling results from Building 290 with the NJDEP Ground Water Quality Standard (GWQS).
- Formulation of a NFA proposal for consideration by the NJDEP based on the results of field and laboratory investigations and the hydrogeologic conditions at Building 290. The rationale for the NFA proposal is presented in this RIRA.

## 1.2 REPORT ORGANIZATION

This RIRA is organized to be consistent with the 2003 RIR (Versar 2003). The RIR and previous investigation reports related to Building 290 provide the basis for the additional remedial investigation activities described in this RIRA and are referenced as appropriate to minimize repetition.

Background information including a general description of Building 290 and a summary of previous investigations are provided in **Section 2.0**. The field activities conducted at Building 290 are summarized in **Section 3.0**. The results of additional physical characterization of Building 290, including lithology and ground water flow conditions, are summarized in **Section 4.0**. The results of additional chemical characterization of Building 290 are presented in **Section 5.0**. Conclusions and recommendations for Building 290 are presented in **Section 6.0**. References cited in this RIRA are listed after the text.

# 2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

This section summarizes background information and describes the environmental setting of the area surrounding Fort Monmouth and M-18 Landfill, which includes the Building 290. A brief summary of the site background, site conditions, and the environmental setting are provided in the following sections.

## 2.1 SITE BACKGROUND

Fort Monmouth is located in the central-eastern portion of New Jersey in Monmouth County, approximately 45 miles south of New York City and 70 miles northeast of Philadelphia (**Figure 2-1**). In addition to the Main Post, the installation includes two sub-posts, the Charles Wood area and the Evans area. Building 290 is located in the northern portion of the Main Post (**Figure 2-2**), between Parkers Creek to the north and Sherrill Avenue to the south. Building 290 is an inactive military vehicle repair and maintenance facility. Utilities present at Building 290 are depicted on **Figure 2-3** and wetlands present at the Main Post are depicted on **Figure 2-5**.

This section summarizes previous investigations at Building 290 underground storage tank (UST) areas presented in Versar's October 2003 RIR (**Appendix A**) and other previous investigation reports (Associates, Inc. [ATC] 2000; Versar 2001; SMC Environmental Services Group [SMC] 1999; Weston 1993). As noted in **Section 1** of this report, the remedial investigation presented in the 2003 RIR included areas originally intended as separate site investigations at former UST sites, including Building 290.

### 2.1.1 1993 UST 290C Closure and Site Investigation

According to the UST Site Investigation and Closure Report, Building 290, Main Post, Fort Monmouth, New Jersey (Weston 1993) (**Appendix B**), one 550-gallon fiberglass waste oil UST (NJDEP Registration No. 81533-193) located immediately adjacent to Building 290 (**Figure 2-4**) was removed in December 1991. No holes were observed in the removed UST and no potentially impacted soil was identified in the excavation. Following removal of the tank, four post-excavation soil samples were collected from locations along the sidewalls and base of the excavation. The soil samples were analyzed for total petroleum hydrocarbons (TPHC) and priority pollutants plus 40 (PP+40) tentatively identified compounds (TIC). Analytical results indicated that all samples contained either non-detectable concentrations of contaminants of concern (COC) or COC concentrations less than applicable NJDEP soil cleanup criteria.

Based on the analytical results, No Further Action (NFA) was proposed at Building 290 for UST No. 81533-193.

### 2.1.2 2001 UST 290B Closure and Site Investigation

According to the UST Site Closure and Site Investigation Report, Building 290B, Main Post West Area, Fort Monmouth, New Jersey (Versar 2001) (**Appendix C**), two 2,000-gallon steel gasoline USTs (NJDEP Registration Numbers 81533-224 and 81533-225) located immediately

southeast of Building 290 (**Figure 2-4**) were removed in December 1993. The NJDEP standard reporting form (UST Registration Questionnaire) included as Appendix B in the UST closure report (Versar 2001) indicates that the tanks may have contained leaded gasoline (**Appendix C**). During the excavation, approximately 259 cubic yards of visually stained soils were removed from the UST area and disposed of off-site. Numerous holes were observed in the USTs and nine post-excavation soil samples were collected from eight locations within the UST excavation. The post-excavation soil samples were analyzed for TPHC, volatile organic compounds (VOC) plus 15 TICs, and lead. None of the target analytes were detected in the post-excavation soil samples at concentrations exceeding the NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC).

Because of the stained soil observed in December 1993, DPW installed two ground water monitoring wells (290MW01 and 290MW02) in July and August 1994 at locations west of Building 290 near the location of the two former USTs (**Figure 2-4**). Monitoring wells 290MW01 and 290MW02 were constructed with 4-inch diameter 20-slot polyvinyl chloride (PVC) pipe to maximum finished depths of 12.5 and 12 feet, respectively. These two wells were installed through fill material and into native material. Ground water was encountered in these wells during the well construction at 3 feet below ground surface (bgs) in well 290MW01 and 7 feet bgs in well 290MW02. The locations of these monitoring wells are shown on **Figure 2-4**. Well construction details are summarized in **Table 2-1**.

Based on the soil and ground water sample analytical results (discussed in **Section 2.1.3** below and included in **Appendix D**) (ATC 2000), no further action was proposed for USTs No. 81533-224 and 81533-225. In their UST Closure Approval/NFA letter dated January 10, 2003 (**Appendix E**), NJDEP approved NFA requests for 68 USTs at the Main Post of Fort Monmouth, including USTs No. 81533-224 and 81533-225.

### 2.1.3 2000 UST 290A Closure and Site Investigation for Building 290

According to the UST Site Investigation and Closure Report, Building 290, Main Post, Fort Monmouth, New Jersey (ATC 2000) (**Appendix D**), one 2,000-gallon fiberglass No. 2 diesel fuel UST (NJDEP Registration No. 81533-64) located immediately adjacent to Building 290 (**Figure 2-3**) was removed in September 1994. No holes were observed in the UST. Following the removal of the UST, approximately 50 cubic yards of visually stained soils were removed from the UST area and disposed off site. Following the excavation, seven post-excavation soil samples were collected from six locations along the sidewalls of the excavation and an eighth sample was collected along the former piping length of the excavation. The soil samples were analyzed for TPHC. TPHC was detected in two samples at concentrations exceeding the NJDEP RDCSCC of 10,000 milligrams per kilogram (mg/kg). Because of the elevated TPHC concentrations, one soil sample was collected from the north sidewall of the excavation and was analyzed for VOCs plus 15 TICs. No VOCs were detected with concentrations greater than the NJDEP RDCSCC.

Two ground water monitoring wells (290MW01 and 290MW02) were installed in July and August 1994 at locations west of Building 290. Well 290MW01 was constructed near the location of the two former USTs (NJDEP Registration Numbers 81533-224 and 81533-225)

(**Figure 2-4**). Ground water samples were collected from well 290MW01 in November 1994 and December 1995 and from well 290MW02 in November 1995. Samples collected from both wells were submitted for VOCs, tertiary butyl alcohol (TBA), methyl tertiary butyl ether (MTBE), and total lead analyses. Ground water analytical results indicated that one sample collected from 290MW01 contained lead at concentrations exceeding NJDEP GWQS. Concentrations of VOCs, TBA, and MTBE did not exceed their respective NJDEP GWQS.

Based on the soil and ground water analytical results, NFA was proposed for UST No. 81533-64. In their UST Closure Approval/NFA letter dated August 29, 2000 (**Appendix E**), NJDEP approved NFA requests for 17 USTs at the Main Post of Fort Monmouth, including UST No. 81533-64.

### 2.1.4 1999 Site/Remedial Investigation Report

According to the Site/Remedial Investigation Report, Building 290, Fort Monmouth, New Jersey (SMC 1999) (**Appendix F**), SMC was retained by the DPW to implement a site/remedial investigation after stained soils was discovered during construction activities near Building 290. The disturbed area was near the location of a former gasoline pump island. Approximately 40 cubic yards of visually contaminated soil were excavated and disposed of offsite in March 1997. The excavated area was located a few feet west of the southwest corner of Building 290. Seven post-excavation soil samples were collected at the site and analyzed for TPHC, VOCs plus 15 TICs, and lead. No soil samples contained concentrations of TPHC, VOCs, or lead exceeding the NJDEP RDCSCC; therefore, NFA was recommended.

In their comment letter dated August 14, 2007 (**Appendix E**), NJDEP approved NFA for the soils located near the former gasoline pump island at Building 290**.**

### 2.1.5 2003 Remedial Investigation Report

As discussed in the Remedial Investigation Report, M-18 Landfill (Versar 2003) (**Appendix A**), DPW conducted additional remedial investigation activities to define the areal extent of potential pollutants and evaluate potential impacts to ground water in the vicinity of the M-18 Landfill. Remedial investigation activities, including the implementation of a long-term ground water monitoring program, were performed from October 1996 through March 2001 to characterize ground water conditions at M-18 Landfill. Monitoring wells 290MW01 and 290MW02 at Building 290 (located upgradient of M-18 Landfill) were included in this long-term ground water monitoring program. Ground water monitoring activities conducted during this remedial investigation are summarized below.

Quarterly ground water monitoring was conducted at M-18 Landfill from June 1997 through February 2001 during 16 quarterly rounds of ground water sampling. During quarterly monitoring, ground water samples were collected from 11 previously installed monitoring wells located at or near M-18 Landfill (wells 290MW01, 290MW02, 296MW01, 296MW02, 296MW03, 296MW04, 296MW06, 296MW07, 296MW08, MP18MW24 and MP18MW25). The ground water samples were analyzed for VOCs, semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyls (PCB) and target analyte list (TAL) metals.

To assess whether elevated metal concentrations observed in ground water samples collected at M-18 Landfill were caused by entrained soil particles (i.e., high turbidity), two additional rounds of ground water sampling were conducted in August and September 2000 using low-flow purging and sampling methods. Ground water samples collected during low-flow sampling were analyzed for TAL metals only.

Ground water analytical results for M-18 Landfill indicated that concentrations of two VOCs, one SVOC, and 15 metals exceeded their respective NJDEP GWQS. No pesticides or PCBs were reported at concentrations that exceeded NJDEP GWQS. Review of the data to account for common laboratory contaminants (such as methylene chloride), common plastics components (such as bis[2-ethylhexyl]phthalate), and background metals concentrations resulted in the identification of one VOC (benzene) and four metals (arsenic, cadmium, chromium, and lead) as COCs in ground water at the M-18 Landfill.

Ground water analytical results for samples collected from wells 290MW01 and 290MW02 during the same period (June 1997 through February 2001) indicated that concentrations of three metals (arsenic, lead, and cadmium) exceeded their respective NJDEP GWQS. Concentrations of cadmium and lead exceeded their respective NJDEP GWQS in ground water samples collected during only one of the 16 rounds of sampling. Concentrations of SVOC TICs exceeded 500 micrograms per liter (µg/L) during three rounds of sampling. No target SVOC concentrations and no VOC, pesticide, or PCB concentrations exceeded NJDEP GWQS.

### 2.1.6 Public Notification

In accordance with the Notification and Public Outreach Rule of the NJDEP Technical Requirements for Site Remediation (TRSR) (N.J.A.C. 7:26E-1.4), Fort Monmouth established a Restoration Advisory Board (RAB) in 2006 with representatives from the local municipalities who represent a variety of interests and viewpoints. The RAB acts as a focal point to exchange information between Fort Monmouth and the local communities regarding environmental and restoration activities and meets on a quarterly basis to review and comment on on-going environmental work. The meetings are open to the public and are advertised in local newspapers. All environmental projects subject to the NJDEP TRSR are presented at the RAB.

Although the Public Notification requirements were amended in 2009 with the implementation of signs or periodic letters to inform the public of on-going environmental work, on June 17, 2010, Fort Monmouth requested that the NJDEP grant approval of an alternate notification and public outreach plan utilizing the existing RAB and document repository of Fort Monmouth environmental reports, which is accessible to the public. The NJDEP response indicated that the alternative plan provided adequate public notice and complied with the intent of 7:26E-1.4; NJDEP approved the request on June 24, 2010.

Copies of public notification documents are presented in **Appendix G.**

### 2.1.7 Baseline Ecological Evaluation (BEE)

Shaw Environmental, Inc. was contracted by the Army to conduct a BEE for Fort Monmouth's Main Post and Charles Wood Areas. Sampling of multiple media was conducted in 2010, the results of which are not available for discussion herein. The final BEE will be submitted to the NJDEP under separate cover in June 2011.

## 2.2 SITE CONDITIONS

On October 21, 2010, Tetra Tech conducted a site walkthrough to assess current conditions at Building 290. The site consists of one and two-story buildings and asphalt parking lots located within the former Building 290 footprint.

## 2.3 ENVIRONMENTAL SETTING

This section summarizes the description of the regional and local geology, hydrogeological setting, soils, and topography and drainage of the area surrounding the M-18 Landfill (including Building 290) as presented in Versar's 2003 RIR (**Appendix A**) (Versar 2003).

### 2.3.1 Regional and Local Geology

A detailed description of the regional and local geology is provided in Section 2 of the 2003 RIR (**Appendix A**) (Versar 2003). As presented in the 2003 RIR, the lithology encountered during monitoring well installation at the M-18 Landfill consists primarily of fill material, fine sand, silt, and clay. Boring logs for monitoring wells 290MW01 and 290MW02 installed at Building 290 indicate that fill material consisting of brown to gray silt and clay was encountered at the top of the borings, ranging in depth from ground surface to approximately 4 to 5 feet bgs. Native soil consisting of brown sand and silt was encountered at 290MW01 from approximately 4.5 to 9 feet bgs. Green to black silty clay, potentially glauconitic, was encountered below this layer in 290MW01 and below the fill material in 290MW02. Further discussion of the subsurface conditions within the area of Building 290 and the M-18 Landfill is presented in Section 4.0 of the 2003 RIR (**Appendix A**) (Versar 2003).

A Basewide Glauconitic Investigation Report was completed by DPW in March 2011 and a Background Metals Evaluation was prepared by Brinkerhoff for DPW in May 2011. Both documents indicate the potential for soil particles present in ground water samples which are potentially affecting the metals analysis results in ground water samples collected from the overall FTMM site. Additional ground water sampling including the comparison of filtered and unfiltered samples results has been proposed to determine the potential affect of soil particles on metals analysis results. Results and conclusions from these future sampling events will be provided to NJDEP under separate cover.

The Basewide Glauconitic Investigation Report and the Background Metals Evaluation Report are provided in **Appendix H**.

### 2.3.2 Hydrogeology

A detailed description of the hydrology is provided in Section 2 of the 2003 RIR (**Appendix A**) (Versar 2003). The site is underlain by a Class III-A aquifer. The primary designated use for Class III-A ground water is the release or transmittal of ground water to adjacent classification areas and surface water, as relevant. Secondary designated uses in Class III-A include any reasonable use.

During ground water sampling at the M-18 Landfill (16 quarterly rounds and two low-flow rounds), ground water was encountered in both the fill and native soils in each monitoring well at depths ranging from 2.54 to 8.68 feet bgs. Five ground water elevation contour maps generated based on ground water depth measurements from the 11 monitoring wells at the site (collected in September 1999, December 1999, March 2000, June 2000, and February 2001) indicate that ground water underlying the M-18 Landfill consistently flows radially from the northwest to the northeast towards Parkers Creek (**Appendix A**). Ground water beneath Building 290 generally flows northward toward M-18 Landfill and Parkers Creek. Ground water flows in this direction because of the site's proximity to the bend in Parkers Creek. No significant variations in ground water flow conditions were observed in these ground water contour maps.

Based on slug tests conducted on the 11 monitoring wells located within the M-18 Landfill in February 2001, the calculated hydraulic conductivity values range from 0.342 feet per day (ft/day) at monitoring well 290MW02 to 14.3 ft/day at monitoring well 296MW03, with a calculated geometric mean of 2.5 ft/day. The ground water flow gradient for the M-18 Landfill, based on water level measurements collected on February 8, 2001, was calculated to range from 0.0075 feet per foot to 0.02 feet per foot. Using these data and a porosity estimate of 40 percent based on the average values for silt and sands (Heath 1989), the ground water velocity for the site was calculated to range from 0.047 ft/day to 0.125 ft/day. Further discussion of the subsurface conditions within the area of Building 290 and M-18 Landfill is presented in Section 4.0 of the 2003 RIR (**Appendix A**) (Versar 2003).

### 2.3.3 Soils

A detailed description of the soils in the vicinity of the site is provided in Section 2 of the 2003 RIR (**Appendix A**) (Versar 2003). According to the RIR, the soils in the vicinity of Building 290 are classified as UA – Udorthents, smoothed, which may also include old sand and gravel pits that have been smoothed or filled in. The Udorthents soils have been altered by excavation or filling activities. In filled areas, these soils consist of loamy material that is more than 20 inches thick. The filled areas include floodplain, tidal marshes and areas with moderately well-drained to very poorly drained soils. Some Udorthent soils contain concrete, asphalt, metal, and glass.

### 2.3.4 Topography and Surface Drainage

A detailed description of the topography and surface drainage in the vicinity of Building 290 is provided in Section 2 of the 2003 RIR (**Appendix A**) (Versar 2003). According to the RIR, the land surface of the Main Post is relatively flat and ranged in elevation from approximately 4 feet

above mean sea level (amsl) in the east at Oceanport Creek to 32 feet amsl at the western end of the Main Post, near Highway 35. The eastern half of the post is generally 10 feet amsl in elevation (Versar 2003).

Surface water runoff from the western part of the Main Post flows into Lafetra Creek to the north or into Mill Creek to the south. The U.S. Geological Survey (USGS) topographic map (**Figure 2-1**) shows Lafetra Creek as Parkers Creek Branch and Mill Creek as Wampum. Both Mill Creek and Lafetra Creek originate off post. Mill Creek is channelized and flows along the southern boundary of the Main Post, turning north just past the Auto Craft Shop. Lafetra Creek forms the northern boundary of the Main Post and joins Mill Creek to form Parkers Creek. Parkers Creek flows east along the northern boundary and joins Oceanport Creek east of the post. Most of Parkers Creek, Lafetra Creek, and Mill Creek are tidally influenced.

The M-18 Landfill (including Building 290) is located just south of Parkers Creek, which empties to the east into the Shrewsbury River. The USGS topographic map (**Figure 2-1**) shows that the land surface of the site is relatively flat at an elevation of less than 20 feet amsl. Surface water runoff from this area is likely northward into Parkers Creek.

# 3.0 SITE ACTIVITIES

The 2003 RIR (**Appendix A**) documented RI activities and analytical results from October 1996 through March 2001 (Versar 2003). One purpose of the remedial investigation was to define the areal extent of potential pollutants and evaluate potential impacts to ground water near the M-18 Landfill, which includes Building 290. Ground water wells located at Building 290 were sampled on a quarterly basis as part of this effort. This RIRA documents the results of quarterly ground water monitoring conducted by Fort Monmouth DPW at Building 290 from April 2001 through September 2010. These activities were managed by Fort Monmouth DPW and conducted by base operations contractor TECOM-Vinnell Services (TVS).

The details of recent RI activities at Building 290—including sample collection activities and off-site receptor evaluation data—are described in the following sections.

## 3.1 SAMPLE COLLECTION ACTIVITIES

As part of the supplemental remedial investigation conducted at the Building 290, quarterly ground water monitoring was conducted from April 2001 through September 2010. Sampling activities were performed in accordance with the NJDEP Field Sampling Procedures Manual (May 1992; August 2005) (NJDEP 1992 and 2005) and applicable Fort Monmouth Standard Operating Procedures (**Appendix I**) (DPW 1997). Laboratory analyses of the samples collected at Building 290 were conducted at the Fort Monmouth Environmental Testing Laboratory (FMETL), a New Jersey certified laboratory (Certification No. 13461).

This section summarizes ground water sampling activities and ground water depth measurements conducted at Building 290.

### 3.1.1 Ground Water Sampling Activities

DPW conducted quarterly ground water monitoring of 11 previously installed monitoring wells near the M-18 Landfill (290MW01, 290MW02, 296MW01, 296MW02, 296MW03, 296MW04, 296MW06, 296MW07, 296MW08, MP18MW24 and MP18MW25). As noted in **Section 2**, two of the 11 wells (290MW01 and 290MW02) were installed in 1994 during site investigations related to the removal of various USTs at Building 290. **Figure 2-4** shows the locations of the monitoring wells at Building 290. The construction details for these wells are summarized in **Table 2-1**.

A total of 59 samples (not including duplicates, field blanks, and trip blanks) were collected during 38 rounds of quarterly ground water sampling conducted from April 2001 to September 2010. The quarterly ground water samples were analyzed as follows:

- During quarterly sampling rounds from April 2001 through November 2004, ground water samples were analyzed for VOCs plus 15 TICs using U.S. Environmental Protection Agency (EPA) Method 624, SVOCs plus 25 TICs using EPA Method 625,

pesticides and PCBs using EPA Method 608, and TAL metals using EPA Methods 3112B and 3120B.

- After NJDEP accepted a request to reduce the analytical program, ground water samples were analyzed for VOCs plus 15 TICs using EPA Method 624 and TAL metals using EPA Methods 3112B, 3113B, 3120B, and 279.2 during quarterly sampling rounds from January 2005 through September 2010.

During quarterly monitoring in August 2006, monitoring well 290MW02 could not be located and was not sampled. No ground water samples were collected from this well during subsequent ground water monitoring rounds conducted at Building 290.

A summary of ground water sampling activities, including sampling round numbers, well IDs, sample IDs, sampling locations, collection dates, analytical parameters, and analytical methods, is provided in the laboratory data packages found in **Appendix J**. The results of the quarterly ground water monitoring program for the Building 290 are discussed in this RIRA in **Section 5**.

As discussed in **Section 2.1.5**, a low-flow sampling methodology was proposed for use by DPW and accepted by the NJDEP to assess the impact of entrained sediments on the dissolved-phase metals concentrations at Fort Monmouth. Two additional rounds of low-flow sampling were conducted on May 2010 (Low-Flow #3) and September 2010 (Low-Flow #4) using a low-flow ground water sampling technique. Ground water samples were collected and analyzed for TAL metals (using the EPA methods noted above) to determine whether elevated metal concentrations observed in the ground water samples collected from Building 290 are caused by entrained soil particles (e.g., high turbidity), rather than dissolved-phased ground water constituents. Low-flow sampling results for ground water samples collected from Building 290 are discussed in **Section 5**.

Sampling equipment was thoroughly decontaminated before and after each use in accordance with applicable Fort Monmouth Standard Operating Procedures (DPW 1997) and the current version of the NJDEP Field Sampling Procedures Manual in effect at the time sampling was conducted (NJDEP 1992 and 2005). The waste types generated by the remedial activities included three-gallon polyethylene pails, polyethylene tubing, Teflon® bailers, mason string, and personal protective equipment (PPE). The pails were recycled, and the other materials were disposed of in accordance with the *Fort Monmouth Solid Waste Management Plan.*

Following collection, ground water samples were immediately placed in laboratory-supplied bottles. The samples were labeled, sealed, packed in ice, and transported to the FMETL following proper chain-of-custody procedures. Copies of the ground water sampling chain-of-custody forms and laboratory data sheets are presented in **Appendix J**.

During each round of the monitoring well sampling, aquifer chemical characteristics including pH, temperature, conductivity, and dissolved oxygen were recorded prior to sampling. These chemical characteristics are included in the laboratory data packages.

### 3.1.2 Ground Water Depth Measurements

During each round of the ground water monitoring conducted at Building 290, depth-to-ground water measurements were recorded with an accuracy of 0.01 foot. The depth-to-ground water measurements, recorded from October 2008 through September 2010, are presented in **Table 3-1.** Depth to ground water was only documented for the eight most recent quarters of ground water sampling. The ground water elevation at each well was calculated by subtracting the measured depth to ground water from the elevation of the top of the well casing. Ground water elevations are discussed in this RIRA in **Sections 4.2 and 4.3.**

## 3.2 OFFSITE RECEPTOR EVALUATION

A visual and documentary search of sensitive populations was performed by the U.S. Army Fort Monmouth (FTMM), Directorate of Public Works (DPW) and their subcontractor to identify any potentially sensitive populations within 200 feet of the FTMM boundary. The identification of said populations is in accordance with New Jersey Department of Environmental Protection (NJDEP) statutory requirement. An Offsite Receptor Report (dated October 13, 2010) was prepared for the Main Post of Fort Monmouth by Environmental Data Resources, Inc. (EDR) of Southport, Connecticut. A copy of the Offsite Receptor Report, identifying sensitive receptors in the area, is provided in **Appendix K**. In the following written summary, the sensitive populations and their locations have been identified. Their locations are plotted on the Offsite Receptor Survey Map, **Figure 3-1**.

Although the identified populations are within 200 feet of the FTMM boundary, all of the environmentally impacted locations are a significant distance from the fence line and in all cases exceed the 200-foot buffer established by NJDEP.

In addition to the sensitive receptors, the DPW has included all identified off-site wells within 2,000 feet of the FTMM perimeter. No production wells were identified within 2,000 feet of the FTMM boundary. The majority of off-site wells are monitoring wells associated with various remedial activities. A ground water model has been developed for FTMM, with the overall ground water flow pattern for the Main Post being easterly with a localized northeasterly component. FTMM is bounded by surface water bodies to the east and northeast. Any domestic and/or irrigation wells to the east or northeast of the Main Post would not be impacted by base.

Surface water bodies interact with ground water at FTMM. The interaction takes place in three basic ways: streams gain water from inflow of ground water through the Streambed, they lose water to ground water by outflow through the streambed or or they do both, gaining in some reaches and losing in other reaches. When ground water discharges into a surface water body, the altitude of the ground water table in the vicinity of the creek must be higher than the altitude of the stream-water surface. Conversely, for surface water to seep to ground water, the altitude of the water table in the vicinity of the stream must be lower than the altitude of the stream-water surface. The surface water bodies at FTMM (Oceanport and Parkers Creeks) may be gaining or losing depending upon the tidal cycle. Throughout the entire tidal cycle however, net results is that ground water inflows into the creeks, albeit at low flow rates.

A copy of the off-site receptor evaluation report (Tetra Tech 2010) is provided in **Appendix K**.

# 4.0 SITE PHYSICAL CHARACTERISTICS

The following sections summarize the physical characteristics of Building 290, based mainly on the findings of the M-18 Landfill geologic and hydrogeologic characterization program. DPW collected the ground water elevation data between April 2001 and September 2010. Specifically, this section summarizes lithology, ground water flow, and ground water flow direction data collected for the area surrounding Building 290.

## 4.1 LITHOLOGY

The lithology encountered at Building 290 consists primarily of fill material, fine sand, silt and clay. The lithology of the M-18 Landfill (including the Building 290) is summarized in **Section 2.3** of this RIRA and described in detail in the Remedial Investigation Report, M-18 Landfill, attached as **Appendix A** (Versar 2003).

## 4.2 GROUND WATER FLOW

Ground water flow direction and elevations are consistent with those observed and documented in the Versar's 2003 RIR. During the ground water sampling program at Site 290 (38 quarterly rounds and two low-flow sampling rounds), ground water was encountered in monitoring wells at Building 290 at depths ranging from 7.08 to 9.27 feet bgs (**Table 3-1 and Table 5-4**) with a slight gradient toward the north in the direction of Site M18 and Parkers Creek. Depth to ground water was only observed for the most recent eight quarters of ground water sampling. Ground water velocity and flow directions were predicted based on the ground water elevation data, as well as the interpretation of ground water contour maps prepared for selected sampling events. Figures depicting the ground water contours during recent sampling events are provided as **Figures 4-1 through 4-3.**

## 4.3 GROUND WATER FLOW DIRECTION

In accordance with New Jersey Administrative Code (NJAC) 7:26E-3.13(d)2iv, eight ground water contour maps were generated based on ground water depth measurements collected from the 11 monitoring wells at M-18 Landfill (including Building 290) during the eight most recent rounds of quarterly ground water sampling (**Table 3-1**). The groundwater contour reporting forms are provided in **Appendix L**. The ground water elevation data indicate that ground water underlying the M-18 Landfill consistently flows radially to the northwest and the northeast towards Parkers Creek. This flow direction is likely due to the site's proximity to the bend in Parkers Creek. Ground water beneath Building 290 generally flows northward toward M-18 Landfill and Parkers Creek. No significant variations in ground water flow conditions were observed in these ground water contour maps presented as **Figures 4-1** through **4-3**. Ground water elevation data are presented in **Table 3-1**

# 5.0 SITE CHEMICAL CHARACTERIZATION

This section includes a discussion of the chemical characterization of Building 290 based on the various samples collected and analyzed during 38 quarterly rounds of ground water sampling conducted from April 2001 to September 2010. DPW personnel were responsible for the collection of samples during this site investigation. Sample analyses were performed by FMETL, a New Jersey certified laboratory (Certification No. 13461).

Specifically, this section discusses ground water action levels, ground water sample results, and COCs for Building 290.

## 5.1 GROUND WATER ACTION LEVELS

Ground water analytical data was compared against NJDEP GWQS, or the Practical Quantitation Limits (PQL) (whichever was higher), and the maximum background concentrations (MBC) established during a facility-wide site investigation of the Main Post and Charles Wood areas of Fort Monmouth (Weston 1995). If concentrations exceeded NJDEP GWQS, the sample concentrations were then compared to the MBC. Those compounds that exceeded both the NJDEP GWQS and established background levels were classified as COCs.

According to the 2008 Site Inspection Report (SIR) prepared by Shaw Environmental (Shaw) (**Appendix M**), several natural and anthropogenic factors can influence chemical concentration (specifically metals) in soil and ground water samples collected at Fort Monmouth. The primary natural influence at Fort Monmouth is parent material: glauconitic quartzose sands of the Tinton and Red Bank sands and their fluvially and tidally reworked equivalents. The mineral glauconite found in these sands is a potassium-, sodium-, calcium-, iron-, aluminum-, magnesium-rich hydrosilicate. These glauconitic soils therefore contain abundant iron, aluminum, calcium, magnesium, manganese, sodium, and potassium (Shaw 2008).

Ground water quality is often affected by the composition of the aquifer; in this case, the Tinton and Red Banks sands affect ground water at Building 290. Coastal Plain aquifers are susceptible to saltwater encroachment. Aquifers underlying Fort Monmouth can also be identified by saltwater intrusion, affecting ground water chemistry. High concentrations of sodium are likely a result of saltwater intrusion (Shaw 2008).

As a result of these natural influences, aluminum, calcium, iron, manganese, magnesium, potassium, and sodium likely to be present at elevated concentrations are not considered COCs in soil and ground water at Fort Monmouth. Therefore, these metals are not included in the ground water results summary tables included in this RIRA. Laboratory data for all analytes, including the metals listed above, are provided in **Appendix J**.

A low-flow sampling methodology was used to reduce the presence of suspended sediments within ground water samples. Slightly decreased concentrations of non-native metals (arsenic, antimony, beryllium, cadmium, lead, selenium, and thallium) and naturally occurring metals (aluminum, barium, calcium, copper, iron, magnesium, manganese, nickel, potassium, sodium,

and zinc) were observed in ground water samples collected during low-flow sampling. However, the native metal constituents (those indigenous to the soils at Fort Monmouth) were consistently present in the ground water within the M-18 Landfill, including Building 290.

Two separate rounds of low-flow ground water sampling were conducted in May 2010 and September 2010 during the quarterly ground water sampling program at Building 290, as discussed in **Section 2.1.3**. This low-flow sampling approach resulted in reduced concentrations or non-detections of some of the metals; however, concentrations of arsenic, lead, and selenium detected during the low-flow sampling events at Building 290 exceeded NJDEP GWQS.

## 5.2 GROUND WATER SAMPLE RESULTS

This section presents a discussion of the results of laboratory analyses performed for the 38 rounds of ground water samples collected from April 2001 through September 2010 from monitoring wells 290MW01 and 290MW02 at Building 290. The ground water samples were collected and analyzed for VOCs plus 15 TICs, SVOCs plus 15 TICs, pesticides, PCBs, and TAL metals through November 2004. On November 10, 2004, DPW submitted a letter to NJDEP requesting a reduction of ground water sampling analyses at the Main Post and Charles Wood areas; on November 12, 2004, NJDEP approved the request. Accordingly, ground water samples collected from January 2005 through September 2010 at M-18 Landfill were analyzed for VOCs plus 15 TICs and TAL metals only.

During quarterly monitoring in August 2006, monitoring well 290MW02 could not be located and was not sampled. No ground water samples were collected from this well during subsequent ground water monitoring rounds conducted at Building 290.

As discussed in Versar's 2003 RIR (**Appendix A**), Fort Monmouth military installation is underlain by a Class III-A aquifer. The appropriate ground water quality criteria for Class III-A are the criteria for the most stringent classification for vertically or horizontally adjacent ground waters that are not Class III-A (N.J.A.C. 7:9-6.7E). The NJDEP criteria used to compare ground water analytical results were the higher of the PQLs and the NJDEP GWQS for Class II-A aquifers (NJAC 7:9-6, Table 1) (NJDEP 1999).

The laboratory analytical results for ground water samples are summarized in **Tables 5-1 and 5-2**. Analytes detected in ground water samples at concentrations greater than the NJDEP GWQS are presented in bold and are highlighted in **Tables 5-1 and 5-2**. The laboratory data packages, which include chain-of-custody forms, laboratory data sheets for the ground water samples, and the method detection limits (MDL) for the sample analyses are provided in **Appendix J**. All analytical date for these sites were validated for any laboratory issues and the data validation packages for the last quarterly sampling events are provided in **Appendix N.**

The contaminant distribution for ground water within the area of Building 290 for the eight most recent quarters of sampling (October 2008 through September 2010) is depicted on **Figure 5-1**. As noted above, in November 2004 NJDEP approved a reduction of ground water analytical parameters to VOCs plus 15 TICs and TAL Metals only. This section discusses analyte detections within the two relevant analytical categories (VOCs and TAL metals) over the eight

most recent quarters of sampling. Monitoring well 290MW02 has not been located since August 2006; therefore, only one monitoring well (290MW01) at Building 290 was sampled during the last eight quarters.

The analyte exceedances of the appropriate GWQS in ground water samples are presented in three subsections: VOCs (**5.2.1**), TICs (**5.2.2**), and Metals (**5.2.3**). In order to define the current ground water quality beneath Building 290, these four subsections will concentrate on the most recent eight quarters of sampling, from October 2008 to September 2010.

### 5.2.1 Volatile Organic Compounds

During the eight most recent quarterly sampling events, no VOCs metals were detected in ground water samples at concentrations greater than their respective NJDEP GWQS.

### 5.2.2 Tentatively Identified Compounds (TICs)

During the reporting period, all wells sampled had no VOC TICs detected at concentrations exceeding the GWQS or individual or total TIC compounds in ground water samples.

### 5.2.3 Metals

During the eight most recent quarterly sampling events, five metals were detected in ground water samples at concentrations exceeding their respective NJDEP GWQS.

***Antimony*** was detected at concentrations exceeding the NJDEP GWQS of 6 micrograms per liter (µg/L) during four of the eight most recent rounds of sampling conducted at monitoring well 290MW01. Concentrations greater than NJDEP GWQS ranged from an estimated result of 7.51 µg/L (Low-Flow #4 – sampling round 56) to 34.7 µg/L (sampling round 50).

***Arsenic*** was detected at concentrations exceeding the NJDEP GWQS of 3 µg/L during five of the eight most recent rounds of sampling conducted at monitoring well 290MW01. Concentrations greater than NJDEP GWQS ranged from an estimated range of 3.15 µg/L (Low-Flow #4 – sampling round 56) to 123 µg/L (sampling round 50).

***Cadmium*** was detected at concentrations exceeding the NJDEPGWQS of 4 µg/L during only 1 of the 8 most recent rounds of sampling conducted at monitoring well 290MW01 (6.68 µg/L during sampling round #50).

***Lead*** was detected at concentrations exceeding the NJDEP GWQS of 5 µg/L during three of the eight most recent rounds of sampling conducted at monitoring well 290MW01. Concentrations greater than NJDEP GWQS ranged from 7.79 µg/L (sampling round 50) to 24.3 µg/L (sampling round 49).

***Selenium*** was detected at concentrations exceeding the NJDEP GWQS of 40 µg/L during three of the eight most recent rounds of sampling conducted at monitoring well 290MW01.

Concentrations greater than NJDEP GWQS ranged from 41.4 µg/L (Low-Flow #4 – sampling round 56) to 131 µg/L (sampling round 50).

## 5.3 CONTAMINANTS OF CONCERN

To determine the potential COCs in ground water, the first step was to identify exceedences of the NJDEP GQWS in monitoring well samples collected at Building 290. These exceedences are presented in **Section 5.2** above and in **Tables 5-1 and 5-2**. If concentrations exceeded NJDEP GWQS, the sample concentrations were compared to MBCs established for specific analytes. Those compounds that exceeded both the regulatory standard and the MBC were classified as potential COCs.

Several factors were used to eliminate or identify analytes as COCs. These factors include the magnitude and frequency of the exceedences, comparisons to low-flow sampling results (for metals only), and comparisons to established background concentrations. **Table 5-3** summarizes the process used to identify COCs in ground water at Building 290.

During the eight most recent quarterly sampling rounds, no VOCs were detected at concentrations exceeding the GWQS. Therefore VOCs are not considered COCs at Building 290. During the 38 rounds of sampling conducted from October 1996 to September 2010, no SVOCs, pesticides, or PCBs were detected at concentrations exceeding the GWQS. Therefore SVOCs, pesticides, or PCBs are not considered COCs at Building 290.

During the eight most recent quarterly sampling rounds, 11 metals were detected at Building 290, with five metals detected at concentrations exceeding their respective NJDEP GWQS (antimony, arsenic, cadmium, lead, and selenium). According to FTMM, data quality objectives were not met in low range detection of selenium during the first three quarters in 2010. Therefore, selenium is not a COC and will not be discussed below. The specific exceedances and the identification of antimony, arsenic, cadmium, and lead as potential COCs are discussed below.

Two rounds of sampling (May 2010 and September 2010) were performed during the quarterly ground water sampling program using the low-flow ground water sampling technique, as discussed in **Section 2.1.3** and **Section 5.1** of this RIRA. Results from each of the low-flow sampling events were compared with quarterly ground water sampling data, which yielded the following results:

- Antimony concentrations exceeded NJDEP GWQS in samples collected during both low-flow sampling rounds. Antimony was also detected at concentrations exceeding the NJDEP GWQS during two of the eight most recent quarterly sampling rounds, excluding low-flow rounds, at Building 290. A significant decrease in antimony concentrations was observed during low-flow sampling rounds. Based on these results, antimony is not considered a potential COC at Building 290.

- Arsenic concentrations exceeded NJDEP GWQS in samples collected during only one of the low-flow sampling rounds. Arsenic was also detected at concentrations exceeding the

NJDEP GWQS during four of the eight most recent quarterly sampling rounds, excluding low-flow rounds, at Building 290. However, a significant decrease in arsenic concentrations was observed during low-flow sampling rounds. Based on these results, arsenic is not considered a potential COC at Building 290.

- Cadmium was not detected at concentrations exceeding the NJDEP GWQS during the two low-flow sampling rounds. Cadmium was detected at a concentration exceeding NJDEP GWQS during only one of the eight most recent quarterly sampling rounds, excluding low-flow rounds, at Building 290. Based on these results, cadmium is not considered a potential COC at Building 290.

- Lead was either not detected or detected at a concentration less than the NJDEP GWQS during both low-flow sampling rounds. Lead was detected at concentrations exceeding the NJDEP GWQS during three of the eight most recent quarterly sampling rounds, excluding low-flow rounds, at Building 290. A significant decrease in lead concentrations was observed during the low-flow sampling rounds. Based on these results, lead is not considered a potential COC at Building 290.

Comparison of the analytical results for antimony, arsenic, and lead to site-specific ground water MBCs supports the determination that these metals are not considered potential COCs at Building 290. Antimony concentrations exceeded the site-specific MBC (20.7 µg/L) in only one of the eight most recent rounds, and reported antimony concentrations exceeded the MBC in only four of the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290. Based on the infrequency and magnitude of antimony concentrations that exceed the MBC in the ground water samples, antimony is not considered a COC for Building 290.

Arsenic concentrations exceeded the NJDEP GWQS in samples collected from monitoring well 290MW01 during five of the eight most recent rounds of sampling; however, only one arsenic concentration exceeded the site-specific MBC (89.3 µg/L) during the eight most recent rounds, and only three arsenic concentrations exceeded the MBC in the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290. Based on the infrequency and magnitudes of arsenic concentrations that exceed the MBC in the ground water samples, arsenic is not considered a COC for Building 290.

Similarly, lead exceeded the NJDEP GWQS in samples collected from monitoring well 290MW01 during three of the eight most recent rounds of sampling; however, only one lead concentration exceeded the site-specific MBC of 22.7 µg/L during the eight most recent rounds, and only five lead concentrations exceeded the MBC in the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290. Based on the infrequency and magnitude of lead concentrations that exceed the MBC in the ground water samples, lead is not considered a COC for Building 290.

Therefore, based on the ground water analytical results and the factors used to eliminate or identify analytes as COCs (specifically, the magnitude and frequency of the exceedences, comparisons to low-flow sampling results [for metals only], and comparisons to established MBCs as noted above), no potential COCs were identified in ground water at Building 290.

## 5.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Quality assurance/quality control (QA/QC) samples including sample duplicates, field blanks and trip blanks were collected in accordance with the version of the NJDEP *Field Sampling Procedures Manual* in effect at the time sampling was conducted. There was no evidence of any QA/QC issues identified based on the results of the QA/QC sample results.

## 5.5 AQUIFER PH

During each of the monitoring well sampling rounds, the pH of the ground water was recorded prior to sampling. The average pH ranged from 4.54 to 6.32 in well 290-MW1 for the most recent eight quarters of sampling (October 2008 through September 2010). The aquifer pH measurements are shown in **Table 5-4**. The pH data is included in the laboratory data in **Appendix J**.

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes conclusions from the site investigations, and ground water and soil recommendations for Building 290 at the Main Post of Fort Monmouth.

## 6.1 CONCLUSIONS

The analytical results for the ground water samples collected from April 2001 to September 2010 indicate that four metals concentrations (antimony, arsenic, cadmium, and lead) exceed the NJDEP GWQS at Building 290. Class II-A criteria were used for comparison with site-specific data obtained from the various sampling rounds because NJDEP GWQS (NJAC 7:9-6.7E) state that the ground water quality criteria to be used for Class III-A aquifers are the most stringent criteria associated with vertically or horizontally adjacent ground waters that are not Class III-A (NJDEP 1999).

Antimony, arsenic, cadmium, and lead detected at concentrations exceeding NJDEP GWQS were compared to the results from low-flow sampling and their established MBCs.

Cadmium was not detected in the low-flow rounds, and was detected at a concentration exceeding NJDEP GWQS during only one of the eight most recent quarterly sampling rounds. Based on the infrequency and magnitudes of cadmium concentrations that exceed the NJDEP GWQS and the MBC in the ground water samples, cadmium is not considered a COC at Building 290.

A significant decrease in antimony, arsenic, and lead concentrations was observed during the low-flow sampling rounds. Comparison of the analytical results for antimony, arsenic, and lead to site-specific ground water MBCs indicates that these metals have exceeded their respective MBCs infrequently during ground water sampling conducted from April 2001 to September 2010, particularly during the eight most recent rounds of sampling.

Antimony concentrations exceeded the site-specific MBC (20.7 µg/L) in only one of the eight most recent rounds, and reported antimony concentrations exceeded the MBC in only four of the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290.

Arsenic concentrations exceeded the NJDEP GWQS in samples collected from monitoring well 290MW01 during five of the eight most recent rounds of sampling; however, only one arsenic concentration exceeded the site-specific MBC (89.3 µg/L) during the eight most recent rounds, and only three arsenic concentrations exceeded the MBC in the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290.

Lead exceeded the NJDEP GWQS in samples collected from monitoring well 290MW01 during three of the eight most recent rounds of sampling; however, only one lead concentration exceeded the site-specific MBC of 22.7 µg/L during the eight most recent rounds, and only five lead concentrations exceeded the MBC in the total 38 rounds of sampling conducted from April 2001 to September 2010 at Building 290.

## 6.2 GROUND WATER RECOMMENDATIONS

Based on the factors used to eliminate or identify analytes as COCs (specifically, the magnitude and frequency of the exceedences, comparisons to low-flow sampling results, and comparisons to established MBCs as noted above), no potential ground water COCs were identified at Building 290. Therefore, NFA is recommended for ground water at Building 290.

DPW recommends continued quarterly ground water monitoring of well 290MW01 to provide data to support the monitored natural attenuation (MNA) remedy for M-18 Landfill that includes Building 290. As noted in **Section 3.1.1** of this RIRA, monitoring well 290MW02 was not sampled during the August 2006 sampling event because it could not be located. No ground water samples have been collected from this well during subsequent ground water monitoring rounds conducted at Building 290. Tetra Tech recommends that monitoring well 290MW02 be located and inspected. If the well is too damaged to sample or well integrity cannot be confirmed, the well should be properly abandoned in accordance with NJDEP requirements.

## 6.3 SOIL RECOMMENDATIONS

NJDEP has provided NFA approvals for most of the soil associated with the UST removals at Building 290.

As described in **Section 2.1.1** of this RIRA, analysis of post-excavation soil samples collected following the removal of one 550-gallon fiberglass waste oil UST (UST No. 81533-193) indicated that no TPHC or priority pollutant compound concentrations exceeded the NJDEP RDCSCC. In addition, no holes were observed in the removed UST and no potentially impacted soil was identified in the excavation. Based on field observations and the soil results, NFA was proposed for UST No. 81533-193. DPW reiterates their recommendation that NFA is warranted for UST No. 81533-193.

As described in **Section 2.1.2** of this RIRA, analysis of post-excavation soil samples collected following the removal of two 2,000-gallon steel gasoline USTs (USTs No. 81533-224 and 81533-225) indicated that no VOCs, TPHC, or lead concentrations exceeded the NJDEP RDCSCC. Based on the soil results, NFA was proposed for USTs No. 81533-224 and 81533-225. In their UST Closure Approval/NFA letter dated January 10, 2003 (**Appendix E**), NJDEP approved no further action (NFA) requests for 68 USTs at the Main Post of Fort Monmouth, including USTs No. 81533-224 and 81533-225. In their comment letter dated August 14, 2007 (**Appendix E**), NJDEP indicated that no further investigation is required for the soil related to these USTs.

As described in **Section 2.1.3** of this RIRA, analysis of post-excavation soil samples collected following the removal of one 2,000-gallon fiberglass No. 2 diesel fuel UST (UST No. 81533-64) indicated that TPHC was detected in two samples at concentrations exceeding the NJDEP RDCSCC of 10,000 mg/kg, but no VOCs concentrations were detected greater than the NJDEP RDCSCC. Based on the soil results, NFA was proposed for UST No. 81533-64. In their UST Closure Approval/NFA letter dated August 29, 2000 (**Appendix E**), NJDEP approved NFA requests for 17 USTs at the Main Post of Fort Monmouth, including UST No. 81533-64.

In their August 14, 2007 comment letter (Soil – UST Removals Comment #3), NJDEP noted that the soil data from UST No. 81533-64 indicated "two post-excavation samples contained total petroleum hydrocarbons (TPHC) in excess of the RDCSCC (samples A and B at 16,200 and 11,900 ppm [parts per million]), both at a depth of 5.5 to 6 feet. No further excavation was conducted to address those spots, Additional excavations should be considered. If the Army proposes to leave the contaminated soils in place, a deed notice must be filed to document the contamination, including location" (NJDEP 2007).

DPW intends to incorporate a document equivalent to a Declaration of Environmental Restriction (DER) into the Fort Monmouth Master Plan for soil parameter concentrations that exceed the NJDEP RDCSCC at the former location of UST No. 81533-64. Given the depth of the TPHC exceedences (5.5 to 6 feet bgs), enough soil is present to adequately cover impacted soil to prevent direct contact and engineering controls are not warranted. Additional delineation of soil exceedences will be conducted if needed during the drafting of the DER.

As described in **Section 2.1.4** of this RIRA, analysis of post-excavation soil samples collected following the removal of approximately 40 cubic yards of visually contaminated soil at the location of a former gasoline pump island indicated that no VOCs, TPHC, or lead concentrations exceeded the NJDEP RDCSCC. Based on the soil results, NFA was proposed for the soils at the former gasoline pump island. In their comment letter dated August 14, 2007 (**Appendix E**), NJDEP approved NFA for the soils located near the former gasoline pump island at Building 290**.**

Based on the above recommendations, NFA is proposed for soils at Building 290.

## REFERENCES

ATC Associates, Inc. (ATC). 2000. UST Closure and Site Investigation Report, Building 290, Main Post, New Jersey Department of Environmental Protection (NJDEP) Underground Storage Tank (UST) Registration No. 81533-64, Fort Monmouth, New Jersey. May.

Brinkerhoff Environmental Services, Inc. (Brinkerhoff). 2010. MODFLOW Ground water Modeling Report. June 10.

Brinkerhoff Environmental Services, Inc. (Brinkerhoff). 2011. *Background Metals Evaluation*. May.

Heath, R.C. 1989. "Basic Ground-Water Hydrology." U.S. Geological Survey Water-Supply Paper 2220. Fifth printing. U.S. Government Printing Office. Washington, DC.

NJDEP. 1992. Field Sampling Procedures Manual. May.

NJDEP. 1999. Technical Requirements for Site Remediation. N.J.A.C. 7:26E, et seq. July.

NJDEP. 2000. UST Closure Approval/NFA, Fort Monmouth Main Post Monmouth County. August 29.

NJDEP. 2003. UST Closure Approval/NFA, Fort Monmouth Main Post Monmouth County. January 10.

NJDEP. 2005. Field Sampling Procedures Manual. August.

NJDEP. 2007. M-18 Landfill, Fort Monmouth, NJ. August 14.

Shaw Environmental (Shaw). 2008. U.S. Army BRAC 2005 Site Investigation Report Fort Monmouth. July.

SMC Environmental Services Group (SMC). 1999. Site/Remedial Investigation Report, Building 290, Main Post-West Area. July.

Tetra Tech EM Inc. (Tetra Tech). 2010. Offsite Receptor Evaluation Report.

U.S. Army Garrison, Fort Monmouth, Directorate of Public Works (DPW). 1997. Fort Monmouth Standard Sampling Operating Procedure. New Jersey. December.

U.S. Army Garrison, Fort Monmouth, Directorate of Public Works (DPW). 2011. Glauconitic Investigation Report. March.

Versar, Inc. (Versar). 2001. UST Closure and Site Investigation Report, Building 290B, Main Post-West Area. NJDEP UST Registration No. 81533-224 and 225. Fort Monmouth, New Jersey. May.

Versar. 2003. Remedial Investigation Report, M-18 Landfill. October.

Roy F. Weston, Inc. (Weston). 1993. UST Closure and Site Investigation Report, Building 290, NJDEP UST Registration No. 81533-193. Fort Monmouth, New Jersey. October.

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

# TABLES

# FIGURES

# APPENDICES

**APPENDIX A**
**Remedial Investigation Report M-18**
**Landfill Site, Versar, October 2003**

**APPENDIX B**
**UST Site Investigation and Closure Report, Building 290C, Main Post, Fort Monmouth, New Jersey, Weston, 1993**

**APPENDIX C**
**UST Site Closure and Site Investigation Report, Building 290B, Main Post West Area, Fort Monmouth, New Jersey, Versar, 2001**

**APPENDIX D**
**UST Site Investigation and Closure Report, Building 290A,**
**Main Post, Fort Monmouth, New Jersey, ATC, 2000**

# APPENDIX E
# NJDEP Correspondence

**APPENDIX F**
**Site/Remedial Investigation Report, Building 290, Fort Monmouth, New Jersey, SMC Environmental Services Group (SMC), 1999**

**APPENDIX G**
**Public Notification Documentation**
**APPENDIX H**
**2011 Glauconitic Investigation Report and Background Metals Evaluation**

# APPENDIX I
# Standard Operating Procedures (SOPs)

# APPENDIX J
# Laboratory Analytical Data Packages for Ground water Samples

**APPENDIX K**
**Offsite Receptor Evaluation Report, Tetra Tech, 2010**

# APPENDIX L

## Ground Water Contour Reporting Forms

# APPENDIX M

## U.S. Army BRAC 2005 Site Investigation Report Fort Monmouth, Shaw Environmental, July 2008

# APPENDIX N
# Data Validation Report

TETRA TECH

Fort Monmouth Comments
Tetra Tech Response to Comments

Site Name: Building 290

Report Type: Remedial Investigation Report Addendum

Date: June 20, 2011

**(1) Fort Monmouth DPW Comment:** Incorporate results of DPW's glauconitic study into the metals discussion and Conclusions and Recommendations section.

***Tetra Tech Response:*** Glauconitic study and metals background evaluation were inserted in text and appendices.

**(2) Fort Monmouth DPW Comment:** Several reports identify the aquifer classification at Fort Monmouth as Class III-A, which is incorrect. Text needs to be revised with Class II-A.

***Tetra Tech Response:*** According to the Versar 2005 RIR and the 2004 Versar CEA Information for Various Sites, the aquifer classification at Fort Monmouth is Class III-A; however, Class II-A criteria are used for comparison. NJDEP comments disputing this were not found in our files. Therefore, the aquifer classification remains as Class III-A in the RIR.

**(3) Fort Monmouth DPW Comment:** Incorporate BEE findings into Conclusions and Recommendations section of each report. Discuss whether COC migration pathways to sensitive receptors do or do not exist.

***Tetra Tech Response:*** Standard language regarding the BEE was added to the RIRA

**(4) Fort Monmouth DPW Comment:** Incorporate aerial photo reviews/summaries where applicable.

***Tetra Tech Response:*** Not applicable to this site.

**(5) Fort Monmouth DPW Comment:** Add Mann-Whitney U test results to all reports as applicable. Discuss/reference Mann-Whitney U test results in groundwater sampling results section of reports.

***Tetra Tech Response:*** Mann Whitney test results available for this site

**(6) Fort Monmouth DPW Comment:** Incorporate NJDEP comments and responses into text as applicable. Include copy of NJDEP correspondence letter in an appendix.

***Tetra Tech Response:*** Reference to NJDEP's correspondence was already discussed in the text and included as appendix E

**(7) Fort Monmouth DPW Comment:** Concentration with time graphs need to be included in all reports. Monitoring wells identified in the Fort Monmouth Groundwater Model as being tidally influenced need a depth-to-water line added as an additional Y-axis.

***Tetra Tech Response:*** Does not apply to Tetra Tech. We believe this is a comment for Brinkerhoff.

**(8) Fort Monmouth DPW Comment:** Both 4th Quarter 2009 and 2nd Quarter 2010 data validation QA/QC needs to be discussed and referenced in each report (2nd quarter 2010 available for the 290 site).

***Tetra Tech Response:*** Data validation for the most recent round of groundwater sampling is discussed in text and presented in **Appendix M**.

**(9) Fort Monmouth DPW Comment:** Add Sensitive Receptor Survey figure, referencing it in the text. Add standard SRS language developed by the DPW into the text. Add EDR report document in an appendix, referencing it in the text.

***Tetra Tech Response:*** SRS language developed by DPW is included in the RIRA The SRS figure was added to the report. The EDR report is already included in Appendix K.

**(10) Fort Monmouth DPW Comment:** Reference fence diagrams/cross-sections in the report text (Site Conditions section) and include them in an appendix. Include copies of the well and/or soil boring logs used to generate the fence diagrams/cross sections in the same appendix.

***Tetra Tech Response:*** Does not apply to Tetra Tech. We believe this is a comment for Brinkerhoff.

**(11) Fort Monmouth DPW Comment:** Refer to the Fort Monmouth Evans Area in the past tense or delete the reference.

***Tetra Tech Response:*** Addressed.

**(12) Fort Monmouth DPW Comment:** Include soil analytical result summary tables as applicable.

***Tetra Tech Response:*** Not applicable for this site

**(13) Fort Monmouth DPW Comment:** All UST sites need a NJDEP UST Certification checklist (completed but not signed) included in an appendix.

***Tetra Tech Response:*** UST certification checklist should have been included in the UST closure report previously prepared for these sites, task not included in Tt SOW

**(14) Fort Monmouth DPW Comment:** NJDEP Sensitive Receptor Survey Form needs to be prepared for all reports.

***Tetra Tech Response:*** Tetra Tech prepared one form for this site, Brinkerhoff to fill in the well search spreadsheet information, BEE information missing to complete the ecological receptor section of form.

**(15) Fort Monmouth DPW Comment:** Add well inspection language to CEA section of each report.

***Tetra Tech Response:*** Does not apply to Tetra Tech. We believe this is a comment for Brinkerhoff.

**(16) Fort Monmouth DPW Comment:** Reference landfill disruption permits in all landfill reports as applicable.

***Tetra Tech Response:*** Not applicable for this UST site

**(17) Fort Monmouth DPW Comment:** Include vapor intrusion discussion in all reports in Conclusions and Recommendations section.

***Tetra Tech Response:*** Does not apply to Tetra Tech. No VI investigation for site. We believe this is a comment for Brinkerhoff.

**(18) Fort Monmouth DPW Comment:** Add Long-Term Monitoring (LTM) groundwater sampling reduction proposal to Conclusions and Recommendations sections.

***Tetra Tech Response:*** Does not apply to Tetra Tech. We believe this is a comment for Brinkerhoff.

**(19) Fort Monmouth DPW Comment:** Include the following standard waste disposal language in all reports: "The waste types generated by the remedial activities included three-gallon polyethylene pails, polyethylene tubing, Teflon® bailers, mason string, and personal protective equipment (PPE). The pails were recycled, and the other materials were disposed of in accordance with the *Fort Monmouth Solid Waste Management Plan*."

***Tetra Tech Response:*** Tetra Tech inserted the waste disposal language for both the groundwater sampling activities in the SIR.

**(20) Fort Monmouth DPW Comment:** Where applicable each report needs to include the following DPW-provided figures, with references to each in the text:

a. Utility Figure – Included
b. Wetland Figure – Tetra Tech created and included
c. Receptor Survey - Included
d. Streambank Stabilization Figure (landfills) Not applicable for this site

***Tetra Tech Response:*** Figures were added as appropriate, see above.

**(21) Fort Monmouth DPW Comment:** Need separate Tentatively Identified Compounds (TICs) section within Analytical Results section. Use the following example from a past VEETech report

***Tetra Tech Response:*** Inserted discussion on TICS within groundwater results section

**(22) Fort Monmouth DPW Comment:** Site Specific Comments

***Tetra Tech Response:*** Not applicable to this site

**(23) Fort Monmouth DPW Comment:** Grammatical comments

***Tetra Tech Response:*** addressed in the text, however Tetra Tech disagrees with the comment h regarding spelling the alphanumerical number, general rule is to spell out number less than ten and use alphanumerical numbers for numbers greater than ten.