# SAMPLING AND ANALSIS PLAN

# MONITORED NATURAL ATTENUATION EVALUATION
## STRATFORD ARMY ENGINE PLANT
**Stratford, Connecticut**

**July 2011**

**Prepared for**

**U.S General Services Administration**
**New England Region**
**Boston, Massachusetts**

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## 1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared to outline the field activities required to evaluate Monitored Natural Attenuation (MNA) for groundwater contamination at the Stratford Army Engine Plant (SAEP).

### 1.1 Purpose

The purpose of this SAP is to identify data requirements associated with evaluation of MNA and to present the field procedures, data collection methods and sample analysis. The SAP is to be used during field activities by all sampling personnel. Analytical methods and quality control procedures are included in the Quality Assurance Project Plan (QAPP), and health and safety practices for the field investigations are in the Site Safety and Health Plan (SSHP).

### 1.2 Project Background

SAEP is located on approximately 78 acres in Stratford, Connecticut. SAEP was formerly a government-owned, contractor-operated facility. The land and buildings are owned by the U.S. Army. The SAEP was used for the manufacturing and testing of turbine engines. The property consists of 49 buildings, paved roadways and grounds, and five paved parking lots. A site map is provided as Figure 1-1.

In October 1995, SAEP was placed on the Base Closure and Realignment (BRAC) list, known as BRAC 95. The environmental contamination on the property was investigated during multiple phases of investigation. The Army completed a Remedial Investigation (RI) in September 2004. The RI identified volatile organic and metals contamination in groundwater. As part of the RI, multiple rounds of groundwater monitoring were conducted to evaluate the suitability of monitored natural attenuation (MNA) as a remedy for contaminants in groundwater that have migrated, or have the potential to migrate, to the Housatonic River.

A MNA report summarizing the groundwater data collected during the RI was prepared in June 2011. It was determined that the organic contaminants in groundwater, primarily chlorinated hydrocarbons, were attenuating and generally decreasing concentration trends were observed at many monitoring well locations. Geochemical data collected during the RI phase also indicated that groundwater conditions are suitable for MNA to occur. Inorganic contaminant results associated with the former plating facility also indicated decreasing concentration trends.

The MNA report recommended additional monitoring events to confirm trends as well as to track the concentrations as they decrease to compliance levels. The report also identified data gaps associated with demonstration of MNA for inorganics. MNA data requirements are provided in Section 2.

## 2.0 DATE REQUIREMENTS AND DATA QUALITY OBJECTIVES

The following subsections describe the data requirements and scope of work activities to be conducted, and the anticipated site hazards which may be encountered while conducting these proposed activities.

### 2.1 Data Needs

The following data requirements have been identified:

- Groundwater elevation data is needed to evaluate flow direction in the shallow aquifer.
- Groundwater monitoring is necessary to establish concentration trends for VOCs and metals to make remedial decisions and determine potential for offsite migration.
- Groundwater analysis is needed to evaluate MNA as a remedy or component of the remedy in the Remedial Action Plan (RAP) for offsite groundwater migration.
- Supplemental groundwater data is needed to evaluate the immobilization of the metals plume associated with the former chromium plating facility

### 2.2 Scope of Work

This section summarizes the scope of work that will be implemented during the MNA field program. The field program will include implementation of groundwater monitoring. The following tasks are scheduled for completion as part of investigation activities:

- Collection of water level measurements to document groundwater flow direction and calculate vertical hydraulic gradients;
- Groundwater sample collection and analysis for site-related contaminants and monitored natural attenuation (MNA) parameters; and
- Collection of direct-push groundwater samples along the flow path of the chromium plume to supplement the groundwater monitoring well data.

## 3.0 FIELD ACTIVITIES

The following subsections present the rationale, field procedures, documentation, and data processing for field activities. In addition, sample management/validation, investigation-derived waste handling/disposal, and the planned sequence of field activities are presented.

The work will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USEPA, 1990), the U.S. Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988) and CTDEP Draft Site Characterization Guidance Document (CTDEP, 2000). Work conducted will be consistent with USEPA MNA protocol.

### 3.1 Water Level Measurements

#### 3.1.1 Objectives and Rationale

One round of synoptic groundwater level measurements will be made during low tide to determine shallow groundwater elevations and flow direction. Monitoring wells planned for water level measurement are screened within the upper 50 feet of the ground surface.

#### 3.1.2 Field Procedures

The planned monitoring wells for water level measurements are listed in Table 3-1. The sequence of water level measurements will be to start with wells along the shoreline and Dike near low tide and work inland. The monitoring well locations are shown on Figure 3-1.

The depth of the static water level in each well will be measured using an electronic water level meter. The measuring point will be the top of the steel or PVC well casing. Measurements will be made to an accuracy of 0.01 foot and recorded on a field data sheet.

#### 3.1.3 Data Processing

Water level depth measurements will be converted to groundwater level elevations, and a contour map will be prepared to determine groundwater flow direction.

### 3.2 MNA Groundwater Sampling

#### 3.2.1 Objectives and Rationale

To obtain current concentrations of VOC and inorganic groundwater contamination, one round of groundwater samples will be collected from 45 monitoring wells and piezometers. Figure 3-1 shows the planned monitoring well locations, and Table 3-2 lists these wells/piezometers with the planned analyses.

### 3.2.2 Field Procedures

Monitoring wells will be sampled using low-stress purging and sampling methods for the collection of groundwater samples, and will generally follow the USEPA Region 1 Standard Operating Procedure (SOP), Revision Number 2, July 30, 1996 (USEPA, 1996a), as described below. Samples will be sent to an off-site laboratory for VOC, metals including hexavalent chromium and cyanide analyses. Samples will be collected from existing wells.

Table 3-4 lists the planned groundwater sampling analyses and total analytical samples to be collected. Table 4-1 in the QAPP presents a summary of the analytical methods, and Table 6-1 of the QAPP identifies sample handling requirements for the collection of analytical samples.

The following equipment and supplies may be used during groundwater sample collection:

- Low Flow Groundwater Data Sheet (see Appendix B of the QAPP);
- Field log book;
- Peristaltic pump;
- Appropriate hoses and connectors for dedicated and non-dedicated systems;
- PID;
- Multi-parameter water quality meter equipped with a flow through cell;
- Water level indicator;
- Volumetric measuring device;
- Sample containers;
- Decontamination supplies;
- Plastic sheeting to establish a clean area for equipment staging and sample collection;
- Keys and tools for opening protective casings; and
- Containers for temporary storage of purge water.

Non-dedicated groundwater sampling equipment will be decontaminated prior to use in accordance with the procedures outlined in Subsection 6.5 of the QAPP. Calibration of the monitoring equipment will be in accordance with the manufacturer's suggested procedures (see Subsection 8.1 of the QAPP) and will be completed prior to each day's sampling activities and as required during the course of the day. Daily instrument calibration data will be recorded on the Field Instrumentation Calibration Record (see Appendix B of the QAPP).

Groundwater samples will be collected from each monitoring well using the procedures described in the following section. Data generated during groundwater sampling will be recorded on the Groundwater Sample Data Sheet. To the extent practical, sampling of groundwater wells will proceed from upgradient wells to the more contaminated wells as best as can be determined, based on existing data.

The USEPA SOP will be followed during groundwater sampling activities, with the following variations to the USEPA SOP anticipated:

- Up to 1 hour will be spent per well to obtain stabilization of field parameters;

- An adjustable rate, peristaltic pump (Geopump™), or equivalent, will be used to purge wells and collect samples;

- A ¼-inch LDPE tubing will be inserted into the wells and used to collect samples. Most of the listed wells already have dedicated tubing stored on-site and will be used to collect the required samples. New tubing used to collect samples from each well will be dedicated to each well;

- Silicon tubing will be used for the section around the rotor head of the Geopump™ peristaltic pump;

- An in-line, 0.45-micron, filter will be used at the pump discharge to collect the filtered fraction for metals. Metals samples will be collected following collection of samples for VOCs. Hexavalent chromium samples will not be field-filtered.

The following activities will be performed immediately prior to purging each well:

1. Check the well for proper identification and location.

2. Measure and record the height of the protective casing (not applicable for flush mount installations).

3. After unlocking the well and removing any well cap, measure and record the ambient and well-mouth organic vapor levels using the PID. Appropriate action levels and safety equipment are described in the SSHP.

4. Measure and record the distance between the top of the well casing and the top of the protective casing.

5. Measure the depth to groundwater from the surveyor's mark on the well riser or, in the absence of such mark, from the highest point on the rim of the well casing or riser using an electronic water level meter. The water level will be measured to 0.01 feet and shall be re-checked by raising the probe 1 to 2 feet following the initial reading and re-measuring the water level. The probe end of the water level meter will be decontaminated between monitoring wells.

6. Inspect the well for any signs of poor integrity.

7. Place plastic sheeting on the ground surface around the well to protect sampling equipment from becoming contaminated by material located around the well.

A peristaltic pump will be used to conduct the low-flow purging and sampling. Field parameter measurements will be made using instrumentation and a commercially manufactured flow through cell. Dedicated high-density polyethylene (HDPE) tubing will be used. Further details on the low-flow purging and sampling procedure are presented in the USEPA Region I - New England Low Stress (low-flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells, Revision 2, July 30, 1996 (USEPA, 1996a). Sample collection information will be recorded on the Low Flow Groundwater Sampling Record in Appendix B of the QAPP. The pH stabilization criteria of +/-0.2 units specified in this subsection will take precedence over the pH stabilization criteria of +/- 0.1 units specified in the USEPA guidance. The USEPA guidance will be used for purging and sampling procedures only.

The following steps outline the purging and sample collection activities for low-flow sampling.

1. Determine target depth for location of the pump intake. Target depth should be the portion of the screened interval that intersects the zone of highest hydraulic conductivity. If the zone of highest hydraulic conductivity is unknown, or if the screen is placed within homogenous material, then the target depth will be the midpoint of the saturated screen length. Primary flow zones should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock.

2. Measure and record the depth to water. Care should be taken to minimize disturbance of the water column within the well during pre-sample measurements.

3. Attach appropriate length of dedicated HDPE tubing or mark the tubing at the appropriate point so that when tubing is lowered into the well, and the mark is at the top of the well riser, the intake will be located at the target depth within the screened interval.

4. Lower the tubing to the predetermined target depth. Start the pump at a purge rate low enough to achieve 0.3 feet of drawdown or less based on historical data. If sampling the well for the first time, start the pump at the lowest possible setting (or approximately 100-milliliter [mL] per minute) and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no drawdown (less than 0.3 feet) if possible. If minimal drawdown that can be achieved exceeds 0.3 feet (at a pump rate of approximately 100 mL per minute) but remains stable, continue purging until indicator field parameters stabilize.

5. Monitor and record pumping rate and water levels every 3 to 5 minutes (or as appropriate) during purging. Record any adjustments to pumping rates.

6. During purging, monitor field parameters using a flow through cell (the flow through cell can not be used for turbidity measurements and the sample for turbidity measurement must be collected prior to entering the flow through cell). Purging is considered complete and sampling may begin when the field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3 to 5 minute intervals, are within the following limits:

    - turbidity (+/- 10% for values >1 NTU);
    - dissolved oxygen (DO) (+/- 10%);
    - specific conductivity (+/- 3%);
    - temperature (+/- 10%);
    - pH (± 0.2 unit); and • oxidation-reduction potential (ORP) (± 10 millivolts).

7. The final purge volume must be greater than the stabilized drawdown volume plus the volume of the water in the tubing at the time of water level equilibration prior to purging.

8. During purging and sampling the tubing should remain filled with water.

9. Disconnect the tubing from the flow through cell to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow-through assembly.

10. The sample for VOC analysis will be collected first. The VOC sample will not be collected after passing through the pump head. Disconnect the tubing before the pump head. Allow the sample to drain slowly from the tubing into the vials. Sufficient length of tubing is needed at the well head to fill the vials. The VOC sample container will be completely filled without air space within the container. VOC sample containers will be filled with as little agitation as possible.

11. For inorganic and MNA analysis reconnect the tubing to the pump head and purge until the volume in the tubing has been replaced. Fill sample containers directly from the tubing without alterations to the pumping rate.

12. The sampler will collect the sample(s) in appropriate containers as listed in Section 6.4.1 of the QAPP. Where duplicate, matrix spike/matrix spike duplicate, or split samples are to be collected, samplers should fill all containers for a given analytical parameter before moving on to the next parameter.

13. The containers for filtered metals will be triple rinsed with filtered sample water. Water samples to be analyzed for dissolved inorganic compounds will be pumped through a 0.45-micron high capacity in-line disposable filter.

14. For subsequent sampling efforts, duplicate the pump intake depth and final purge rate from the initial sampling event (use final pump dial setting information).

15. Obtain and record a depth to bottom of well measurement before closing and locking the well.

Special Cases:

If the above sampling criteria cannot be met after 4 hours of purging, the following options will be considered:

- continue purging until stabilization of parameters is achieved;
- collect sample using a bailer; or
- discontinue purging and collect samples.

If the recharge rate of the well is less than the lowest possible extraction rate of the pump (i.e., drawdown does not stabilize at a purge rate of approximately 100 mL per minute or less), the purge rate will be increased and the water will be evacuated down to the pump intake level. This will result in several feet of stagnant water below the pump intake that will not be evacuated. The pump should then remain in place, and the well should be sampled after the water level has recovered to at or near the initial static water level. Collect the sample from the pump at a pumping rate of approximately 100 mL per minute.

### 3.2.3 Pore Water Sampling

Shallow pore water will be collected at two former tidal flats piezometer locations (D-4 and D-8) shown on Figure 3-2. The samples will be collected from the top 1-2 feet of sediment using a sampler consisting of a tubular stainless steel body with a screened zone at one end and a sampling port at the other. A guard rod that is nested in the tube during deployment will provide structural support and prevent plugging and deformation of the screened zone. The screened zone consists of a series of machined slots which form a short screened zone with approximately 20% open area. Pore water is collected through the opposite end of the point through flexible tubing using a syringe or peristaltic pump through the sampling port. Teflon tubing will be used.

### 3.2.4 Sample Analyses

VOC samples will be analyzed by SW-846 Method 8260B. Both unfiltered (total) and filtered (dissolved) metals groundwater samples will be collected, and analyzed by SW-846 Method 6020. Hexavalent chromium will be analyzed by SW-846 Method 7196 and cyanide will be analyzed by SW-846 Method 9012B. MNA field parameters listed in the table below will be collected.

| MNA FIELD PARAMETER | ANALYTICAL METHODOLOGY |
|---|---|
| Dissolved oxygen (DO) | Field Instrumentation |
| Oxidation-reduction potential (ORP) | Field Instrumentation |
| Specific conductivity | Field Instrumentation |
| Temperature | Field Instrumentation |
| Turbidity | Field Instrumentation |
| PH | Field Instrumentation |

## 3.3 Former Chromium Facility MNA Sampling

### 3.3.1 Objectives and Rationale

Direct-push groundwater grab samples will be collected downgradient of the chromium plume to supplement the monitoring well sample locations. Historical groundwater data from downgradient monitoring wells indicate the chromium plume is stable and not expanding. However, additional groundwater spatial data is required to determine current concentrations of metals within the plume. If attenuation of chromium and other plating metals present in groundwater is occurring a trend of decreasing contaminant concentrations in groundwater is expected along the flow path of the plume.

### 3.3.2 Field Procedures

Two direct-push borings locations will be used for collection of additional groundwater samples. The direct-push borings will be completed at the locations shown on Figure 3-2. At each location groundwater samples will be collected from three depth intervals (10 feet bgs, 20 feet bgs, and 30 feet bgs). Samples will be collected using direct-push sample equipment and a peristaltic pump.

### 3.3.3 Sample Analyses

Samples will be analyzed for metals, hexavalent chromium and cyanide. Both unfiltered (total) and filtered (dissolved) metals groundwater samples will be collected, and analyzed by SW-846 Methods 6020.

## 3.4 Sample Management and Data Validation

### 3.4.1 Sample Handling

Section 6.4 of the QAPP details the documentation, packaging, and shipping procedures to be used during field activities and sample collection.

Each sample collected during field activities will receive a unique sample identification number, which will be recorded on the sample label, the laboratory COC, and the field logbook. Field data sheets will be used to record observations and details regarding field activities, including boring logs, monitoring well installation information, water levels, field water quality parameters, and general observations. Sample handling requirements, including holding times, are presented in Table 6-1 of the QAPP.

Samples to be sent off-site for analysis will be appropriately packaged to prevent damage to the sample containers, and to maintain required temperatures and adequate custody.

### 3.4.2 Data Validation

Data validation will be completed on results from the analysis of samples collected as described in Section 3.1, above. Data from the VOC and inorganics analyses will be validated in accordance with USEPA Region I guidelines (USEPA, 1996b). Tier III validation will be completed on approximately 10 percent of the data from each of the field investigations; Tier II validation will be completed on all remaining data.

A project chemist review will be completed on analytical chemistry data associated with the analysis of the remaining methods. The goal of the chemist review is to provide a general evaluation of quality control data and identify data usability considerations. The project chemist review will include evaluations of sample collection and preservation processes, holding time compliance, QC blanks, field duplicates, and laboratory control sample results, and matrix spike sample results. If necessary, sample results may be qualified by the project chemist. The project chemist will use professional judgments and general procedures identified in USEPA validation guidelines as the basis for qualification actions.

A data validation report will be written summarizing the analytical chemistry program, and data validation and data review actions. Data usability discussions will include identification of data uncertainties associated with qualified results, and a summary of data quality issues that should be considered when using the analytical results.

Following validation, all data will be entered into the SAEP Geographic Information System database.

Section 9.0 of the QAPP details data reduction, validation, and reporting procedures.

## 4.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

This waste management section covers the disposition of investigation-derived waste (IDW) that is anticipated to be generated at SAEP during MNA sampling. IDW will potentially include soil generated during direct-push investigations, groundwater generated during well development, purging and sampling, and decontamination water generated during field decontamination of equipment. IDW will be stored separately (liquid and solid) in appropriately labeled drums inside the container storage area at Building 72. The final disposition of IDW will be determined based upon waste contents and analytical results, if necessary.

### 4.1 IDW Handling

The following waste streams are anticipated as a result of the planned field investigation activities:

- Disposable sampling equipment (plastic tubing, sample jars, etc.), and Personal Protective Equipment;
- Contaminated soils;
- Contaminated groundwater;
- Decontamination fluids without surfactants (e.g., water and site contaminants); and
- Decontamination fluids with surfactants.

IDW from the program will be segregated into 55-gallon drums according to the above lists to facilitate the handling and disposal of drums. The drums will be Department of Transportation UN specification drums.

Drums containing soil generated during direct-push completion will be stored briefly on-site (a maximum of 90 days following characterization of the waste) in accordance with regulatory requirements, and then sent off-site for disposal based on analytical findings of the contents. Personal protective equipment and disposable sampling equipment will also be drummed for off-site disposal.

Groundwater generated during well development, purging, sampling and decontamination activities will be stored briefly on-site (a maximum of 90 days following characterization), and will be sent off-site for disposal based on analytical results of the contaminant concentrations.

### 4.2 IDW Sampling and Disposal

In order to properly characterize and to ultimately dispose of generated IDW, containerized IDW will undergo hazardous waste characterization pursuant to 40 CFR Parts 261 and 268 prior to assessing disposal options. Laboratory analytical results obtained from the sampling and analysis program will be used to evaluate whether the waste exhibits the toxicity characteristic using the “20 times” rule. For soil samples, if the total constituent concentration is less than 20 times the toxicity characteristic regulatory concentration, then the IDW soil will not be considered to exhibit toxicity characteristics. Soil concentrations greater than 20 times the regulatory concentration will trigger the need for a TCLP analysis. For water, the total concentration will be compared directly to the toxicity characteristic regulatory concentration. Sampling for the characteristic hazards of ignitability, corrosivity, and reactivity will be conducted on composite samples from like materials. Should a disposal facility require additional testing, they will be conducted on composite samples from like materials.

If results from the analytical testing indicate that a "RCRA Listed Waste" was detected in the IDW sample, then sample concentrations will be compared to CTDEP RSR criteria health-based levels. If concentrations are detected above these levels, then the IDW will be considered a hazardous waste. If the IDW is neither a listed waste nor a toxicity characteristic waste, IDW will be managed and disposed of as non-hazardous. If IDW is either a listed waste or exhibits toxicity characteristics, it will be managed and disposed of as a hazardous waste.

Test America Laboratory of Shelton, Connecticut will provide analytical services to determine IDW disposal. If required, waste will be disposal of at an appropriately permitted facility. If sampling indicates the material is non-RCRA-regulated and non-Toxic Substance Control Act-regulated, then disposal will be at an appropriate solid waste facility.

Onyx will responsible for the appropriate disposal of the waste streams according to all applicable federal, state and local regulations and requirements. The scope of work includes analytical testing required for final acceptance and disposal of wastes. All disposal facilities (hazardous and solid waste) will be approved by the generator (United States Army) prior to waste transport.

## LIST OF ACRONYMS

| | |
|---|---|
| ACSIM | United States Army Assistant Chief of Staff for Installation Management |
| BZ | breathing zone |
| COC | contaminant of concern |
| CPR | cardiopulmonary resuscitation |
| CRZ | contamination reduction zone |
| CTDEP | Connecticut Department of Environmental Protection |
| DOT | Department of Transportation |
| DNAPL | dense non-aqueous phase liquid |
| eV | electron volt |
| HCS | Hazard Communication Standard |
| IDLH | immediately dangerous to life or health |
| IDW | investigation derived waste |
| LEL | lower explosive limit |
| LNAPL | light non-aqueous phase liquid |
| MNA | monitored natural attenuation |
| MSDS | Material Safety Data Sheets |
| OSHA | Occupational Safety and Health Administration |
| PPE | personal protection equipment |
| PID | photo ionization detector |
| RI | remedial investigation |
| RSHM | Regional Safety and Health Manager |
| RSRs | remediation standard regulations |
| SAEP | Stratford Army Engine Plant |
| SCBA | self contained breathing apparatus |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| TLV | threshold limit value |
| USEPA | United States Environmental Protection Agency |
| UV | ultraviolet |
| VOCs | volatile organic compounds |

# FIGURES

FIGURE 1–1

SITE MAP

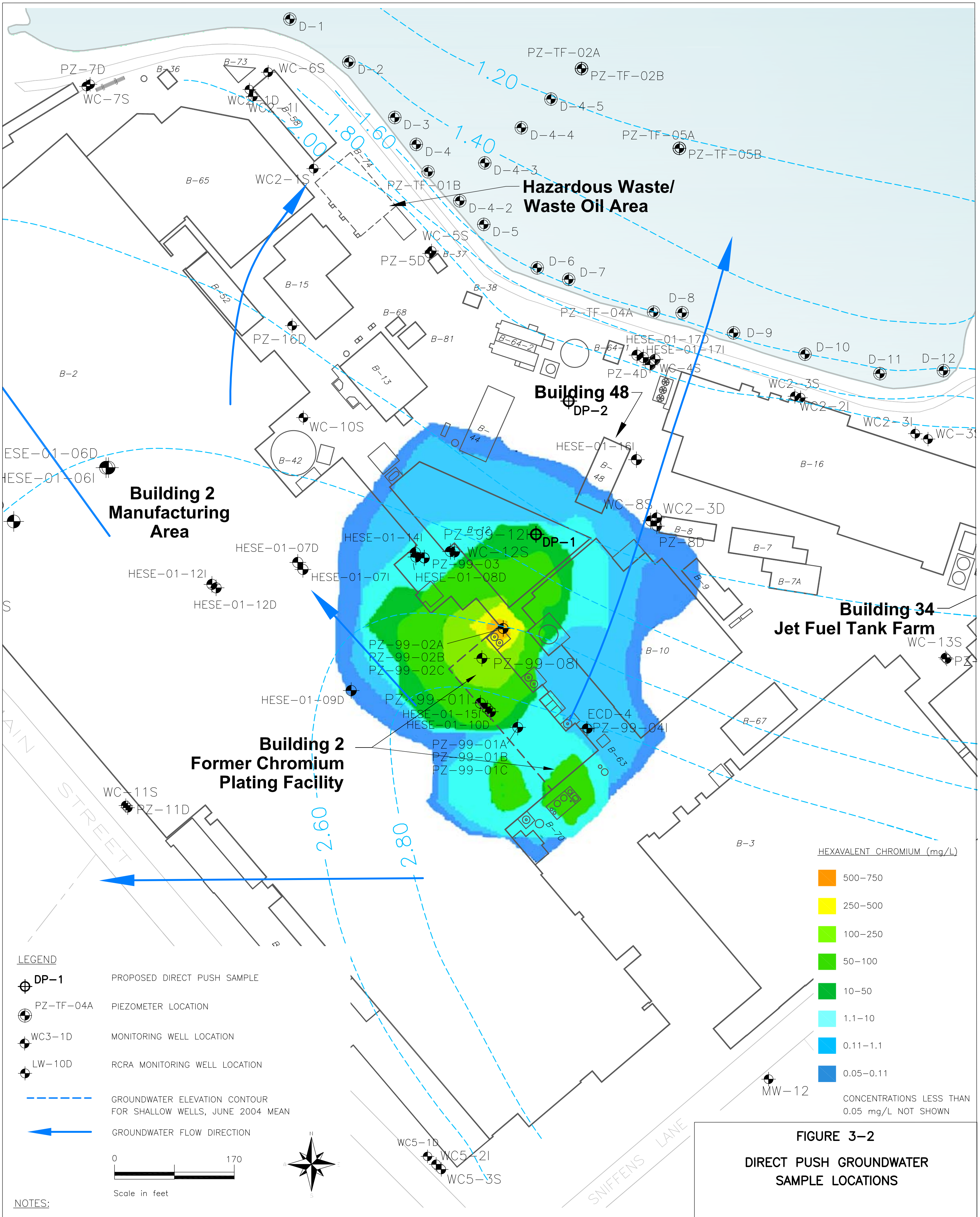
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

ANDERSON MULHOLLAND & ASSOC.

FIGURE 3-1

MONITORING WELL LOCATIONS

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT
ANDERSON MULHOLLAND & ASSOC.



NOTES:

1. HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER ELEVATION -25 FT, MSL
2. CONCENTRATION CONTOURS FROM STRATFORD ARMY ENGINE PLANT REMEDIAL INVESTIGATION, SEPTEMBER 2004

## FIGURE 3-2

## DIRECT PUSH GROUNDWATER SAMPLE LOCATIONS

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT
ANDERSON MULHOLLAND & ASSOC.

# TABLES

# Table 3-1
## Planned Monitoring Well Water Level Locations
## Stratford Army Engine Plant
## Stratford Connecticut

| Well ID | Bottom of Screen (Feet BGS) | Top of Screen (Feet BGS) | Screen Length (Feet) | Stratigraphic Unit |
|---|---|---|---|---|
| MW-1 | 15 | 5 | 10 | Fill / Sand, Silty Sand |
| MW-2 | 15 | 5 | 10 | Fill / Sand, Silty Sand |
| MW-3 | 15 | 5 | 10 | Sand, Silty Sand / Silt |
| MW-4 | 15 | 5 | 10 | Fill / Sand, Silty Sand |
| WC-1S | 14 | 4 | 10 | Sand, Gravel |
| WC-2D | 34.5 | 24.5 | 10 | Gravel / Sand, Gravel / Peat |
| WC-3S | 13 | 3 | 10 | Fill / Gravel |
| WC-4S | 13 | 3 | 10 | Sand, Gravel |
| WC-5S | 13 | 3 | 10 | Sand, Gravel |
| WC-6S | 13 | 3 | 10 | Fill |
| WC-7S | 13 | 3 | 10 | Fill / Silt |
| WC-8S | 13 | 3 | 10 | Peat / Sand, Gravel |
| WC-9S | 14 | 4 | 10 | Fill / Sand, Gravel |
| WC-10S | 13 | 3 | 10 | Sand, Gravel |
| WC-11S | 14 | 4 | 10 | Fill / Sand, Gravel |
| WC-12S | 13 | 3 | 10 | Sand, Gravel |
| WC-13S | 13 | 3 | 10 | Fill / Sand, Silty Sand |
| WC-14S | 13 | 3 | 10 | Fill / Sand, Silty Sand |
| WC-15S | 13 | 3 | 10 | Fill/ Sand, Gravel |
| WC1-1S | 12 | 2 | 10 | Sand, Gravel |
| WC2-1S | 12 | 2 | 10 | Fill / Sand, Gravel |
| WC2-3S | 12 | 2 | 10 | Fill / Sand, Gravel |
| WC2-4S | 12 | 2 | 10 | Sand, Gravel |
| WC2-4I | 35 | 25 | 10 | Sand, Gravel |
| WC2-5S | 12 | 2 | 10 | Sand |
| WC2-5I | 40 | 30 | 10 | Sand |
| WC2-6I | 50 | 40 | 10 | Sand, Gravel |
| WC3-1I | 40 | 30 | 10 | Sand |
| WC3-2I | 40 | 30 | 10 | Sand |
| WC5-1S | 11.5 | 1.5 | 10 | Sand |
| WC5-2I | 40 | 30 | 10 | Sand, Gravel |
| WC5-2S | 12 | 2 | 10 | Fill |
| WC5-3S | 12 | 2 | 10 | Fill, Sand |
| WC6-1I | 50 | 40 | 10 | Sand, Gravel |
| PZ-1D | 34 | 24 | 10 | Sand, Silty Sand |
| PZ-4D | 39 | 29 | 10 | Sand, Silty Sand |
| PZ-5D | 43 | 33 | 10 | Silt |
| PZ-7D | 29 | 19 | 10 | Sand, Gravel |
| PZ-8D | 33.5 | 23.5 | 10 | Sand, Gravel |
| PZ-9D | 34 | 24 | 10 | Sand, Silty Sand |
| PZ-11D | 34 | 24 | 10 | Silt / Sand, Sandy Silt |
| PZ-13D | 31.5 | 21.5 | 10 | Sand, Gravel |
| PZ-16D | 29 | 19 | 10 | Sand, Gravel |
| PZ-17D | 39 | 29 | 10 | Sand, Silty Sand |

# Table 3-1
# Planned Monitoring Well Water Level Locations
# Stratford Army Engine Plant
# Stratford Connecticut

| Well ID | Bottom of Screen (Feet BGS) | Top of Screen (Feet BGS) | Screen Length (Feet) | Stratigraphic Unit |
|---|---|---|---|---|
| MW-1S | 9.9 | -0.1 | 10 | Fill / Peat |
| MW-4 | 34.05 | 24.05 | 10 | Sand, Gravel |
| MW-6 | 25.89 | 15.89 | 10 | Sand, Gravel |
| MW-7 | 30.3 | 20.3 | 10 | Sand, Gravel |
| MW-10I | 48.41 | 38.41 | 10 | Sand, Gravel |
| MW-10S | 14.43 | 4.43 | 10 | Fill / Peat |
| MW-12 | 13.9 | 3.9 | 10 | Sand, Silty Sand |
| MW-13 | 15.33 | 5.33 | 10 | Sand, Gravel |
| HESE-01-06I | 19.8 | 29.8 | 10 | |
| HESE-01-07I | 19.7 | 29.7 | 10 | |
| HESE-01-16I | 23.9 | 33.9 | 10 | |
| HESE-01-17I | 17.6 | 27.6 | 10 | |
| HESE-01-15I | 25 | 35 | 10 | |
| PZ-99-12I | 16.1 | 21.1 | 5 | |

## Table 3-2
## Planned Groundwater Sampling Locations and Analysis
## Stratford Army Engine Plant
## Stratford Connecticut

| Well ID | Location | Screen Interval | Analytical | | | |
|---|---|---|---|---|---|---|
| | | | VOCs | Metals | Hexavalent Chromium | Cyanide |
| ECD-4 | In plume | 8-18 | X | X | X | X |
| PZ-99-04I | In plume | 30-35 | X | X | X | X |
| PZ-99-01A | In plume | 4-9 | X | X | X | X |
| PZ-99-01B | In plume | 30-35 | X | X | X | X |
| PZ-99-01C | In plume | 45-50 | X | X | X | X |
| PZ-99-02A | In plume | 4-9 | X | X | X | X |
| PZ-99-02B | In plume | 30-35 | X | X | X | X |
| PZ-99-02C | In plume | 45-50 | X | X | X | X |
| PZ-99-08I | In plume | 16-21 | X | X | X | X |
| PZ-99-12I | Downgradient | 16-21 | X | X | X | X |
| PZ-8D | Downgradient | 23.5-33.5 | X | X | X | |
| WC-8S | Downgradient | 3-13 | X | X | X | |
| HESE-01-16I | In plume | 23.9-33.9 | X | | | |
| PZ-16D | Downgradient | 19-29 | X | | | |
| WC-4S | Downgradient | 3-13 | X | | | |
| PZ-4D | Downgradient | 29-39 | X | | | |
| WC-9S | Downgradient | 4-14 | X | | | |
| PZ-9D | Downgradient | 24-34 | X | | | |
| HESE-01-17I | In plume | 17.6-27.6 | X | X | X | X |
| HESE-01-17D | In plume | 112.3-122.3 | X | | | |
| HESE-01-06I | Downgradient | 23.9-33.9 | X | | | |
| HESE-01-06I | In plume | 24-34 | X | | X | X |
| HESE-01-07I | Downgradient | 17.6-27.6 | X | | | |
| WC-4S | Downgradient | 3-13 | X | | | |
| PZ-4D | Downgradient | 29-39 | X | | | |
| D-8 * | Downgradient | 1-2 | X | | | |
| WC-1S | In plume | 5-15 | X | | | |
| PZ-1D | In plume | 24-34 | X | | | |
| WC-3S | Downgradient | 3-13 | X | | | |
| WC-2D | Downgradient | 24.5-34.5 | X | | | |
| MW-4 | Downgradient | 5-15 | X | | | |
| HESE-01-18D | Downgradient | 38.9-48.9 | X | | | |
| TFMW-1 | In plume | 4-14 | X | | | |
| WC-5S | In plume | 3-13 | X | | | |
| PZ-5D | In plume | 33-43 | X | | | |
| D-4 * | Downgradient | 1-2 | X | | | |
| WC2-3S | Downgradient | 2-12 | X | X | X | X |
| WC2-2I | Downgradient | 45-55 | X | X | X | X |
| WC-3S | Downgradient | 3-13 | X | | | |
| WC2-3I | Downgradient | 45-55 | X | | | |

### Table 3-2
### Planned Groundwater Sampling Locations and Analysis
### Stratford Army Engine Plant
### Stratford Connecticut

| Well ID | Location | Screen Interval | Analytical | | | |
|---|---|---|---|---|---|---|
| | | | VOCs | Metals | Hexavalent Chromium | Cyanide |
| WC-13S | Downgradient of Building 3 | 3-13 | X | X | X | X |
| PZ-13D | Downgradient of Building 3 | 21.5-31.5 | X | X | X | X |
| WC2-4S | Downgradient of Building 6 | 2-12 | X | X | X | X |
| WC2-4I | Downgradient of Building 6 | 25-35 | X | X | X | X |
| WC-15S | Downgradient of Building 6 | 3-13 | X | | | |
| SUBTOTALs | | | 45 | 19 | 20 | 18 |
| Trip Blanks | | | 5 | | | |
| Duplicates | | | 5 | 2 | 2 | 2 |
| MS/MSDs | | | 5 | 2 | 2 | 2 |
| TOTALs | | | 60 | 23 | 24 | 22 |

**Notes:**

* Tidal Flats piezometers D-4 and D-8 no longer exist. Groundwater samples will be collect at same location using shallow pore water sampling equipment

# Table 3-3
# Direct Push Groundwater Sampling Locations and Analysis
# Stratford Army Engine Plant
# Stratford Connecticut

| Sample ID | Location | Sample Depth Interval (Feet BGS) | Metals | Hexavalent Chromium | Cyanide |
|---|---|---|---|---|---|
| DP-1A | In plume | 10 | X | X | X |
| DP-1B | In plume | 20 | X | X | X |
| DP-1C | In plume | 30 | X | X | X |
| DP-2A | downgradient | 10 | X | X | X |
| DP-2B | downgradient | 20 | X | X | X |
| DP-2C | downgradient | 30 | X | X | X |
| SUBTOTALs | | | 6 | 6 | 6 |
| Duplicates | | | 1 | 1 | 1 |
| MS/MSDs | | | 1 | 1 | 1 |
| TOTALs | | | 8 | 8 | 8 |

**Notes:**

Groundwater samples collected from direct push sampling equipment