**USACE CONTRACT NO. DACW33-94-D-0002**
**TASK ORDER NO. 020**
**TOTAL ENVIRONMENTAL RESTORATION CONTRACT**

# FINAL
# PRE-DESIGN INVESTIGATION REPORT
# CAUSEWAY AND DIKE NCRA
# STRATFORD ARMY ENGINE PLANT
# Stratford, Connecticut

**April 14, 2000**

**Prepared for**

**U.S. Army Corps of Engineers**
**New England District**
**Concord, Massachusetts**

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***Prepared for:***

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

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**April 2000**

| Revision | Date | Prepared By | Approved By | Pages Affected |
|---|---|---|---|---|
| 1 | 2/01/00 | T. Longley<br>R. Pendleton | N. Walter<br>J. Borkland | All |
| 2 | 4/14/00 | | | |

FINAL
PRE-DESIGN INVESTIGATION REPORT
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# 1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) and Harding Lawson Associates (HLA) have been contracted through the U.S. Army Corps of Engineers – New England District (USACE) to complete a Non-time Critical Removal Action (NCRA) for the Causeway and Dike Area at the Stratford Army Engine Plant (SAEP) under Task Order No. 020 of The New England TERC (Contract No. DACW33-94-D-0002). The objectives of this Task Order are to: 1) complete additional field activities necessary to characterize physical and chemical subsurface conditions on the Causeway and Dike, 2) summarize the results of field activities in a Pre-Design Investigation Report, and 3) document the decision process for selection of a removal action for the Causeway and Dike area in an Engineering Evaluation/Cost Analysis (EE/CA) and a Removal Action Memorandum (RAM). This report satisfies aforementioned items 1 and 2 by documenting the results of the field investigation activities conducted by Foster Wheeler and HLA during the summer and fall of 1999.

## 1.1 PROJECT INTRODUCTION

SAEP is located on approximately 126 acres in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (Figure 1-1). About 76 acres of the land are improved and 48 acres are riparian (water) rights.

SAEP was formerly a government-owned, contractor-operated facility. The U.S. Army owns the land and buildings, and both the U.S. Army and its contractor, AlliedSignal Engines, owned former plant equipment (removed in early 1998). The U.S. Army-owned land, buildings, and equipment were formerly provided to AlliedSignal under a facilities contract for executing government contracts, including the manufacture and testing of turbine engines for the U.S Army. The SAEP property consists of 49 buildings, paved roadways and grounds, and five paved parking lots (Figure 1-2).

Responsibility for the jurisdiction, control, and accountability of SAEP was transferred from the U.S. Army Aviation and Troop command to the U.S. Army Tank-Automotive and Armament Command (TACOM) in September 1995. In October 1995, SAEP was placed on the Base Closure and Realignment (BRAC) list, known as BRAC 95. Pursuant to the Defense Base Closure and Realignment Act of 1990, the BRAC Environmental Restoration Program mandates that environmental contamination on BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse. In August 1998, SAEP was transitioned from an active production facility to caretaker status.

## 1.2 PREVIOUS SITE ACTIVITIES

For BRAC 95 facilities, the Environmental Restoration Program begins with an Environmental Baseline Survey (EBS) to describe the environmental condition of the property. ABB Environmental Services, Inc. (subsequently HLA) published the Final EBS in December 1996. A Remedial Investigation (RI) is currently being conducted by URS Greiner-Woodward Clyde Federal Services (URSGWCFS) under a contract to the USACE to characterize the type and extent of contamination at SAEP and evaluate potential risks to human health and the environment.

## 1.3 PURPOSE AND SCOPE OF NCRA

In order to provide a removal action recommendation for the Causeway and Dike, subsurface geologic and analytical data was required to characterize and evaluate subsurface conditions. This Pre-Design Investigation Report summarizes that data. Using this data, an EE/CA will be written presenting the recommended removal action alternative. Previous investigations at SAEP have characterized soil and groundwater contamination on the facility side of the dike. This NCRA includes only the Dike and the Causeway areas (Figure 1-3).

## 1.4 REPORT ORGANIZATION

This Pre-Design Investigation Report is divided into seven sections, plus Attachments and Appendices. Section 1 contains an introduction to the SAEP site and the purpose and scope of the NCRA. Section 2 provides information on the history of the SAEP. Section 3 summarizes previous investigations completed at the site. Section 4 outlines the project objectives. The pre-design field activities and the laboratory analytical program are discussed in Section 5. Section 6 presents the results of the field activities, and Section 7 contains the Summary and Conclusions.

This report also includes appendices of field boring logs, test pit records, geophysical results, grain-size analysis data, monitoring well details, ground survey information, and laboratory analytical data.

# 2.0 SITE DESCRIPTION AND HISTORY

Section 2.0 of the URSGWCFS RI Work Plan (URSGWCFS, 1998) provides a description of SAEP, including a land use assessment, a physical setting description, an ecological setting description, and a site history. Appendix A of this report contains a copy of Section 2.0 of the URSGWCFS RI Work Plan.

# 3.0 PREVIOUS INVESTIGATIONS

Previous investigations conducted at SAEP include:

- Preliminary Assessment Screening (1991)
- Resource Conservation and Recovery Act (RCRA) Facility Assessment (1992)
- Phase I Remedial Investigation (1993)
- Phase II Remedial Investigation (1996)
- Environmental Baseline Survey (1996)
- Remedial Investigation (1998-2000)
- Chromium Plating Facility Investigations (1998 and 1999)
- VOC Groundwater Investigations (1999)

The first five investigations are summarized in Section 3.0 of the URSGWCFS RI Work Plan (URSGWCFS, 1998). Brief summaries of the Remedial Investigation, Chromium Plating Facility Investigation, and VOC Groundwater Investigations are presented in the OU 2 NCRA Work Plan (Foster Wheeler/HLA, 1999). The Draft Remedial Investigation Report is scheduled for delivery in March 2000. Figure 1-3 presents the approximate area included in the Causeway and Dike NCRA.

## 3.1 CAUSEWAY

Information obtained from the EBS Report (ABB Environmental Services, Inc., 1996) indicated the Causeway was initially constructed and used as a means of launching seaplanes in the 1930s. Additional materials, of unknown origin, were deposited along the northern edge of the Causeway during the 1950s and 1960s. Building B-59 was constructed to house the nose cones of missiles (without warheads), including the explosive charges used to open the nose cones. Currently, there is no unexploded ordnance stored on the facility. The source of the fill used to construct the Causeway was not documented, but the fill is known construction debris. Analyses of ten surface soil samples collected from depths of 0 to 6 inches on non-vegetated areas of the Causeway during the Phase I RI did not indicate the presence of asbestos (ABB Environmental Services, Inc., 1996).

It was also reported that paint solvents and wastes were burned on the Causeway as part of fire training operations (ABB Environmental Services, Inc., 1996). Although no subsurface soil or groundwater samples were collected prior to the NCRA investigation in the area of the Causeway, Phase I RI data from the area near Building B-16 (see Figure 1-2) indicated the potential for subsurface contamination.

An investigation conducted by WE-Manage, Inc. in 1999 consisted of a radiological survey of the area containing the Causeway. The May 1999 report entitled, "Radiological Assessment of the Causeway", summarizes the results of the survey (WE-

Manage, 1999). The historical assessment associated with the survey determined the following activities were reportedly conducted on the Causeway:

- The residues from magnesium-thorium fires, which occurred in the production plant, were routinely dumped onto the Causeway.
- Fire control training was conducted on the Causeway with magnesium-thorium alloys.
- Waste oil, which potentially contained thorium-232, was spread on the Causeway to control dust.

The historical assessment also indicated that:

- The area surrounding Building B-59 was found to have radiological background measurements approximately twice the background of adjacent areas; and
- Analysis of previously collected samples identified uranium; a radionuclide not identified as a manufacturing process material during the years of plant operation, but found in Building 73.

During 1997, a surface scan radiological survey was conducted over 100 percent of the Causeway, and soil samples were collected from the area of the Causeway and sent off-site for radiological analysis. In general, samples were collected from depths of 0 to 6 inches. The survey concluded that:

- the average concentration of suspected residual radioactive contamination is below the Nuclear Regulatory Commission (NRC) property release criteria;
- areas with potential elevated concentrations do not exceed size limitations; and
- over the next 1,000 years, the maximum hypothetical annual dose is approximately half that permitted by current NRC regulations.

Subsurface soil samples were collected in September 1999 by the Connecticut Department of Environmental Protection (CTDEP) for radiological analysis during Pre-design Field Activities for this NCRA. A summary of findings is presented in Section 6.0 of this report.

## 3.2 DIKE

Information from the EBS Report indicates that a severe flood of the Housatonic River occurred in 1948, rendering the Stratford plant's manufacturing space unusable. In 1951, the U.S. Air Force purchased the plant, repaired the water-damaged buildings, and built the dike to provide flood protection for the facility. Otherwise, little previous information exists for the dike.

Information regarding the construction of the dike, including the material used to complete construction, is generally unknown; however, aerial photographs indicate rip-

rap material was primarily used during dike construction. Currently, an asphalt-paved road approximately 8 to 10 feet wide is placed on top of the dike. Rip-rap covers each of the sloped sides of the dike.

# 4.0 PROJECT OBJECTIVES

This section summarizes the project objectives for the Causeway and Dike NCRA at SAEP. Three general categories are discussed to address project objectives, including regulatory framework, project goals, and Applicable or Relevant and Appropriate Requirements (ARARs).

## 4.1 REGULATORY FRAMEWORK

The NCRA for the Causeway and Dike at SAEP is being performed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). In October 1995, SAEP was placed on the BRAC 95 list. The BRAC Environmental Restoration Program mandates that environmental contamination on U.S. Army BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse.

The CTDEP and the U.S. Environmental Protection Agency (USEPA) provided regulatory oversight. The Work Plan was prepared in accordance with CTDEP, CERCLA, and BRAC requirements.

The CTDEP and Nuclear Regulatory Commission (NRC) oversees radiological activities conducted at the SAEP site. Radiological activities have been previously conducted at SAEP under a NRC license held by AlliedSignal. AlliedSignal has submitted a request to the NRC to terminate the license for the Causeway portion of the facility.

## 4.2 PROJECT GOALS

The goal of the Causeway and Dike NCRA is to characterize subsurface conditions and provide a recommended removal action to address identified contamination, if necessary. Project activities addressed the following goals:

- Evaluate using geophysical (electromagnetic induction [EMI] and ground-penetrating radar [GPR]) surveys, the location of subsurface features and potential drilling obstructions on the Causeway and Dike.
- Evaluate the presence or absence of contamination in the area of the Causeway and Dike through surface and subsurface soil sampling and analysis, and assess the potential for migration of contaminants to groundwater.
- Determine the location and elevation of sampling locations with an elevation and location survey.
- Document the removal action alternative evaluation process in an EE/CA and the removal action selection in a Remedial Action Memorandum (RAM).

Radiological contamination issues are out of the scope of this report, and will be covered by subsequent reports or memoranda prepared by FW/HLA and/or other contractors

## 4.3 REGULATORY COMPLIANCE PLAN (ARARS)

Federal, state, and local laws and statutes were reviewed in the planning stages of the NCRA for two purposes: 1) to determine if permits are required for the proposed field activities, and 2) to evaluate the environmental criteria against which analytical results will be compared. CTDEP has developed criteria in their Remediation Standard Regulations (RSRs) which will be followed as one of the driving considerations in the selection and implementation of any removal action(s).

As part of the EE/CA process, the applicable, relevant and appropriate federal, state and local laws, regulations and policies that might impact the various removal activities, either through cost or procedural requirements, will be identified for each of the removal alternatives detailed in the EE/CA. The ARARS for the various proposed remedies will be further researched as to the potential schedule, cost, design, construction means and methods, monitoring, and operation and maintenance impacts that they may incur. A table will be prepared for the EE/CA that will present:

- title and citation of the law, regulation or policy;
- a brief summary of the regulatory requirements;
- a brief summary of how the project activities will comply with the spirit of the requirements. (It is assumed that written exemptions or waivers will be obtained by TACOM and/or the USACE from the appropriate agencies such that actual permits will not be required for project activities); and
- a brief summary of the impact of the ARARS on the various project aspects (including schedule, cost, design, construction means and methods, monitoring, and operation and maintenance).

Additionally, a summary of the anticipated ARARS effects upon the suggested remedy will be carried through to the RAM. A regulatory strategy will be presented in the RAM, which will identify the regulatory drivers, the anticipated affects of the regulatory issues on the removal activity aspects, and the anticipated action, or actions, which will be required to address the ARARS.

### 4.3.1 Permit Requirements

Disposal of investigation-derived waste (IDW) water is covered under an Emergency Discharge Authorization, which was issued by the CTDEP on March 18, 1999. This authorization covers discharge of wastewater from the SAEP Chemical Waste Treatment Plant (CWTP) generated during investigation and remediation activities conducted on-site. The expiration date for this authorization is March 18, 2000. No additional permit requirements for NCRA investigation activities were identified.

### 4.3.2 Criteria for Comparison to Sample Data

CTDEP has established criteria in their RSR for various media including target concentrations for indoor air and criteria for soil, groundwater, and surface water. The Causeway and Dike NCRA compares detected contaminant concentrations against the CTDEP criteria, and a previously developed asbestos standard to determine if removal actions are required. The criteria to be considered include:

- Surface soil analytical data are compared to Direct Exposure Criteria (DEC) for Soil (residential scenario);
- Subsurface soil analytical data from above the water table (vadose zone) are compared to the GB Pollutant Mobility Criteria (PMC); and
- Soil analytical data for asbestos are compared to the residential standard established for another TERC project (i.e., Raymark in Stratford, CT) of 1 percent total asbestos by the polarizing light microscope (PLM) method.

Tables of the results of chemical screening and analysis conducted on the Causeway and Dike as part of this Pre-Design Investigation are included in Section 6 and also contain the respective appropriate criteria for comparison.

# 5.0 PRE-DESIGN INVESTIGATION FIELD ACTIVITIES

The following subsections describe the pre-design field activities and present a brief rationale for exploration locations. The field activities were conducted between September 7, 1999 and October 12, 1999. Summaries of explorations, soil sampling, and monitoring well completion details are also presented. Additionally, the off-site laboratory analytical program is discussed.

During the pre-design investigation activities, a total of 33 borings, 10 test pits, and four monitoring wells were completed at the Causeway and Dike areas. In addition, five hand auger borings were completed along the facility side of the Dike. Exploration locations are shown on Figure 1-3. Table 5-1 summarizes the number and type of explorations completed.

## 5.1 GEOPHYSICAL SURVEYS

EM-61 and Ground Penetrating Radar (GPR) surveys were completed within the Causeway and Dike areas. The objective of the geophysical investigation was to detect and characterize potential underground buried debris, buried rip-rap, voids, and other potential obstructions and hazards within the survey areas that may have limited access to the subsurface during additional investigations. The geophysical surveys were completed in advance of subsurface investigations to allow time for identification of potential exploration locations.

Foster Wheeler Environmental/HLA conducted the non-intrusive geophysical survey of the Stratford Army Engine Plant Causeway and Dike areas to determine suitable locations for subsurface borings. Geophysical data were utilized to detect and map subsurface obstructions. Boring locations were subsequently adjusted to avoid these obstructions, thereby eliminating the unnecessary time and effort often associated with subsurface refusal.
The survey was conducted during a seven-day period from 7 September 1999 through 15 September 1999 utilizing two geophysical methods:

- Time Domain Electromagnetic Induction (TDEMI) using Geonics EM61 High Sensitivity Metal Detector

- Ground Penetrating Radar (GPR) using GSSI SIR-3 Ground Penetrating Radar with 500 MHz and 200 MHz antennas

All accessible areas of the Causeway and Dike were fully covered utilizing each geophysical method. For ease of data collection, the Dike was divided into four separate grids and the Causeway was divided into three separate grids. EM61 data were collected utilizing a Trimble Pathfinder Pro XR/XRS Differential Global Positioning System (DGPS) for navigational control. DGPS positions were collected synchronous with

EM61 data, at a rate of 1 sample per second. EM61 data collection lines were approximately parallel and spaced 1 meter apart. Three 500 MHz GPR lines were collected along the entire length of the paved portion of the Dike. The lines were parallel and spaced approximately 1.5 meters apart, running down the middle of the Dike, and along each edge of the Dike. One 200 MHz GPR line was collected along the entire length of the paved portion of the Dike, running down the middle of the Dike. The endpoints of GPR lines along the Dike, as well as waypoints within the GPR lines, were surveyed with the DGPS system to allow for accurate positioning of the GPR data. 500 MHz (partial coverage) and 200 MHz (full coverage) GPR data were acquired along a pre-established, orthogonal grid system on the Causeway, with coverage similar to that displayed for the EM61 survey. However, GPR data were collected at a line spacing of 2 meters. The corners of the GPR data acquisition grids were surveyed with the DGPS system to allow for accurate positioning of the GPR data.

### 5.1.1 METHODS

#### EM61 Data Collection

Line-based EM61 data were acquired along parallel to subparallel geophysical data acquisition lines within the areas of the Dike and Causeway. The EM61 lines were spaced approximately 1 meter apart to obtain full coverage of the approximately 1.8 acre Dike and the approximately 2.4 acre Causeway. A total of 25577.7 linear feet, or approximately 4.84 linear miles, of EM61 data were acquired along the Dike. A total of 25517.6 linear feet, or approximately 4.83 linear miles, of EM61 data were acquired along the Causeway. Data were collected at a rate of 6 samples per second, which resulted in a sample density of one sample every 0.2 m (0.66 ft) along the ground surface.

#### GPR Data Collection

Line-based GPR data were acquired at two center band frequencies: 500 MHz and 200MHz. Line spacing varied dependent upon survey area, obstacles, and GPR frequency, but was generally 2 meters. 500 MHz GPR data were collected along three parallel lines along the length of the Dike, separated by approximately 1.5 meters; the lines ran along the middle of the paved portion of the Dike and along each edge of the paved portion of the Dike. 200 MHz GPR data were collected along one line running down the middle of the paved portion of the Dike. A total of 9196.9 linear feet, or approximately 1.74 linear miles, of GPR data were acquired along the Dike. Based upon interpretation of preliminary 500 MHz and 200 MHz GPR data collected on the Causeway, only 200 MHz data were acquired throughout the entire Causeway. Only limited 500 MHz GPR data were collected on the Causeway due to the low quality of the data. 200 MHz GPR data were acquired in the same survey area as performed for the EM61 survey. 200 MHz GPR data were acquired along 42 parallel lines of varying length, spaced 2 meters apart. A total of 6292.7 linear feet, or approximately 1.19 linear miles, of GPR data were acquired along the Causeway. GPR data plots for both the Dike and Causeway are retained in the project files and can be made available upon request.

GPR data were acquired at a rate of 32 scans per second, with each scan consisting of 512 samples. This sampling rate translates to a scan collected every 0.03 meter (0.1 ft) along the ground surface. The length of each scan was 100 ns for 500 MHz data and 150 ns for 200 MHz data.

**Global Positioning**

A global positioning system (GPS) was used during the geophysical survey to determine the location coordinates for the collected data and to physically locate optimal drilling locations.

## 5.2 Near-Surface And Subsurface Soil Sampling

Near-surface and subsurface soil samples were used to evaluate subsurface lithology and the presence or absence of contamination in the area of the Causeway and Dike. In-situ (standard penetration tests-SPTs) and off-site laboratory geotechnical testing (grain-size analysis) was performed to provide information on the engineering properties of the Causeway and Dike soils. Figure 1-3 identifies the locations of the explorations.

Samples were collected during the field program using split-spoon samplers and HSAs as described in Standard Operating Procedure (SOP) No. 1 of the Causeway and Dike NCRA Work Plan (Foster Wheeler/HLA, 1999). SOP No. 11 in the Work Plan details the test-pit sample collection technique. VOC soil samples were preserved in methanol at the time of sample collection as described in SOP No. 13, and decontamination between borings was performed as described in SOP No. 7. The SOPs are contained in Attachment A of the SAEP QAPjP (Foster Wheeler/HLA, 1999).

At each soil sample location, VOC samples, were collected from discrete locations (not composited); all other parameters were sampled from composited and homogenized soils.

### 5.2.1 Soil Borings

A total of 33 soil borings were completed on the Causeway and Dike in order to document stratigraphy, assess the extent of soil contamination, and install monitoring wells.

Causeway borings. A total of 15 borings were placed on the Causeway. The borings were drilled using traditional hollow-stem auger (HSA) techniques and using split-spoons for sample collection. Generally, two soil samples were collected from each of the boring locations: one from near the ground surface (either 0-2 or 1-3 feet bgs), and a second from immediately above or at the water table, using split-spoon samplers. Samples at selected depths were collected for geologic logging, grain-size analysis, and laboratory chemical analysis, depending on specific data needs. During sample collection standard penetration tests (SPTs) were completed in accordance with the American Society for

Testing and Materials (ASTM) method D-1586 to provide information on physical subsurface conditions. Except for two of the borings (CB-99-09 and CB-99-14), all borings were completed to depths generally up to 10 feet below ground surface (bgs). Once completed, all borings (except the two deep borings which had monitoring wells installed in them) were backfilled with the soil from the auger borings. The two deep borings, CB-99-09 and CB-99-14, were intended to extend to bedrock; CB-99-14 was terminated at a depth of 110 feet bgs and did not hit bedrock, but CB-99-09 hit bedrock refusal at a depth of 102 feet bgs. Both deep borings were drilled using HSA drilling techniques to evaluate subsurface lithology and to investigate the potential for dense non-aqueous phase liquids in those areas of the Causeway. In these two borings, soil samples were collected at 10-foot intervals using split-spoon samplers, and SPTs were completed. Boring logs are included in Appendix B. Table 5-2 lists all the explorations that were sampled during the pre-design field activities and shows the sampling depths and sampled parameters collected at each of the explorations.

Analytical soil samples were sent to an off-site laboratory for analysis for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) inorganics, polychlorinated biphenyls (PCBs), inorganics using the Synthetic Precipitate Leaching Procedure (SPLP) (for samples above the water table), and asbestos. Additionally, some samples were identified for the laboratory to have tentatively identified compounds (TICs) provided (see Table 5-2). Off-site laboratory grain-size analyses were also completed on select samples (see Table 5-2). Samples collected for grain size analyses were randomly chosen. The results of these grain-size analyses are included in Appendix C. Because the samples collected from the Causeway were potentially radiologically contaminated, all of the Causeway samples were sent to a licensed laboratory able to receive and process such samples.

Radiological monitoring for Health and Safety purposes was performed by both a Foster Wheeler health physicist and by CTDEP personnel during subsurface investigations on the Causeway. The CTDEP personnel were on site during the investigation on the Causeway in order to assess of elevated radiological readings and to collect soil samples at select locations for radiological analysis only. The CTDEP used a sodium iodide (Gamma Scintillator) instrument and the Foster Wheeler physicist used a pancake probe (Gamma-Mueller) to perform screening of the exposed soils in test pits and borings and to screen soil samples so that elevated radiological samples were not collected for the analytical samples. Representative samples of the elevated radiological soils were collected by the CTDEP and sent to their laboratory for characterization.

Dike borings. A total of 18 subsurface explorations were completed along the top of the Dike using HSA drilling techniques. Depths of these borings generally extended up to 11 feet bgs. Two samples were collected from each of the borings at locations above and/or at the water table using split-spoon samplers. SPTs were completed in the borings and are shown on boring logs included in Appendix B. Once completed, all borings were backfilled with the soil from the auger borings and were completed with a surface seal of cement grout.

### 5.2.2 Test Pits

Ten test pits were completed by backhoe at locations on the Causeway that were either suspected, based on the geophysical survey, as not being able to be sampled by HSA methods, or in areas where access by a drill rig was not feasible. At eight of the ten test pit locations, soil samples were collected using stainless steel spatulas and spoons, with samples being collected either at the face of the test pits or from the backhoe bucket whenever sampling was conducted from the deeper portions of the test pits. Two test pits, TP-99-25 and TP-99-26, were excavated to test for magnetic anomalies identified during the geophysical survey; analytical samples were not collected from these test pits. Test pit logs are included in Appendix D. Table 5-2 lists the depths and the sample parameters for samples collected from the test pits. Analytical soil samples were sent to the off-site laboratory for analysis for VOCS, SVOCs, TAL inorganics, PCBs, SPLP inorganics, and asbestos as shown on Table 5-2.

### 5.2.3 Hand Auger Borings

Originally, up to nine hand-auger borings were to be collected on the facility side of the Dike. It was observed at certain locations that there was a geotextile liner material that would have to be penetrated in order to collect samples. It was decided that the liner should not be penetrated since this could potentially impact the integrity of the Dike. For this reason, and due to other physical constraints from abutments, paved areas, etc., only five hand-auger borings were placed at the locations as shown on Figure 1-3. Analytical samples collected from these borings were for the parameters as shown on Table 5-2. Sampling logs are presented in Appendix E.

## 5.3 MONITORING WELL INSTALLATION

Two pairs (4 total wells) of groundwater monitoring wells were installed at two locations on the Causeway during the Pre-Design Field Activities (see Figure 1-3). Monitoring well installations were not originally scoped as part of the Pre-Design Investigation activities for the Causeway however, these were installed at the request of the USACE and TACOM so as not to incur future mobilization costs. Also, ongoing assessment of data needs and lithological observations gained during the installation of the deep borings CB-99-09 and CB-99-14, demonstrated a need for the installation of these wells.

Monitoring wells were constructed of Standard Schedule 40 polyvinyl chloride (PVC) with five-foot lengths of 0.020-inch slotted PVC well screen in the shallow wells (MWCD-99-01A and MWCD-99-02A), and 10-foot lengths of well screen installed in the deep wells (MWCD-99-01B and MWCD-99-02B). Individual well construction specifics are contained in the monitoring well details in Appendix F. The annulus around each screen was backfilled with silica sand to one foot above the shallow well screens and three feet above the deep well screens. Typically, a one to three-foot bentonite pellet

seal was installed above the sandpack. A bentonite grout slurry seal was tremied from above the bentonite seal to the surface to eliminate the vertical conduit created by the drilling process.

The monitoring wells were developed using a submersible pump and surging techniques. Development logs are included in Appendix G. Each well was pumped and surged for at least one hour, or until the discharge water was clear and the field parameters stabilized. Wells were completed with protective steel casings cemented into the ground and equipped with locking covers.

The monitoring wells were sampled in November 1999 by URSGWCFS as part of the ongoing RI program. Analytical results will be presented in the Draft RI Report, scheduled to be issued in March 2000.

## 5.4 LOCATION AND ELEVATION SURVEY

The location and elevation of all exploration locations were surveyed by Meridian Engineering of Concord, Massachusetts, registered land surveyor. Horizontal and vertical control points used during previous RI surveys by URSGWCFS at SAEP were used during this survey for consistency. Vertical elevation accuracy was established at 0.01-foot and horizontal location accuracy was set at 0.1-foot. Ground survey data are in Appendix H.

## 5.5 INVESTIGATION-DERIVED WASTES

Handling and disposal of Investigation-Derived Wastes (IDW) were performed as outlined in Section 7.0 of the Causeway and Dike NCRA Work Plan. Generally, all soils excavated during drilling activities were placed back into the borings if photoionization detector (PID) readings did not exceed 5 parts per million. All soils excavated with the backhoe were placed back into their respective excavations. Contaminated protective clothing and sampling equipment were drummed, labeled, and placed at a drum staging area for future disposal inside the chrome plating room. Additionally, decontamination fluids and well development water generated during the drilling program were collected in labeled drums and also brought to the staging area.

## 5.6 LABORATORY ANALYTICAL PROGRAM

Off-site laboratory analytical procedures for samples obtained during the Pre-Design field investigation were conducted by a USACE validated laboratory. Quanterra, Inc. of Pittsburgh, Pennsylvania performed analyses for contract laboratory samples collected from the Dike. Samples collected from the Causeway were sent to Quanterra's laboratory in Earth City, Missouri where they underwent radiological screening prior to analysis. Quality assurance (QA) samples were analyzed by the USACE at Severn Trent Laboratories in Colchester, Vermont. Chemical analyses were performed according to USEPA methods designated in Table 5-3, and Table 5-4 lists the analytical reporting limits. Table 5-5 summarizes the samples submitted to the QA laboratory.

A field preservation technique was used for the off-site VOC analysis of soil samples. The soil sample (approximately 10 grams) was collected with a syringe device, and then extruded into a pre-weighed vial containing approximately 20 milliliters of methanol. The sample was then shipped along with all other samples to the off-site laboratory for analysis. Although this method results in a higher sample quantitation limit (SQL), it is believed that the results are more accurate than traditional soil collection, preservation, and analysis techniques, because the chances for volatilization and biodegradation are greatly reduced.

Due to the loss of methanol from some VOC samples after their collection but prior to analysis, a total of 10 VOC samples had to be resampled. Therefore, a resampling effort using a backhoe was performed at seven locations on October 12, 1999. These samples were collected for VOCs using a syringe as described above, and included both QA and QC samples. Table 5-6 lists the affected samples.

Data Quality Assessment

Analytical results generated at the off-site laboratory were validated prior to use in the report. Data validation was completed in accordance with USEPA Region I guidelines (USEPA, 1996) specified for Tier II review. Based on actions recommended in the guidelines, a subset of sample results have been qualified based on reporting or data quality considerations. A detailed discussion of the validation actions and assessments for the entire data set is provided in Appendix I.

The majority of results have been determined to be usable for the purpose of contamination or risk assessment. A subset of results have been qualified estimated J indicating some uncertainty regarding the quantitative result reported by the laboratory. For some results potential bias has been identified as indicated in Appendix I. The potential low or high bias should be considered when making assessments with these results. A complete discussion of all data validation actions is presented in Appendix I. Several data quality issues that are interpreted to be important to the investigation are also presented for consideration below:

Several volatile compounds were reported in the data set that may represent laboratory or field-introduced contamination. Positive results for methylene chloride and acetone were reported in nearly all samples and quality control blanks. The majority of the positive results were qualified non-detect U during validation due to contamination in associated blanks. In a subset of samples, little or no methylene chloride was reported in the associated blank, and results have been reported as a positive detection in accordance with validation guidelines. Based on trends in blanks collected throughout the program, which routinely had detections of these common lab contaminant, the positive results for these compounds may represent false positive data.

A trend for low surrogate recovery was observed for soil samples submitted for volatile analysis. All soil samples were collected using methanol preservation at the time of collection. A subset of soil volatile results were qualified estimated J or UJ due to low surrogate recovery with samples listed in Appendix I, Section 2.1. Results for these samples are interpreted to be potentially biased low. Based on reported recovery data presented in Appendix I, results for the majority of samples are expected to be 60% to 90% of the actual concentrations and the bias is interpreted to be relatively small.

Results for volatile sample CB9908005XX (lab number 22186-015) were rejected due to a suspected spiking error or reporting error at the laboratory. Positive results were reported for every target compound at a similar concentration of approximately 1 to 3 mg/kg. HLA interpreted this to be an impossible situation, and likely the results of an accidental spiking of the sample during preparation. No results are available for this sample location.

A subset of inorganic element results has been qualified as estimated due to low or high recoveries in associated spikes. Samples are identified in Appendix I, Section 2.4. Biases for the estimated results should be considered when evaluating inorganics.

A review of the analytical results was completed to determine if reporting limits (RLs) and method detection limits (MDLs) provided by the laboratory were sufficiently low enough for comparisons with residential direct exposure and pollutant mobility standards. A subset of target analytes had RLs that were routinely greater than the standards. However, the laboratory supplied MDL data that indicate detectable concentrations of these target analytes would be reported in the samples if they were present at concentrations equal to or greater that the applicable standards in samples. An estimation of method quantitation limits (MQLs) defined as 5X the MDL, indicates that, for most results, MQLs would also be less than the applicable standards. RL and MDL information is presented in Table 5-4. As indicated in this table, the laboratory reported detected concentrations down to the MDL.

A subset of samples were analyzed at a dilution due to the presence of target compounds or non-target interferences. For some target analytes with a reported non-detect, reporting limits and estimated MDLs exceeded applicable standards. Summary discussions of detection limit reviews for each method are presented below.

VOCs

Routine reporting limits for VOCs in soils are .25 mg/kg for most compounds. All MDLs are less than .1 mg/kg for all target compounds.

All reporting limits for non-detected VOCs were less than the residential direct exposure standards with the exception of results for vinyl chloride with a laboratory RL of .5 mg/kg and a residential direct exposure standard of .32 mg/kg. MDLs for vinyl chloride of .059 mg/kg indicate that concentrations or vinyl chloride would be detected and reported in samples if present at concentration greater than the residential direct exposure standard, and the higher RL for vinyl chloride is not interpreted to be a significant data gap.

A subset of VOC target compounds routinely has RLs greater than the pollutant mobility standards including bromodichloromethane, trans-1,3-dichloropropane, benzene, dibromochloromethane, 1,2-dichloroethane, cis-1,3-dichloropropene, and 1,1,2,2-tetrachloroethane. Pollutant mobility standards are slightly below the .25 mg/kg reporting limits ranging from .1 - .2 mg/kg. With the exception of benzene, these compounds are not interpreted to likely be present at the site based on available data. The laboratory MDL for benzene of .071 indicates that benzene should be reported if present at the pollutant mobility standard concentrations; however, the low concentration would be flagged as an estimated concentration.

All VOC samples were analyzed without a dilution in the original analysis, and no additional reporting limit data gaps were identified in the data set due to sample dilution.

SVOCs

During routine analysis three SVOC target compounds had RLs that were routinely greater than residential direct exposure or the pollutant mobility standards. The compounds 3,3-dichlorobenzidine, 2-nitroaniline, and pentachlorophenol had a routine reporting limit of 1.7 mg/kg with standards ranging from .33 to 1.65 mg/kg. These compounds are not interpreted to likely be present at the site based on available data, and the high RLs are not interpreted to be a significant data gap.

In a subset of samples, higher RLs greater than the pollutant mobility standards were reported for a number of target analytes due to extract dilution prior to analysis. Samples with dilution factors greater than 5, had a significant number of additional target compounds with RLs greater than the pollutant mobility standards. Table I-1 in Appendix I presents results for SVOC samples with dilution factors of 5 or greater. A review of the detections show that the explorations with these detections have other target compounds that exceed the pollutant mobility standard and would therefore not effect remediation scenarios. The exploration location DB-99-12 has detections with reporting limits greater than the pollutant mobility standards for a number of compounds. This

sample, collected at a depth of between nine- to 11-feet bgs, may have been collected below the water table and would therefore not have pollutant mobility standards apply (see boring logs in Appendix B).

PCBs

All PCB results for non-detected aroclors were less than the regulatory standards with the exception of sample HA9907001XX. The sample was analyzed at a dilution of 500 due to non-target interferences, and detection limits of 22 mg/kg exceeded the residential direct exposure standard of 1 mg/kg. This location has been identified as exceeding standards due to target compounds detected in other methods; however, assessment of PCBs for this sample location is not possible.

Inorganics

With the exception of antimony in a subset of samples, all results for target analytes for total inorganics and SPLP inorganics are interpreted to be adequate for evaluation of residential direct exposure standards and pollutant mobility standards. Results for antimony in samples listed on Table I-2 in Appendix I have RLs above the residential direct exposure standards due to a 10X dilution. Contamination at nearly all of these locations exceeded the residential direct exposure standard due to other target analytes, and the high RLs for antimony are not interpreted to be a significant data gap. Antimony was not detected at other locations above regulatory standards.

RLs for some SPLP inorganics are reported at concentrations greater than regulatory standards in the laboratory data tables in Appendix I. The laboratory uses standard RLs typically used for non-detected analytes in SPLP Method 1312 samples; however, the laboratory is reporting all detected analytes down to the MDL listed in Table 5-4. MDLs are orders of magnitude lower than applicable standards for all target analytes, and laboratory results would identify any contamination exceeding pollutant mobility standards.

## 5.7 SAMPLE IDENTIFICATION

Samples collected for laboratory analysis during the field investigations were typically labeled with an 11-digit sample identification code identifying the site location and type of exploration, horizontal and vertical location, and a modifier. This identification system used for sample numbering allowed for tracking and data manipulation.

The sample identification system consists of 11 alphanumeric characters in four information groups. Undesignated portions of the sample identification use an "X," or for placeholders to define the sample type, such as; XX = standard sample, XD = duplicate sample, MS = matrix spike sample, and MD = matrix spike duplicate sample.

| INFORMATION GROUP ITEM | DIGITS |
|---|---|
| Site and/or sample type | 1-2 |
| Year of sample collection | 3-4 |
| Horizontal locators | 5-6 |
| Vertical locator | 7-9 |
| Modifier (e.g., duplicate) | 10, 11 |

The following are examples of sample identification numbers:

CB9913009XX: a Causeway boring (CB) soil sample taken from the location CB-99-13 (in this case, 99 is the last two digits of the year collected, and 13 is the boring number); sample collected from the 7- to 9-foot depth, in feet below ground surface, (009) (the number shown is the bottom depth of the split-spoon sample interval).

DB9912011XD: a Dike boring (DB) soil sample taken from the location DB-99-12; sample collected from the 9- to 11-foot depth (011); duplicate sample (D).

TP9910005XX: a test pit (TP) soil sample taken from the location TP-99-10; sample collected from the five-foot depth.

Trip blanks were identified with the prefix "TB" followed by a six-digit character designated for the month (MM), day (DD), and year (YY) of the sampling. For example, a trip blank associated with samples collected on July 31, 1999 would be identified as "TB073199".

Field blanks were identified with the prefix "FB" followed by a six-digit character designated for the month (MM), day (DD), and year (YY) of the sampling. For example, a field blank associated with samples collected on July 31, 1999 would be identified as "FB073199". Field blanks associated with samples collected from the Causeway, as well as those collected from the Dike, would have the designator "CB" or "DB" added to the end of the identifier, e.g., "FB092299CB".

# 6.0 PRE-DESIGN FIELD INVESTIGATION RESULTS

Section 6.0 of this report is divided into two subsections: Subsection 6.1 presents the results of Causeway Pre-Design investigations, and Subsection 6.2 presents the results of Dike Pre-Design investigations. Results presented include:

- surface geophysical results
- soil/fill observations
- chemical results
- asbestos results
- radiological results (Causeway only)

## 6.1 CAUSEWAY

To characterize site conditions, the exploration program conducted at the Causeway during the Pre-Design field investigation included the following activities:

- geophysical survey
- installation of 15 borings
- installation of 10 test pits
- installation of four monitoring wells
- collection of soil samples

### 6.1.1 Surface Geophysics Results

The primary goal of the geophysical survey was to identify likely locations for the installation of either borings or test pits. If areas had signatures indicating potentially poor results using drilling techniques or where access by a drill rig was limited, then test pits were installed. Also, two test pits (TP-99-25 and TP-99-26) were installed at two locations where elevated electromagnetic readings were obtained during the geophysical survey.

#### EM61 Data Processing & Analysis - Causeway

All EM61 data were compiled into a single file containing X and Y coordinates in Connecticut State Planar Coordinates (NAD83), and four columns of EM61 response datum, annotated Channels 1 through 4 (Top Coil, Bottom Coil, Normalized Differential Channel, and Differential Channel). Data for each channel were interpolated to a regular grid using a minimum curvature gridding algorithm. The data were then displayed as high-resolution color plots. Figure 6-1 illustrates the bottom coil (Channel 2) EM61 data in units of mV for the Causeway. Light blue and green areas represent background areas where no subsurface metallic conductors exist. Yellow through pink and magenta colors represent elevated EM61 response due to surface or subsurface metallic conductors. The

recommended boring locations which were subsequently drilled are displayed on Figure 6-1 for the Causeway.

## GPR Data Processing &Analysis - Causeway

GPR data were printed to a thermal printer in the field and interpreted in real time.

GPR data were also processed and output as color amplitude plots displaying subsurface reflections. Processing included the application of low-pass and high-pass filters, horizontal smoothing, application of gains, and distance normalization. Depth migration was carried out for selected profiles to calculate radar wave velocity. An average velocity was then applied to convert two-way travel time to apparent depth for all profiles.

Color plots of processed GPR data were output and examined for characteristic patterns potentially related to subsurface obstructions or other features.

## EM61 Interpretation - Causeway

Interpretations of the Causeway EM61 data are displayed in Figure 6-1. The EM61 data clearly depicts the location and geometry of surficial and subsurface features including underground pipelines/utilities, and scattered, discrete subsurface debris. The Causeway is characterized by heavily concentrated subsurface debris, much of which can be interpreted as blocks of reinforced concrete. The suggested locations for chemical borings are displayed in Figure 6-1. Exploration locations may or may not have been re-labeled; the final identifiers are shown on Figure 1-3. The locations were selected to obtain sufficient, representative coverage of subsurface conditions on the Causeway, while avoiding subsurface obstructions such as pipelines, debris, or other structures. Borings were placed away from large subsurface debris to avoid potential subsurface refusals.

## GPR Interpretation - Causeway

Field plots of distance versus two-way travel time were generated for each GPR line collected. These plots were analyzed to isolate diffraction patterns or other characteristic responses associated with subsurface structures.

## Summary - Causeway

Fifteen borings and 10 testpits were installed on the Causeway, in the approximate recommended locations displayed in Figure 6-1. All borings were successfully drilled to the target depth, with no refusals occurring.

**Seismic Survey**

A seismic profiling survey, conducted as part of the OU2 (Groundwater) NCRA Pre-Design field investigation, was conducted on site during the same time frame as the Causeway investigations. Some data gathered during the seismic survey was relevant to the Causeway, therefore, pertinent information will be presented in this Subsection. A preliminary seismic refraction survey report showing the seismic profiles and depth to bedrock data is included as Appendix J.

### 6.1.2 Fill and Subsurface Soils Observations

Based on the geophysical survey results, 15 soil borings were drilled. Additionally, 10 test pits were excavated which allowed for good observations of the exposed depths of fill at these locations on the Causeway. Soil samples were collected from these explorations for the parameters as shown in Table 5-2.

The monitoring wells installed on the Causeway were not planned to be part of this phase of investigations. However, two well pairs (MWCD-99-01A/B, and MWCD-99-02A/B) were placed (see Figure 1-3) to monitor groundwater quality, and to gather hydrologic information in these areas of the Causeway. Analytical data from these wells were not available prior to the generation of this report, but will be presented in the Draft RI Report scheduled for submittal in March 2000. Vertical gradients at the time of measurement can be determined by looking at water levels in these two well pairs; the deeper wells screen the top of the lower sand unit, and the shallow wells screen the water table which lies within the filled soils of the Causeway. A downward gradient, indicative of recharge, was observed at the time of measurement in the well pair MWCD-99-01A/B at 0.0165 feet per foot. The second well pair of MWCD-99-02A/B, the wells farther out at the end of the Causeway, showed an upward gradient of 0.0445 feet per foot which indicates that groundwater may potentially discharge to the tidal flats. Additional water level measurements obtained during low and high tide may or may not confirm these observations.

Of the two exploration methods used on the Causeway, the test pit explorations offered better observations of the fill and subsurface soils. Native soils were not seen in any of the test pits, but a trace of native organic-rich soils may have been seen in the bottom of soil boring CB-99-03. Generally, the soils observed included many types of fill material ranging from clean, well graded sands, to dirty, oil-stained wastes, as well as metal, wood, cobbles, asphalt, concrete rubble, etc. There appeared to be episodes of clean sand being placed, as seen in TP-99-06, TP-99-23, and around CB-99-12. This may indicate episodes where the Causeway was being quickly filled possibly for a particular need. But, also apparent is that the Causeway received various types of fill over time based on the types of non-sorted fill materials, and may have served the purpose of being a dumping area for fill, asphalt and concrete rubble. Depths of fill appear to be in the range of 10- to 12-feet throughout the Causeway with lesser amounts being in the low area just

north of building B-59 (e.g., CB-99-03). Greater depths of fill are apparent by the elevation of the Causeway in the area near TP-99-06 and at CB-99-14, where the fill extends to 12-feet bgs. This is also the area of the Causeway with the highest topographic relief. In general, the borings on the Causeway show SPT values that are high to very high in areas of fill, and are much lower in the native soils as seen in the logs for the two deeper borings, CB-99-09 and CB-99-14.

Observations made during the boring and test pitting activities indicate fuel contamination being present throughout a large area of the Causeway. Fuel odors were especially noted within the area behind building B-59 as indicated by the logs of CB-99-03, CB-99-04, TP-99-22, TP-99-23, and TP-99-25. Another area with observations of fuel odors is TP-99-06 with fuel odors present in fill materials near the water table. The use of a PID was limited during days of heavy rain, but as shown on the logs, when the PID was able to be used the presence of volatile organics were detected in these samples. Fuels and fuel odor were present at these locations especially around the water table.

Two borings, CB-99-09 and CB-99-14, were drilled with the intent to reach 100 feet bgs or refusal. These were drilled to evaluate subsurface lithology and to investigate the potential for dense non-aqueous phase liquids (DNAPL) in these areas of the Causeway. Visual observations indicate that DNAPL is not present in these areas. CB-99-14 was drilled with the intent of drilling to bedrock but terminated at 110 feet bgs. Subsequently, CB-99-09 was drilled and was interpreted to hit bedrock at its' refusal depth of 102 feet. Both borings show the fill material being present to a depth of approximately 11 to 12 feet bgs, and show a similar geological sequence of very fine sands to silts overlaying a coarser sandier unit continuing to bedrock. These typical sequences are depicted in Figure 6-2 Figure 6-3, which show cross sectional views of the Causeway. The upper intervals of native soils in these borings are fine silts with very fine sands, organic rich, and having a sulfur dioxide smell similar to tidal mud flat deposits. Also shown in these figures is depth to bedrock information obtained in a seismic survey (see Appendix J) that was conducted as part of the OU2 NCRA. The seismic data indicate that the bedrock surface dips to the north and west in this part of the site. Refusal was reached at a depth of 102 feet bgs in boring CB-99-09 and validates this data, as does CB-99-14, which does not hit bedrock at its termination depth of 110 feet bgs.

### 6.1.3 Contamination Assessment

The contamination assessment in the following subsections presents a comparison of analytical data to the CTDEP criteria for: 1) direct exposure to soils in a residential direct exposure scenario, and 2) pollutant mobility criteria for a "GB", or non-potable, groundwater aquifer. Soil samples from the 0-4 feet bgs range are considered for comparison to the residential DEC, and soil samples from all depth ranges are considered for comparison to the GB PMC.

Soil analytical data with concentrations exceeding the residential DEC is presented in Table 6-1, and are shown in Figure 6-4; soil analytical data with concentrations

exceeding the GB PMC is presented in Table 6-2, and are shown in Figure 6-5. Complete analytical data is presented in Appendix I.

### 6.1.3.1 VOCs in Soil

Residential Direct Exposure Criteria Exceedances. The only VOC exceeding residential DEC in shallow soil samples from the Causeway was vinyl chloride (see Table 6-1). Vinyl chloride was detected in TP-DEP-12 (1-3 ft bgs, 1.9 mg/kg).

Pollutant Mobility Criteria Exceedances. VOCs exceeding GB PMC in soil samples from the Causeway (see Table 6-2) are the chlorinated VOCs cis-1,2-dichloroethene (cis-1,2-DCE), methylene chloride, trichloroethene (TCE), tetrachloroethene (PCE), and vinyl chloride.

Chlorinated VOC concentrations exceed GB PMC in soil samples from the following exploration locations: CB-99-01 through CB-99-04, CB-99-08, CB-99-11, CB-99-13, TP-99-06, TP-99-10, TP-DEP-11, and TP-DEP-12 (see Figure 6-5). These exploration locations are largely confined to the northern one-third, and southern one-third of the Causeway, while the central one-third of the Causeway has limited chlorinated VOC contamination exceeding GB PMC. Depths of samples with concentrations exceeding the GB PMC ranged from 0 to 12 feet bgs (see Table 6-2).

### 6.1.3.2 SVOCs in Soil

Residential Direct Exposure Criteria Exceedances. SVOCs exceeding residential DEC in soil samples from the Causeway (see Table 6-1) can be broken down into two major compound classes:

- Fuel-Related SVOCs: benzo(a)anthracene, benzo(a)pyrene, and benzo(k)fluoranthene; indeno(1,2,3-cd)pyrene; and,
- PCBs: polychlorinated biphenyl (PCB) aroclors 1016 and 1260.

Exceedances of residential DEC for fuel-related SVOCs is evident in samples from explorations CB-99-14 (1-3 feet bgs), CB-99-15 (1-3 feet bgs), and TP-99-10 (3-5 feet bgs), all of which are located on the northern third of the Causeway (see Figure 6-4). In addition, hexachlorobenzene was detected in TP-DEP-11 at a concentration of 1.4 mg/kg, nominally above the residential DEC of 1 mg/kg.

The PCB aroclors 1016 and 1260 were detected at concentrations exceeding the residential DEC in samples from explorations CB-99-02 (0-2 feet bgs), TP-99-10 (3-5 feet bgs), TP-DEP-11 (0-1 feet bgs) TP-99-22 (1-3 feet bgs), and TP-99-23 (1-3 feet bgs). These exploration locations are largely confined to the northern one-third, and southern

one-third of the Causeway, while the central one-third of the Causeway has no PCB contamination exceeding residential DEC.

GB Pollutant Mobility Criteria Exceedances. The majority of SVOCs exceeding GB PMC in soil samples from the Causeway are fuel-related compounds: anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, fluorene, fluoranthene, naphthalene, phenanthrene, and pyrene (see Table 6-2). Exceedances of GB PMC for fuel-related SVOCs is evident in samples from explorations CB-99-09 (10-12 feet bgs), CB-99-11 (0-2 feet bgs), CB-99-12 (8-10 feet bgs), CB-99-14 (1-3 feet bgs), CB-99-15 (1-3 and 7-9 feet bgs) and TP-99-10 (3-5 feet bgs) (see Table 6-2). These exploration locations are largely confined to the northern one-third of the Causeway (except CB-99-09) (see Figure 6-5). The presence of these SVOCs may be due to waste oils being dumped and the residues that remain after the incomplete combustion of fuels.

Other SVOCs exceeding the GB PMC in soil samples from the Causeway include chrysene, carbazole, dibenzofuran, and indeno(1,2,3-CD)pyrene (see Table 6-2 and Figure 6-5).

In addition, hexachlorobenzene was detected in TP-DEP-11 at a concentration of 1.4 mg/kg, nominally above the GB PMC of 1 mg/kg.

### 6.1.3.3 Inorganics in Soil

Residential Direct Exposure Criteria Exceedances. Inorganics exceeding residential DEC in soil samples from the Causeway are arsenic, beryllium, cadmium, lead, thallium, and vanadium (see Table 6-1). Exploration locations with residential direct exposure RSR exceedances for inorganics are CB-99-05 (0-2 feet bgs), CB-99-07 (0-2 feet bgs), CB-99-08 (1-3 feet bgs), CB-99-11 (0-2 feet bgs), CB-99-16 (1-3 feet bgs), TP-99-10 (3-5 feet bgs), TP-DEP-11 (0-1 feet bgs), and TP-DEP-12 (1-3 feet bgs). These exploration locations are largely confined to the northern one-third of the Causeway (see Figure 6-4).

GB Pollutant Mobility Criteria Exceedances. Vanadium is the only inorganic analyte exceeding GB PMC in soil samples from the Causeway (see Table 6-2). Vanadium concentrations exceed GP PMC in soil samples from exploration locations CB-99-03 (4-6 feet bgs), TP-DEP-11 (0-1 feet bgs), and TP-DEP-12 (1-3 feet bgs) (see Figure 6-5). These exploration locations are largely confined to the northern one-third, and southern one-third of the Causeway, while the central one-third of the Causeway has no inorganic contamination exceeding GB PMC.

### 6.1.3.4 Asbestos in Soil

1992 Asbestos Results. Woodward-Clyde Consultants (WCC) performed asbestos sampling on the Causeway in 1992 as part of the Phase I RI (WCC, 1993). A total of ten surface soil samples (SF-1 through SF-10) (see Figure 1-3) were collected at depths of 0- to 6-inches from areas which were not covered with debris or dense vegetation. Asbestos was not detected in any of these soil samples.

Results of asbestos sampling (from both borings and test pits) during the Fall 1999 Pre-Design field activities include a total of 27 samples collected from the depths as indicated in Table 5-2, and from the areas as shown on Figure 1-3. Laboratory results are included in Appendix I. Analyses of these samples by PLM for asbestos content reveal that asbestos was not detected in 23 samples; four samples have a reported trace (less than 1%) visual estimate of asbestos content. A less than one percent visual estimate of asbestos has been established as the accepted limit at a nearby site. Also, any capping scenario for the Causeway would limit any potential exposure.

### 6.1.3.5 Radiological Summary

Radiological results. The installation of four test pits were placed based upon prior work performed by the CTDEP that identified four areas of particular interest due to locally elevated radiological readings. Test pits TP-DEP-11, TP-DEP-12, TP-DEP-15, and TP-DEP-17 were excavated to sample these areas of locally elevated readings (see Figure 1-3, and test pit logs in Appendix D). According to CTDEP, these areas showed elevated readings along linear trends; in plan view, these trends are much longer in one direction relative to the other. Visually, the four test pits all contained a thin layer of grayish-white "clay" or clay-looking material. These layers were at relatively shallow depths (generally 12-inches or less) within each test pit, and appear to be the source of the elevated radiological readings. Generally, readings using a HP-260 Geiger-Mueller probe of these "clay" layers were reported at five times the readings of the surrounding soils, and these elevated readings decreased in each test pit with depth below these layers. Typical readings of the clay material were approximately 1,000 counts-per-minute (cpm), while the maximum readings in the surrounding soil ranged from approximately 100-to 200-cpm. The CTDEP collected samples for analysis from elevated count soils, while samples collected for chemical analyses were collected from the surrounding non-radiologically-active soils. Also, representative samples of the whitish "clay" material from selected locations were collected by AlliedSignal for radiological analysis.

The CTDEP collected eight samples from seven locations during the Pre-Design investigation. These are listed on Table 6-3 with laboratory results for these samples included in Appendix K. It appears that the more radiologically active soils are associated with the whitish "clay" material observed in the DEP-numbered test pits.

The results of the samples collected by AlliedSignal are shown on Table 6-4. Except for AS-109 at the exploration location TP-DEP-11/12, these samples were collected from

near the ground surface at the corresponding exploration location prior to that exploration being installed. The AS-109 sample was collected from around the one-foot depth of TP-DEP-11/12. As with the CTDEP samples, the more radiologically active soils are associated with the whitish "clay" material observed in the test pits.

In January 2000, a radiological survey was conducted on the Causeway to further delineate the extent of radiological contaminated material. The survey identified three areas with elevated radiological readings. These areas are in the vicinity of: (1) TP-DEP-11, TP-DEP-12, and TP-DEP-26; (2) TP-DEP-15; and (3) TP-DEP-17 (see Figure 1-3). A total of five samples were collected, two from the TP-DEP-11/12/26 area, two from TP-DEP-15, and one from TP-DEP-17. The purpose of this sampling was to obtain waste characteristics of the elevated count, whitish "clay" material. This characterization is necessary so that proper removal, containerization, and transportation to an appropriate off-site licensed treatment/disposal facility may be performed. Once obtained, results of this latest sampling will be used for proper disposal.

The following paragraph provides a conservative estimate of the amount of material that would need to be excavated for removal of the radiologically active clay material from the three identified areas. At the TP-DEP-11/12/26 area, it is estimated that the material located in two spots (one measuring 10-feet long by four-foot wide by two-foot thick, and the other measuring two-feet long by two-feet wide by two-feet thick) contains approximately 88 cubic feet of soil, or approximately 3.3 cubic yards. At the TP-DEP-15 area, the estimated amount of low-level radiological-contaminated material measures approximately seven-feet long by three-feet wide by two-feet deep, giving 42 cubic feet, or approximately 1.5 cubic yards. There are two spots at the TP-DEP-17 area that measure eight feet long by four feet wide by four feet deep, and two feet long by two feet wide by four feet deep, giving a total of 144 cubic feet, or approximately 5.3 cubic yards. Using a multiplier of two for estimating purposes, this would compute to a total of approximately 20 cubic yards of low-level radiological-contaminated material that may need to be removed from the three identified areas.

#### 6.1.3.6 Summary of Contamination

Environmental contamination was detected in the soils at concentrations above regulatory criteria for both residential DEC and GB PMC. VOCs were detected in soils at boring locations CB-99-01, CB-99-02, CB-9-03, CB-99-04, CB-99-08, CB-99-11, and CB-99-13. Other locations with VOC exceedances include TP-99-06, TP-99-10, TP-DEP-11, and TP-DEP-12. VOC exceedances were mostly confined to explorations located in southern and northern portions of the Causeway.

The distribution of SVOC exceedances also indicates that these are concentrated in the northern one-third area of the Causeway. SVOCs were detected in eight explorations, with only two explorations (CB-99-02 and CB-99-09) being located next to B-59 toward the southern end of the Causeway. All other exceedances are found in CB-99-11, CB-99-12, CB-99-14, CB-99-15, TP-99-10, and TP-DEP-11. Most detections occur generally at

shallower depths (1-3 feet bgs), whereas the fuel-related compounds may also be found at deeper depths nearer the water table. This is evident at CB-99-09 (10-12 feet bgs), CB-99-12 (8-10 feet bgs), and in CB-99-15 (7-9 feet bgs). PCB exceedances were detected at CB-99-02, TP-99-10, and TP-DEP-11.

The extent of inorganic contamination above contaminant criteria is also located mostly in the outer one-third area of the Causeway. These are mostly for the shallow soils and are residential DEC exceedances. The only inorganic exceedance away from the outer end of the Causeway was detected in CB-99-03, this being a GB pollutant mobility exceedance for vanadium at 4-6 feet bgs.

Asbestos contamination on the Causeway does not appear to be a concern. Of 37 total samples collected from areas in two sampling events, only four of these have trace amounts of less than 1% visual asbestos content.

CTDEP and Allied Signal personnel collected surface and subsurface soil samples for radiological analyses from the Causeway. Th radiological surveys identified three areas with elevated radiological readings: 1) in the vicinity of TP-DEP-11, TP-DEP-12, and TP-DEP-26, 2) TP-DEP-15, and 3) TP-DEP-17 (see Figure 1-3). Almost all samples from these surveys were from relatively shallow depths (0-6 inches bgs). Based on direct observations and instrument response, it was determined that the source for a number of "line anomalies" identified by the CTDEP and NRC is a whitish "clay" substance that is present in the northern end of the Causeway. The placement of this material appears to have occurred during discrete dumping episodes possibly towards the end of the operation of SAEP. This is based on the fact that the material is at shallow depths, and in two areas (TP-DEP-15 and TP-DEP-17) is placed in fill above tarred surfaces.

## 6.2 DIKE

To characterize site conditions, the exploration program conducted at the Dike during the Pre-Design field investigation included the following activities:

- geophysical survey
- installation of 18 borings
- installation of 5 hand auger borings
- collection of soil samples

### 6.2.1 Surface Geophysics Results

A geophysical survey was performed on the Dike for the purpose of locating the proposed boring locations. Information gathered during the geophysical survey allowed the proper placement of the borings with a minimum amount of difficulty.

## EM61 Data Processing & Analysis - Dike

All EM61 data were compiled into a single file containing X and Y coordinates in Connecticut State Planar Coordinates (NAD83), and four columns of EM61 response data, annotated Channels 1 through 4 (Top Coil, Bottom Coil, Normalized Differential Channel, and Differential Channel). Data for each channel were interpolated to a regular grid using a minimum curvature gridding algorithm. The data were then displayed as high resolution color plots. Figure 6-6 illustrates the bottom coil (Channel 2) EM61 response in units of mV for the Dike. Light blue and green areas represent background areas where no subsurface metallic conductors exist. Yellow through pink and magenta colors represent elevated EM61 response due to surface or subsurface metallic conductors. The recommended boring locations which were subsequently drilled are displayed on Figure 6-6 for the Dike.

## GPR Data Processing &Analysis - Dike

GPR data were printed to a thermal printer in the field and interpreted in real time.

GPR data were also processed and output as color amplitude plots displaying subsurface reflections. Processing included the application of low-pass and high-pass filters, horizontal smoothing, application of gains, and distance normalization. Depth migration was carried out for selected profiles to calculate radar wave velocity. An average velocity was then applied to convert two-way travel time to apparent depth for all profiles.

Color plots of processed GPR data were output and examined for characteristic patterns potentially related to subsurface obstructions or other features.

## EM61 Interpretation - Dike

Interpretations of the Dike EM61 data are displayed in Figure 6-6. The EM61 data clearly depicts the location and geometry of surficial and subsurface features including known and unknown underground pipelines/utilities, aboveground pipelines and fences, and a fairly continuous, linear anomaly potentially associated with the preexisting dike. This anomaly is indicated by a blue dot-dash line and is most likely related to a structure such as a fence or retaining wall initially installed prior to or during construction of the original dike. The suggested locations for chemical borings are displayed in Figure 6-6. The locations were selected to obtain sufficient, representative coverage of subsurface conditions along the Dike, while avoiding subsurface obstructions such as pipelines, debris, or other structures. The centerline of the Dike generally exhibited quiet EM61 data, indicating no subsurface metallic debris or structures were present. Borings were placed along the centerline of the Dike, away from pipelines and the buried, preexisting structure. This allowed for easy drill-rig access while avoiding subsurface refusals.

GPR Interpretation - Dike

Field plots of distance versus two-way travel time were generated for each GPR line collected. These plots were analyzed to isolate diffraction patterns or other characteristic responses associated with subsurface structures.

**Summary - Dike**

Eighteen borings were installed on the Dike, in the recommended locations displayed in Figure 6-6. All borings were successfully drilled to the target depth, with no refusals occurring.

### 6.2.2 Fill and Subsurface Soil Observations

Based on results of the geophysical survey, a total of 18 borings were installed on top of the Dike at the locations shown in Figure 1-3. Dike boring logs are included in Appendix B. The purpose of these borings was to collect samples from near the ground surface (within the 0-4 bgs interval) and from immediately above or at the water table. Therefore, most of these borings did not go deep enough to identify the fill/native soil interface. The borings that may have sampled native material are DB-99-01, -02, -03, -04, and DB-99-18. Generally, the fill material of the Dike consists of sand and gravel with some cobbles. This material appears to be consistent in its' makeup throughout the entire Dike area, although some of the Dike borings contained more cobbles than others. The river side of the Dike is covered with cobble rip-rap, and the facility side is covered with a well-sorted gravel placed over a geotextile fabric.

Additionally, five hand auger samples were collected from the facility side of the Dike, and generally on the flat ground just off of the sides of the Dike itself (see Figure 1-3 and sample logs in Appendix E). Since there was observed to be a geotextile fabric covering the Dike and placed below a crushed-stone covering, samples were collected just off of this fabric.

### 6.2.3 Contamination Assessment

The contamination assessment in the following subsections presents a comparison of analytical data to the CTDEP RSRs for: 1) direct exposure to soils in a residential scenario (residential DEC), and 2) pollutant mobility criteria for a "GB", or non-potable, groundwater aquifer (GB PMC). Soil samples from the 0-4 feet bgs range are considered for comparison to the residential DEC, and soil samples from all depth ranges are considered for comparison to the GB PMC.

Soil analytical data with concentrations exceeding the residential DEC is presented in Table 6-5, and GB PMC is presented in Table 6-6. Complete analytical data is presented in Appendix I.

### 6.2.3.1 VOCs in Soil

Residential Direct Exposure Criteria Exceedances. Exceedance of residential DEC by VOCs was not evident in Dike exploration samples except at HA-99-07 (0-1 feet bgs). Cis-1,2-DCE (3,300 mg/kg), 1,1-DCE (12 mg/kg), PCE (1,200 mg/kg), TCE 560 mg/kg) and vinyl chloride (36 mg/kg) were all detected at concentrations in excess of GB PMC.

GB Pollutant Mobility Criteria Exceedances. Exceedance of GB PMC by VOCs was not evident in Dike exploration samples except at HA-99-07 (0-1 feet bgs). The chlorinated VOCs 1,1,1-TCA (340 mg/kg), cis-1,2-DCE (3,300 mg/kg), 1,1-DCE (12 mg/kg), 1,1-DCA (120 mg/kg), PCE (1,200 mg/kg), TCE 560 mg/kg) and vinyl chloride (36 mg/kg) were all detected at concentrations in excess of GB PMC. The fuel-related VOCs benzene (3.8 mg/kg), toluene (180 mg/kg), and xylenes (26 mg/kg) also exceeded GB PMC in exploration HA-99-07.

### 6.2.3.2 SVOCs in Soil

Residential Direct Exposure Criteria Exceedances. SVOCs exceeding residential DEC in soil samples from the Dike (see Table 6-5) can be broken down into two major compound classes:

- Fuel-Related SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene; and
- PCBs: polychlorinated biphenyl (PCB) aroclor 1260.

Exceedances of residential DEC for fuel-related SVOCs is evident in the 0-1 feet bgs sample from hand auger exploration HA-99-03, located on the shore-side of the Dike (see Figure 6-4). Fuel-related SVOCs at concentrations exceeding residential DEC were not detected in any other Dike exploration soil samples.

PCB aroclor 1260 was detected at concentrations exceeding the residential DEC only in Dike boring DB-99-08, located near the entrance to the Causeway, at a concentration of 3.7 mg/kg (see Figure 6-4).

The SVOC bis(2-ethylhexyl)phthalate was also detected at a concentration exceeding the residential DEC in the 0-1 feet bgs sample of exploration HA-99-07.

GB Pollutant Mobility Criteria Exceedances. SVOCs exceeding GB PMC in soil samples from the Dike are fuel-related compounds: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-CD)pyrene, carbazole, 2-methylnaphthalene, and bis(2-ethylhexyl)phthalate (see Table 6-6). Exceedances of GB PMC for fuel-related SVOCs are evident in the 0-1 feet bgs sample from HA-99-03, located on the eastern leg of the Dike, and HA-99-07 on the western portion of the Dike (see Figure 6-5).

### 6.2.3.3 Inorganics in Soil

Residential Direct Exposure Criteria Exceedances. Arsenic is the only inorganic exceeding residential DEC in soil samples from the Dike, at location HA-99-08 (see Figure 6-4). Arsenic was detected at a concentration of 15.7 mg/kg in the 0-1 feet bgs sample from this location.

GB Pollutant Mobility Criteria Exceedances. There are no inorganic analyte concentration exceedances of GB PMC in soil samples from the Dike (see Table 6-6).

### 6.2.3.4 Asbestos in Soil

Twenty four asbestos samples were collected from the locations and depths as shown on Table 5-2. Analytical results (see Appendix I) indicate three samples having less than 1-% visual content of asbestos, and the remaining 21 samples being non-detect. A less than one percent visual estimate of asbestos has been established as the accepted limit at a nearby site. Because soils on the Dike are capped by a tarred surface, any potential exposure is limited.

### 6.2.3.5 Summary of Contamination

Comparison of soil boring data to residential DEC and GB PMC indicate only one exceedance at DB-99-08 in subsurface soil samples collected from 18 Dike borings. Hand auger samples HA-99-03, HA-99-07, and HA-99-08 from the facility-side of the Dike contained VOC, SVOC and inorganic concentrations exceeding residential direct exposure and GB PMC. Given the ease of access by former plant workers to the fenceline on the facility-side of the Dike where these samples were collected, it is possible that the edge of the Dike was used to dispose of used fuels and degreasers (chlorinated VOCs).

# 7.0 SUMMARY AND CONCLUSIONS

## CAUSEWAY

- Soils found within the Causeway indicate that this feature is comprised of many types of fill material ranging from clean, well-graded sands, to dirty oil-stained wastes, with metal, wood, cobbles, asphalt, concrete rubble, etc. It appears that the Causeway was not built in one effort, but that fill deposits suggest this area as being a "dump" possibly used for an extended period of time. These fill materials were found to be as deep as 12 feet. Below the fill, are very fine sands and silts similar to tidal deposits extending down to around 50 feet, which in-turn overlay a coarser sandier unit to bedrock.

- Bedrock below the Causeway near building B-59 was determined to be at an elevation of around -100 feet, with the bedrock surface dipping to the north and west.

- Water level data from two sets of monitoring wells installed on the Causeway indicate downward vertical gradients occur near the Dike, and upward vertical gradients are present at the end of the Causeway. The water table is present in the Causeway at elevations of approximately 2- to 5-feet bgs.

- Contaminants within the Causeway soils exist at concentrations exceeding CTDEP DEC and GB PMC, and include chlorinated VOCs, fuel-related compounds, PCBs and inorganics.

- Distribution of the contaminants exceeding CTDEP criteria, suggests a potential bias of the dumping of VOC, SVOC, and inorganics-contaminated compounds on the northern one-third of the Causeway.

- Asbestos does not exist at concentrations above trace (<1%) levels.

- The source for radiologically active linear features was determined to be thin layers of a whitish "clay-like" material deposited on the Causeway. Radiological surveys by CTDEP and Allied Signal identified three specific areas with elevated radiological readings. An estimate of the amount of the radiologically elevated material is approximately 20 cubic yards.

## DIKE

- Soils that make up the Dike are comprised of clean sand and gravel with some cobbles.

- Results of asbestos sampling indicate that this is not a contaminant on the Dike.

- Dike subsurface soil contamination exceeding CTDEP criteria is generally limited to chlorinated and fuel-related VOCs at select locations along the facility-side of the Dike, and were observed in hand auger explorations.

- Distribution of contaminants in hand auger samples HA-99-03, HA-99-07, and HA-99-08 suggest that the facility-side gravel surface of the Dike may have become contaminated through facility operations.

| | |
|---|---|
| 1,1-DCE | 1,1-dichloroethene |
| 1,1,1-TCA | 1,1,1-trichloroethane |
| 1,1,2-TCA | 1,1,2-trichloroethane |
| 1,1,2,2-TCA | 1,1,2,2-tetrachloroethane |
| cis-1,2-DCE | cis-1,2-dichloroethene |
| 1,2-DCE | 1,2-dichloroethane |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| ASTM | American Society for Testing and Materials |
| bgs | below ground surface |
| BRAC | Base Closure and Realignment |
| CERCLA | Comprehensive Response, Compensation, and Liability Act |
| cpm | counts per minute |
| CTDEP | Connecticut Department of Environmental Protection |
| CWTP | Chemical Waste Treatment Plant |
| DEC | Direct Exposure Criteria |
| DGPS | Digital Global Positioning System |
| EBS | Environmental Baseline Survey |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EMI | electromagnetic induction |
| Foster Wheeler | Foster Wheeler Environmental Corporation |
| GPR | ground-penetrating radar |
| HLA | Harding Lawson Associates |
| HSA | hollow-stem augers |
| IDW | investigation-derived waste |
| HHz | megahertz |
| MS | matrix spike |
| Mv | millivolts |
| NCRA | Non-time Critical Removal Action |
| NRC | Nuclear Regulatory Commission |
| OU | Operable Unit |
| PCB | Polychlorinated Biphenyls |

| | |
|---|---|
| PCE | tetrachloroethene |
| PID | photoionization detector |
| PMC | Pollutant Mobility Criteria |
| PVC | Polyvinyl Chloride |
| QA | Quality Assurance |
| QAPjP | Quality Assurance Project Plan |
| RAM | Removal Action Memorandum |
| RCRA | Resource Conservation and Recovery Act |
| RI | Remedial Investigation |
| RSR | Remediation Standard Regulation |
| SAEP | Stratford Army Engine Plant |
| SOP | Standard Operating Procedure |
| SPLP | Synthetic Precipitate Leaching Procedure |
| SPT | Standard Penetration 'Test |
| SQL | sample quantitation limit |
| SVOC | semi-volatile organic compound |
| TACOM | U.S. Army Tank-Automotive and Armament Command |
| TAL | Target Analyte List |
| TCE | trichloroethene |
| TDEMI | Time Domain Electromagnetic Induction |
| TERC | Total Environmental Restoration Contract |
| URSGWCFS | URS Greiner-Woodward Clyde Federal Services |
| USACE | U.S. Army Corps of Engineers – New England District |
| USEPA | U.S. Environmental Protection Agency |
| VOC | volatile organic compound |

ABB Environmental Services, Inc. ,1996. Final Environmental Baseline Survey Report, Stratford Army Engine Plant, Stratford, Connecticut, prepared for U.S. Army Environmental Center.

Foster Wheeler Environmental Corporation Harding Lawson Associates (Foster Wheeler/HLA), 1999. Draft Work Plan for the non-time Critical Removal Action for Chromium and VOC Groundwater Contamination. Prepared for the U.S. Army Corps of Engineers, June 1999

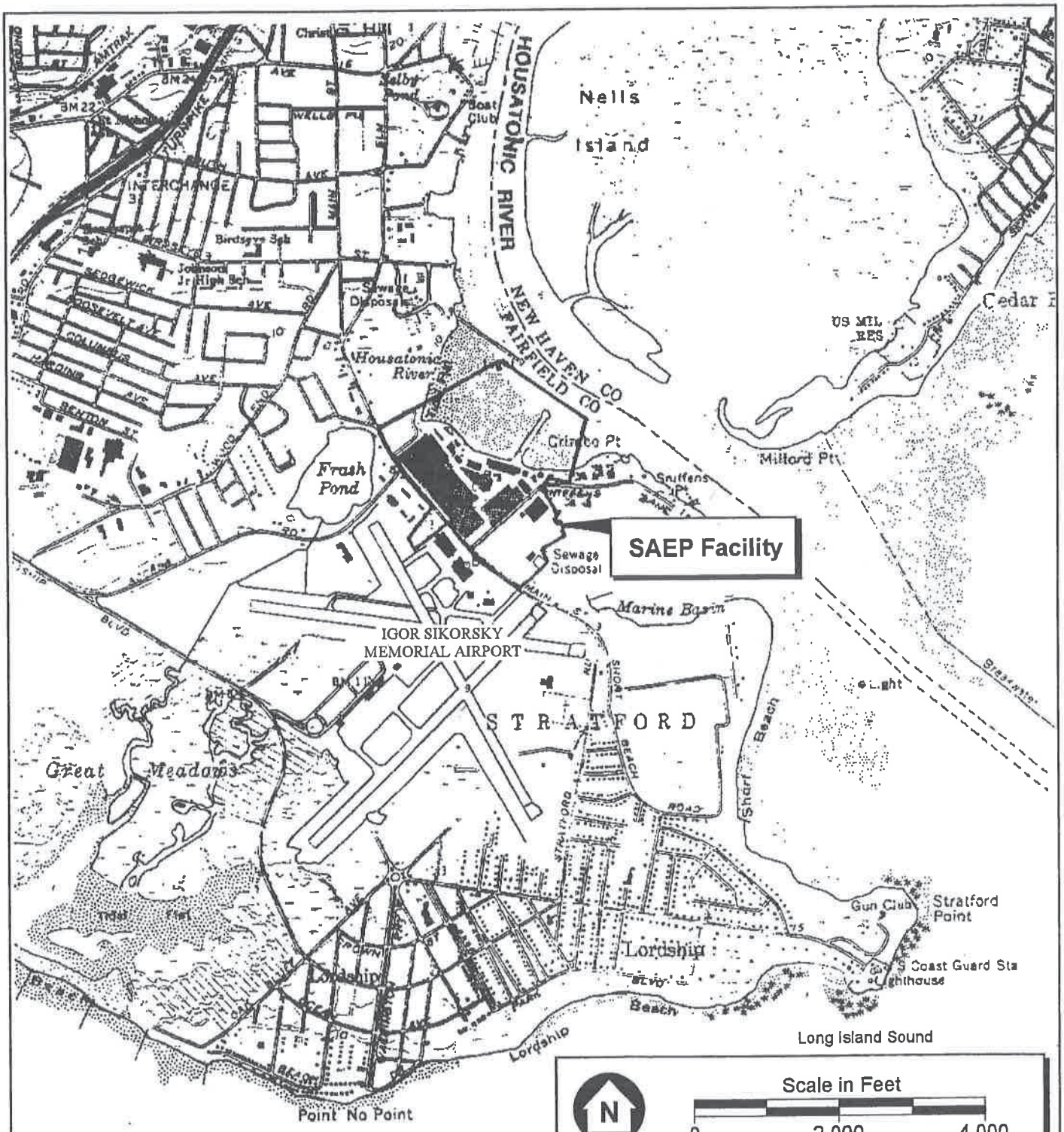
URS Greiner-Woodward Clyde Federal Services (URSGWCFS), 1998. Remedial Investigation Work Plan for the Stratford Army Engine Plant. Prepared for the U.S. Department of the Army, October 26, 1998.

U.S. Environmental Protection Agency (USEPA), 1993. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA. Office of Emergency and Remedial Response. USEPA/540-R-93-057, Washington DC, August 1993.

Woodward-Clyde Consultants (W-C), 1996. Phase II Remedial Investigation Report (Phase I), Stratford Army Engine Plant, Connecticut. Prepared for the U.S. Army Corps of Engineers.

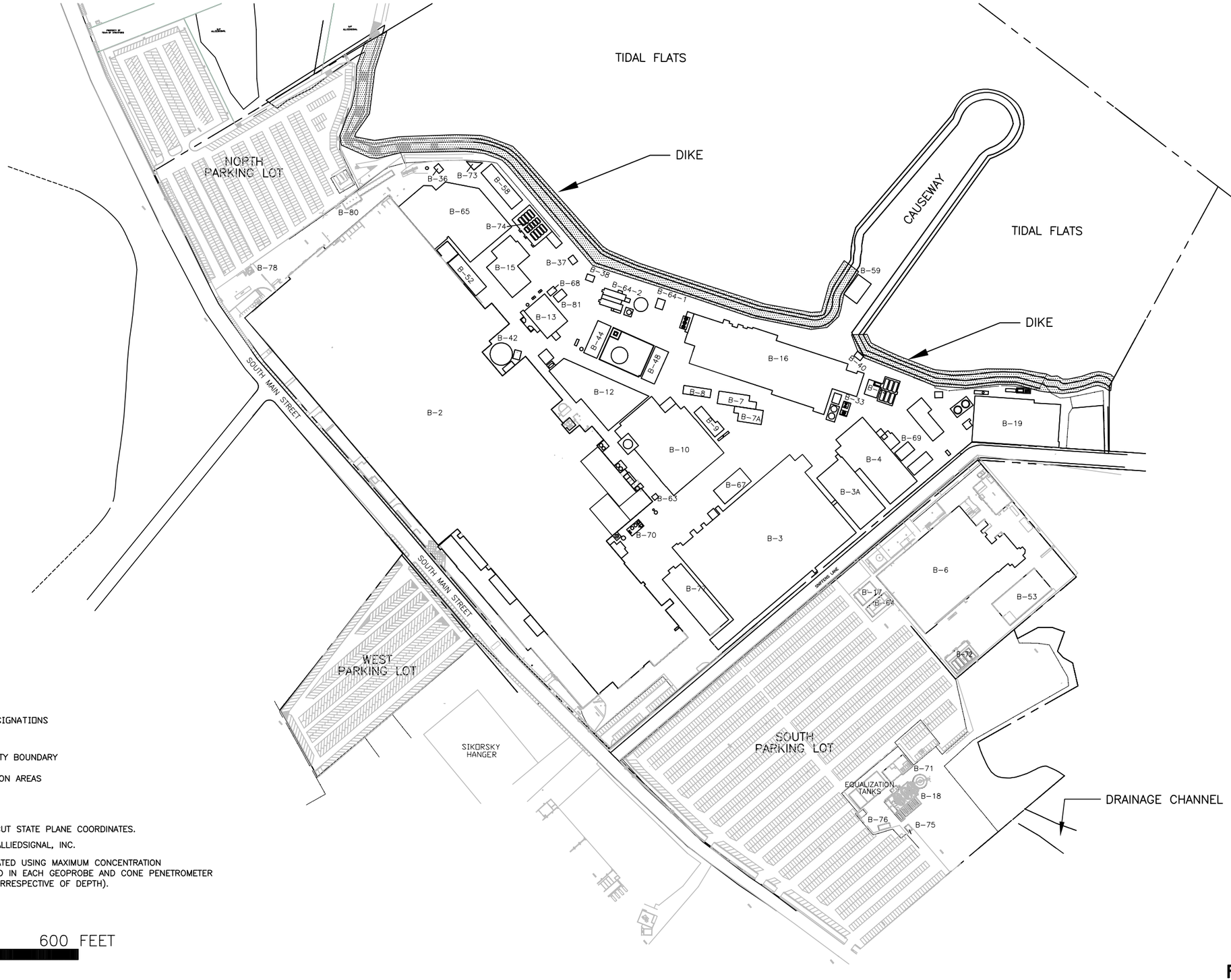
Woodward-Clyde Consultants (W-C), 1993. Remedial Investigation Report (Phase I), Stratford Army Engine Plant, Connecticut. Prepared for the U.S. Army Corps of Engineers, Omaha District.

Woodward-Clyde Consultants (W-C), 1991. Final Preliminary Assessment Screening, Stratford Army Engine Plant, Connecticut. Prepared for the U.S. Army Corps of Engineers, Omaha District.




| | |
|---|---|
| Harding Lawson Associates<br>Engineering and Environmental Services | **SITE LOCATION MAP** |
| STRATFORD ARMY ENGINE PLANT<br>STRATFORD, CONNECTICUT | PRE-DESIGN INVESTIGATION |
| | 47254 **FIGURE 1-1** |

W9909003(a)




LEGEND

B-53 BUILDING DESIGNATIONS

SEA WALL

SAEP PROPERTY BOUNDARY

REMOVAL ACTION AREAS

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. EXCEEDANCES DELINEATED USING MAXIMUM CONCENTRATION OF THE VOC DETECTED IN EACH GEOPROBE AND CONE PENETROMETER SAMPLING LOCATION (IRRESPECTIVE OF DEPTH).

0 150 300 600 FEET

SCALE: 1"=300'

**FIGURE 1-2**
**SITE FEATURES**
**PRE-DESIGN INVESTIGATION**
**STRATFORD ARMY ENGINE PLANT**
**Harding Lawson Associates**

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N/F
ALLIEDSIGNAL

TIDAL FLATS

DIKE RIPRAP

DB-99-16
DB-99-15
DB-99-17
DB-99-18
BLACKTOP
PATHWAY
DB-99-14
DB-99-13
DB-99-12
DB-99-11
DB-99-10
DB-99-09
DB-99-08
DB-99-07
DB-99-06
DB-99-05
DB-99-04
DB-99-03
DB-99-02
DB-99-01

B-73
B-36
B-58
B-80
B-65
B-74
B-37
B-38
B-15
B-52
B-68
B-81
B-64-2
B-64-1
B-13
B-44
B-48
B-42
B-16
B-40
B-59
B-33
B-34
B-12
B-8
B-7
B-7A
B-9
B-10
B-63
B-67
B-70
B-3
B-3A
B-4
B-69
B-19

HA-99-08
HA-99-07
HA-99-03
HA-99-02
HA-99-01

END OF DIKE RIPRAP
DIKE RIPRAP
BLACKTOP PATHWAY

MWCD-99-02B
MWCD-99-02A
MWCD-99-01A
MWCD-99-01B

CONCRETE RAMP
(BADLY DETERIORATED)
CONCRETE PAD &
CHAIN LINK FENCE
FENCE
SIGN
CAUSEWAY
FILL
AREA

A
A'
B
B'

TP-DEP-17
TP-DEP-15
TP-DEP-12
TP-DEP-11
TP-99-26
TP-99-10
TP-99-06
TP-99-24
TP-99-23
TP-99-22
TP-99-25

CB-99-17
CB-99-14
CB-99-15
CB-99-13
CB-99-16
CB-99-11
CB-99-12
CB-99-08
CB-99-07
CB-99-05
CB-99-04
CB-99-03
CB-99-02
CB-99-09
CB-99-01

SF-1
SF-2
SF-3
SF-4
SF-5
SF-6
SF-7
SF-8
SF-9
SF-10

N

LEGEND

- SF-1 — EXISTING WOODWARD–CLYDE ASBESTOS SURFACE SOIL SAMPLING LOCATION (APPROXIMATE)
- MWCD-99-01A — EXISTING HLA CAUSEWAY/DIKE MONITORING WELLS
- TP-99-22 — EXISTING HLA TEST PIT LOCATIONS
- CB-99-01 — EXISTING HLA CAUSEWAY BORING
- DB-99-01 — EXISTING HLA DIKE BORING
- HA-99-01 — EXISTING HAND AUGERS
- B–53 — BUILDING DESIGNATIONS
- CHAINLINK FENCE
- SAEP PROPERTY BOUNDARY
- LIMITS OF PRE–DESIGN INVESTIGATION
- A — A' — GEOLOGIC PROFILE LOCATION

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.

0 40 80 160 FEET

SCALE: 1"=80'

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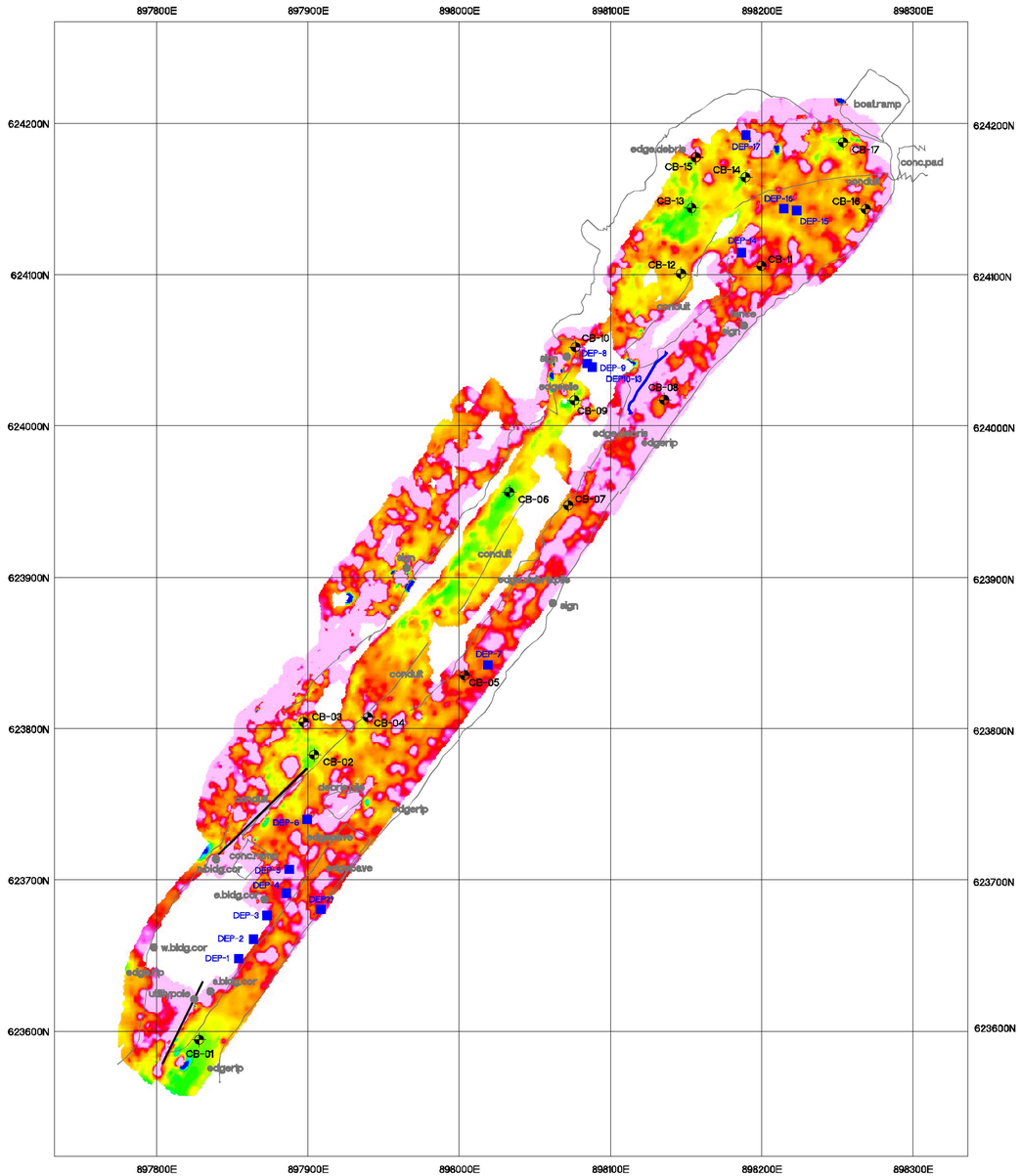
# FIGURE 1-3
# CAUSEWAY AND DIKE INVESTIGATION AREA AND EXPLORATION LOCATIONS PRE-DESIGN INVESTIGATION STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

LEGEND

- Recommended locations for chemical borings, based upon analysis of geophysical data.
- Locations of CTDEP/NRC radiological areas of concern.
- sign — Surficial site features.
- conduit — Pipeline




Scale 1960

50 0 50 100 150

foot

FIGURE 6-1
GEONICS EM61 TDEMI
BOTTOM COIL RESULTS-CAUSEWAY
PRE-DESIGN INVESTIGATION
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

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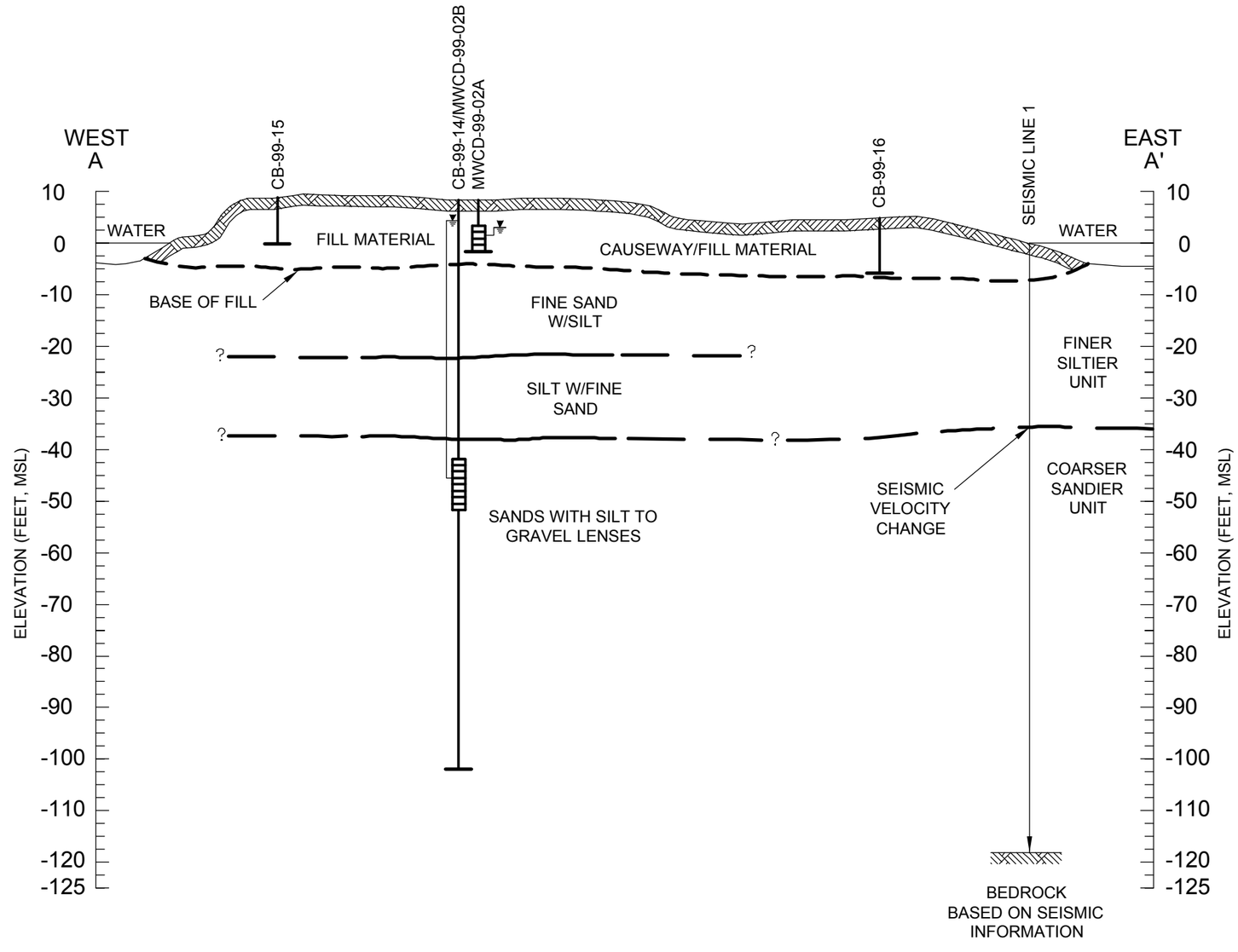
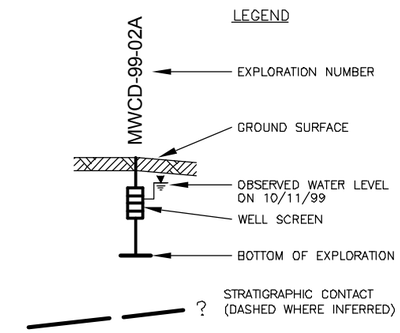
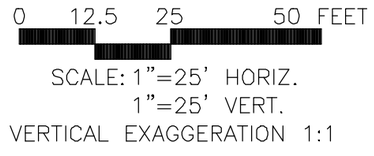



WATER ELEVATIONS ON 10/11/99

| LOCATION | WATER DEPTH BELOW RISER | RISER ELEVATION | WATER ELEVATION |
|---|---|---|---|
| MWCD-99-02A | 6.92' | 10.47' | 3.55' |
| MWCD-99-02B | 5.00' | 10.33' | 5.33' |




# CROSS-SECTION A-A'

SEE FIGURE 1-3 FOR LOCATION OF PROFILE

**FIGURE 6-2**
**INTERPRETIVE GEOLOGIC PROFILE**
**CROSS-SECTION A-A'**
**PRE-DESIGN INVESTIGATION**
**STRATFORD ARMY ENGINE PLANT**
**Harding Lawson Associates**

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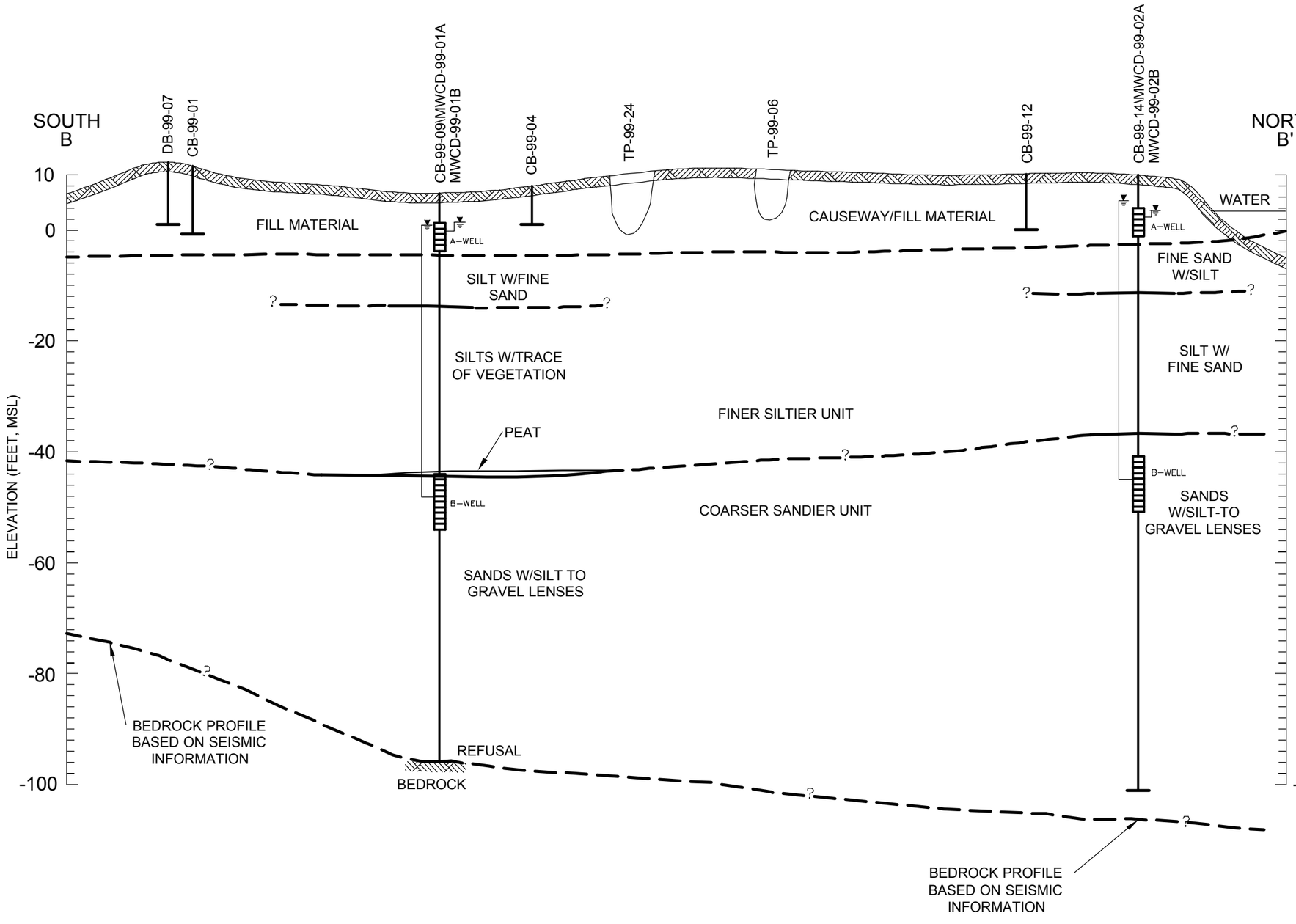
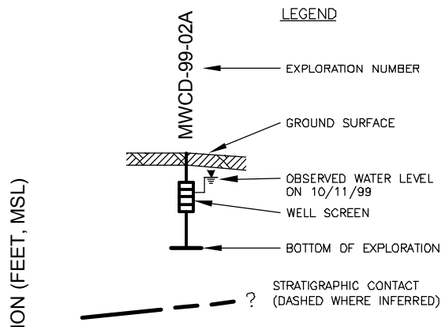
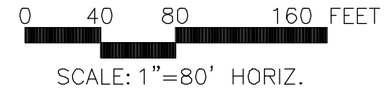



WATER ELEVATIONS ON 10/11/99

| LOCATION | WATER DEPTH BELOW RISER | RISER ELEVATION | WATER ELEVATION |
|---|---|---|---|
| MWCD-99-01A | 6.22' | 7.95' | 1.73' |
| MWCD-99-01B | 7.07' | 8.14' | 1.07' |
| MWCD-99-02A | 6.92' | 10.47' | 3.55' |
| MWCD-99-02B | 5.00' | 10.33' | 5.33' |




SCALE: 1"=80' HORIZ.
1"=20' VERT.
VERTICAL EXAGGERATION 4:1

# CROSS-SECTION B-B'

SEE FIGURE 1-3 FOR LOCATION OF PROFILE

**FIGURE 6-3**
**INTERPRETIVE GEOLOGIC PROFILE**
**CROSS-SECTION B-B'**
**PRE-DESIGN INVESTIGATION**
**STRATFORD ARMY ENGINE PLANT**
**Harding Lawson Associates**

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N/F
ALLIEDSIGNAL

TIDAL FLATS

DIKE RIPRAP

BLACKTOP PATHWAY

DB-99-18 DB-99-17 DB-99-16 DB-99-15 DB-99-14 DB-99-13 DB-99-12 DB-99-11 DB-99-10 DB-99-09 DB-99-08 DB-99-07 DB-99-06 DB-99-05 DB-99-04 DB-99-03 DB-99-02 DB-99-01

HA-99-08 HA-99-07 HA-99-03 HA-99-02 HA-99-01

| HA-99-08 | | 0′ -1′ |
|---|---|---|
| Arsenic | 10 | 15. 7 |

| HA-99-07 | | 0′ -1′ |
|---|---|---|
| 1, 1-Dichloroethene | 1 | 12J |
| Tetrachloroethene | 12 | 1200 |
| Trichloroethene | 56 | 560 |
| Vinyl Chloride | 0. 32 | 36J |
| bis2-Ethylhexyl Phthalate | 44 | 96 |
| cis-1, 2-Dichloroethene | 500 | 3300 |

| HA-99-03 | | 0′ -1′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 13 |
| Benzo(a)Pyrene | 1 | 13 |
| Benzo(b)Fluoranthene | 1 | 9. 9 |
| Benzo(k)Fluoranthene | 8. 4 | 12 |
| Indeno(1, 2, 3-CD)Pyrene | 1 | 9 |

B-80 B-65 B-58 B-73 B-36 B-74 B-15 B-52 B-37 B-38 B-68 B-81 B-64-2 B-64-1 B-13 B-44 B-48 B-42 B-16 B-40 B-12 B-8 B-7 B-7A B-9 B-10 B-63 B-67 B-70 B-3 B-3A B-4 B-69 B-33 B-34 B-19

END OF DIKE RIPRAP

| CB-99-02 | | 0′ -2′ |
|---|---|---|
| Aroclor-1260 | 1 | 2. 1 |

| TP-99-23 | | 1′ -3′ |
|---|---|---|
| Aroclor-1260 | 1 | 2. 2 |

| DB-99-08 | | 2′ -4′ |
|---|---|---|
| Aroclor 1260 | 1 | 3. 7 |

| CB-99-15 | | 1′ -3′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 50 |
| Benzo(a)Pyrene | 1 | 43 |
| Benzo(b)Fluoranthene | 1 | 35 |
| Benzo(k)Fluoranthene | 8. 4 | 32J |
| Indeno(1, 2, 3-CD)Pyrene | 1 | 30 |

| TP-99-10 | | 3′ -5′ |
|---|---|---|
| Aroclor-1260 | 1 | 1. 8 |
| Arsenic | 10 | 10. 7 |
| Benzo(a)Anthracene | 1 | 9. 4 |
| Benzo(a)Pyrene | 1 | 8 |
| Benzo(b)Fluoranthene | 1 | 7. 2 |
| Indeno(1, 2, 3-CD)Pyrene | 1 | 4. 8 |

| TP-DEP-11 | | 0-1′ |
|---|---|---|
| Aroclor-1260 | 1 | 1. 6 |
| Arsenic | 10 | 11. 7 |
| Beryllium | 2 | 13. 1 |
| Cadmium | 34 | 94. 7 |
| Hexachlorobenzene | 1 | 1. 4 |
| Lead | 500 | 1510J |
| Thallium | 5. 4 | 6. 6 |
| Vanadium | 470 | 2640 |

| CB-99-14 | | 1′ -3′ /1′ -3′ DUP |
|---|---|---|
| Benzo(a)Anthracene | 1 | 1. 5/2. 2 |
| Benzo(a)Pyrene | 1 | 2. 3/3. 3 |
| Benzo(b)Fluoranthene | 1 | 2. 4/3. 2 |
| Indeno(1, 2, 3-CD)Pyrene | 1 | 2. 2/2. 6 |

| CB-99-16 | | 1′ -3′ |
|---|---|---|
| Arsenic | 10 | 15. 7 |
| Lead | 500 | 721J |

| CB-99-11 | | 0′ -2′ |
|---|---|---|
| Beryllium | 2 | 2. 6 |

| TP-DEP-12 | | 1′ -3′ |
|---|---|---|
| Beryllium | 2 | 3. 9 |
| Vanadium | 470 | 970 |
| Vinyl Chloride | 0. 32 | 1. 9J |

| CB-99-07 | | 0′ -2′ /0′ -2′ DUP |
|---|---|---|
| Arsenic | 10 | 10. 7/10. 9 |

| CB-99-08 | | 1′ -3′ /1′ -3′ DUP | 3′ -5′ |
|---|---|---|---|
| Arsenic | 10 | 34. 5/19. 8 | -- |
| Beryllium | 2 | 2. 3/2. 3 | 2. 1 |
| Cadmium | 34 | 43. 9/-- | -- |
| Lead | 500 | 1380J/1250J | -- |
| Thallium | 5. 4 | 8. 3/5. 4 | 5. 4 |

| CB-99-05 | | 0′ -2′ |
|---|---|---|
| Beryllium | 2 | 3. 2 |

| TP-99-22 | | 1′ -3′ |
|---|---|---|
| Aroclor-1016 | 1 | 1. 2J |
| Aroclor-1260 | 1 | 1. 7J |

MWCD-99-02A MWCD-99-02B MWCD-99-01A MWCD-99-01B

CONCRETE RAMP (BADLY DETERIORATED)

CONCRETE PAD & CHAIN LINK FENCE

FENCE

SIGN

FILL AREA

CAUSEWAY

BLACKTOP PATHWAY

TP-DEP-17 TP-DEP-15 TP-DEP-12 TP-DEP-11 TP-99-10 TP-99-06 TP-99-24 TP-99-23 TP-99-22 TP-99-25

CB-99-17 CB-99-15 CB-99-14 CB-99-13 CB-99-16 CB-99-12 CB-99-11 CB-99-10 CB-99-08 CB-99-07 CB-99-06 CB-99-05 CB-99-04 CB-99-03 CB-99-02 CB-99-01

SF-1 SF-2 SF-3 SF-4 SF-5 SF-6 SF-7 SF-8 SF-9 SF-10

A A′ B B′

N

## LEGEND

- SF-1 — EXISTING WOODWARD-CLYDE ASBESTOS SURFACE SOIL SAMPLING LOCATION (APPROXIMATE)
- MWCD-99-01A — EXISTING HLA CAUSEWAY/DIKE MONITORING WELLS
- TP-99-22 — EXISTING HLA TEST PIT LOCATIONS
- CB-99-01 — EXISTING HLA CAUSEWAY BORING
- DB-99-01 — EXISTING HLA DIKE BORING
- HA-99-01 — EXISTING HAND AUGERS
- B-53 — BUILDING DESIGNATIONS
- CHAINLINK FENCE
- SAEP PROPERTY BOUNDARY
- LIMITS OF PRE-DESIGN INVESTIGATION
- A — A′ GEOLOGIC PROFILE LOCATION

DUP DUPLICATE SAMPLE
-- LESS THAN REPORTING EXCEEDANCES
J VALUE IS ESTIMATED
BGS BELOW GROUND SURFACE

LOCATION IDENTIFIER: CB-99-07 | 0′ -2′ /0′ -2′ DUP (SAMPLING INTERVAL (BGS))
COMPOUND: Arsenic | 10 | 10. 7/10. 9 (CONCENTRATION (mg/kg))
REMEDIATION STANDARD REGULATION (RSR) CRITERION

ALL CONCENTRATIONS REPORTED IN MILLIGRAMS PER KILOGRAM (mg/kg)

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. ALL ELEVATION CONTOURS ARE INTERPRETIVE AND APPROXIMATE. CONTOUR INTERVAL IS 1 FOOT.

0 40 80 160 FEET

SCALE: 1"=80'

C:\PROJECTS\TERCS\PROJECTS\Da20\CAUSEWAY\FIGURES\47254002.DWG 3/21/00 EJL

# FIGURE 6-4
# EXCEEDANCES OF DIRECT EXPOSURE CRITERIA FOR SOIL PRE-DESIGN INVESTIGATION STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

N/F ALLIEDSIGNAL

DIKE RIPRAP

DB-99-16 DB-99-15 DB-99-17 DB-99-18 DB-99-14 DB-99-13 DB-99-12 DB-99-11 DB-99-10 DB-99-09 DB-99-08 DB-99-07 DB-99-06 DB-99-05 DB-99-04 DB-99-03 DB-99-02 DB-99-01

BLACKTOP PATHWAY

TIDAL FLATS

| HA-99-07 | | 0′ -1′ |
|---|---|---|
| 1,1,1-Trichloroethane | 40 | 340 |
| 1,1-Dichloroethane | 14 | 120J |
| 1,1-Dichloroethene | 1.4 | 12J |
| 2-Methylnapthalene | 9.8 | 25 |
| Benzene | 0.2 | 3.8J |
| Tetrachloroethene | 1 | 1200 |
| Toluene | 67 | 180J |
| Trichloroethene | 1 | 560 |
| Vinyl Chloride | 0.4 | 36J |
| Xylene (total) | 19.5 | 26J |
| bis(2-Ethylhexyl)Phthalate | 11 | 96 |
| cis-1,2-Dichloroethene | 14 | 3300 |

| CB-99-13 | | 7′ -9′ /7′ -9′ DUP |
|---|---|---|
| Tetrachloroethene | 1 | 37/28 |

| TP-99-10 | | 3′ -5′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 9.4 |
| Benzo(a)Pyrene | 1 | 8 |
| Benzo(b)Fluoranthene | 1 | 7.2 |
| Benzo(k)Fluoranthene | 1 | 7.2 |
| Carbazole | 1 | 1.6 |
| Chrysene | 1 | 9.2 |
| Indeno(1,2,3-CD)Pyrene | 1 | 9.2 |
| Tetrachloroethene | 1 | 2.1J |
| Trichloroethene | 1 | 2.3J |

| TP-99-06 | | 6′ -8′ |
|---|---|---|
| Trichloroethene | 1 | 1.2J |
| Aroclor-1260 | 1 | 11 |

| CB-99-04 | | 0′ -2′ | 5′ -7′ |
|---|---|---|---|
| Tetrachloroethene | 1 | -- | 2.7J |
| Trichloroethene | 1 | 3.4J | 1.2J |
| Vinyl Chloride | 0.4 | -- | 24 |
| cis-1,2-Dichloroethene | 14 | -- | 120 |

| CB-99-03 | | 2′ -4′ /2′ -4′ DUP | 4′ -6′ |
|---|---|---|---|
| 2-Methylnapthalene | 9.8 | -- | 45 |
| Methylene Chloride | 1 | 1J/3.3J | -- |
| Vanadium | 0.5 | -- | 5.92 |

| CB-99-02 | | 5′ -7′ |
|---|---|---|
| Methylene Chloride | 1 | -- |
| Tetrachloroethene | 1 | 81 |
| Trichloroethene | 1 | 4.3J |
| cis-1,2-Dichloroethene | 14 | 100 |

| CB-99-15 | | 1′ -3′ | 7′ -9′ |
|---|---|---|---|
| Acenapthene | 84 | -- | 190 |
| Anthracene | 400 | -- | 520J |
| Benzo(a)Anthracene | 1 | 50 | 1200J |
| Benzo(a)Pyrene | 1 | 43 | 880J |
| Benzo(b)Fluoranthene | 1 | 35 | 940J |
| Benzo(k)Fluoranthene | 1 | 32J | 880J |
| Carbazole | 1 | 6.9 | 310 |
| Chrysene | 1 | 46 | 1,200 |
| Dibenzofuran | 5.6 | 6.9 | 130 |
| Fluoranthene | 56 | 120 | 2700 |
| Fluorene | 56 | -- | 250J |
| Indeno(1,2,3-CD)Pyrene | 1 | 30 | 350 |
| Naphthalene | 56 | -- | 97J |
| Phenanthrene | 40 | 100 | 2400 |
| Pyrene | 40 | 93 | 1800J |

| CB-99-14 | | 1′ -3′ /1′ -3′ DUP |
|---|---|---|
| Benzo(a)Anthracene | 1 | 1.5/2.2 |
| Benzo(a)Pyrene | 1 | 2.3/3.3 |
| Benzo(b)Fluoranthene | 1 | 2.4/3.2 |
| Benzo(k)Fluoranthene | 1 | 1.4/2.9 |
| Chrysene | 1 | 1.6/2.4 |
| Indeno(1,2,3-CD)Pyrene | 1 | 2.2/2.6 |

MWCD-99-02B MWCD-99-02A

CONCRETE RAMP (BADLY DETERIORATED)

CONCRETE PAD & CHAIN LINK FENCE

A A′ B B′

| CB-99-11 | | 0′ -2′ |
|---|---|---|
| Benzo(k)Fluoranthene | 1 | 1.1J |
| Trichloroethene | 1 | 2J |

TIDAL FLATS

FENCE

CAUSEWAY

FILL AREA

SIGN

TP-DEP-17 TP-DEP-15 TP-DEP-12 TP-DEP-11

CB-99-17 CB-99-14 CB-99-15 CB-99-16 CB-99-13 CB-99-12 CB-99-11 CB-99-10 CB-99-08 CB-99-07 CB-99-06 CB-99-05 CB-99-04 CB-99-03 CB-99-02 CB-99-01

SF-1 SF-2 SF-3 SF-4 SF-5 SF-6 SF-7 SF-8 SF-9 SF-10

TP-99-24 TP-99-23 TP-99-22 TP-99-25

| TP-DEP-12 | | 1′ -3′ |
|---|---|---|
| Trichloroethene | 1 | 4J |
| Vanadium | 0.5 | 1.07 |
| Vinyl Chloride | 0.4 | 1.9J |

| CB-99-12 | | 8′ -10′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 22J |
| Benzo(a)Pyrene | 1 | 19J |
| Benzo(b)Fluoranthene | 1 | 17J |
| Benzo(k)Fluoranthene | 1 | 18J |
| Chrysene | 1 | 20 |
| Dibenz(a,b)Anthracene | 1 | 8.1 |
| Fluoranthene | 56 | 58 |
| Phenanthrene | 40 | 60 |
| Pyrene | 40 | 46 |

| TP-DEP-11 | | 0′ -1′ |
|---|---|---|
| Hexachlorobenzene | 1 | 1.4 |
| Tetrachloroethene | 1 | 2.9 |
| Trichloroethene | 1 | 8.8 |
| Vanadium | 0.5 | 0.807 |

| CB-99-08 | | 1′ -3′ /1′ -3′ DUP |
|---|---|---|
| Trichloroethene | 1 | --/8.4J |

END OF DIKE RIPRAP

| CB-99-09 | | 10′ -12′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 1.2J |
| Benzo(a)Pyrene | 1 | 1J |
| Benzo(b)Fluoranthene | 1 | 1J |
| Crysene | 1 | 1.3 |

| CB-99-01 | | 0′ -2′ | 9′ -11′ |
|---|---|---|---|
| Methylene Chloride | 1 | 1.4 | 1.9 |
| Trichloroethene | 1 | -- | 3J |

| HA-99-03 | | 0′ -1′ |
|---|---|---|
| Benzo(a)Anthracene | 1 | 13 |
| Benzo(a)Pyrene | 1 | 13 |
| Benzo(b)Fluoranthene | 1 | 9.9 |
| Benzo(k)Fluoranthene | 1 | 12 |
| Carbazole | 1 | 4.2 |
| Chrysene | 1 | 14 |
| Indeno(1,2,3-CD)Pyrene | 1 | 9 |

HA-99-08 HA-99-07 HA-99-03 HA-99-02 HA-99-01

B-80 B-36 B-73 B-58 B-65 B-74 B-15 B-52 B-37 B-38 B-68 B-81 B-64-2 B-64-1 B-13 B-44 B-48 B-42 B-16 B-40 B-59 B-12 B-8 B-7 B-7A B-9 B-33 B-34 B-10 B-67 B-63 B-70 B-3 B-3A B-4 B-69 B-19

N

## LEGEND

- SF-1 — EXISTING WOODWARD-CLYDE ASBESTOS SURFACE SOIL SAMPLING LOCATION (APPROXIMATE)
- MWCD-99-01A — EXISTING HLA CAUSEWAY/DIKE MONITORING WELLS
- TP-99-22 — EXISTING HLA TEST PIT LOCATIONS
- CB-99-01 — EXISTING HLA CAUSEWAY BORING
- DB-99-01 — EXISTING HLA DIKE BORING
- HA-99-01 — EXISTING HAND AUGERS
- B-53 — BUILDING DESIGNATIONS
- CHAINLINK FENCE
- SAEP PROPERTY BOUNDARY
- LIMITS OF PRE-DESIGN INVESTIGATION
- A A′ — GEOLOGIC PROFILE LOCATION

DUP DUPLICATE SAMPLE
-- LESS THAN REPORTING EXCEEDANCES
J VALUE IS ESTIMATED
BGS BELOW GROUND SURFACE

LOCATION IDENTIFIER: CB-99-07 | 0′ -2′ /0′ -2′ DUP (SAMPLING INTERVAL (BGS))
COMPOUND: Arsenic | 10 | 10.7/10.9 (CONCENTRATION (mg/kg))
REMEDIATION STANDARD REGULATION (RSR) CRITERION

ALL CONCENTRATIONS REPORTED IN MILLIGRAMS PER KILOGRAM (mg/kg) EXCEPT FOR VANADIUM WHICH IS REPORTED IN MILLIGRAMS PER LITER (mg/L)

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. ALL ELEVATION CONTOURS ARE INTERPRETIVE AND APPROXIMATE. CONTOUR INTERVAL IS 1 FOOT.

0 40 80 160 FEET

SCALE: 1"=80'

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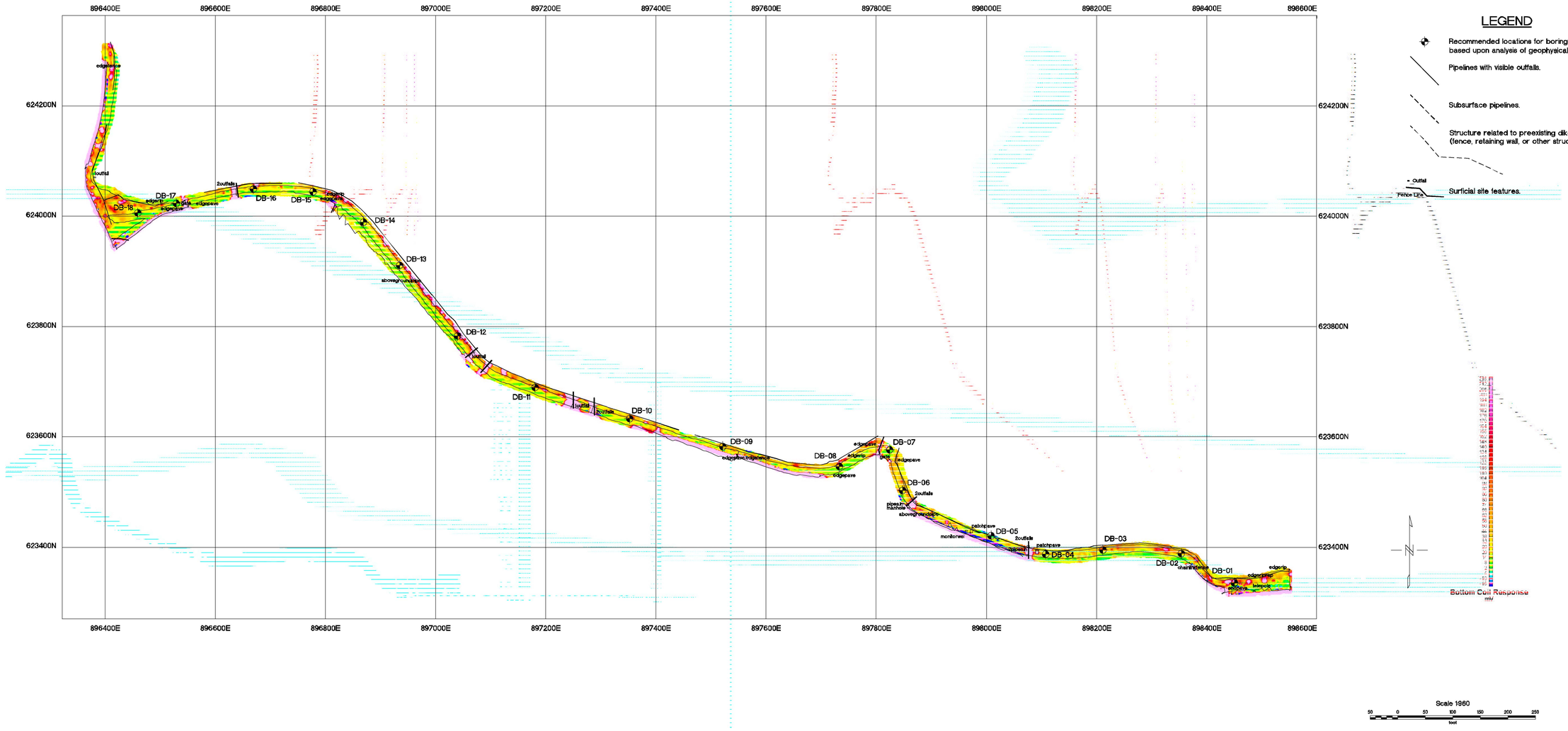
# FIGURE 6-5
# EXCEEDANCES OF GB POLLUTANT MOBILITY CRITERIA PRE-DESIGN INVESTIGATION STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates




## LEGEND

- Recommended locations for borings, based upon analysis of geophysical data.
- Pipelines with visible outfalls.
- Subsurface pipelines.
- Structure related to preexisting dike (fence, retaining wall, or other structure).
- Surficial site features.

# FIGURE 6-6
# GEONICS EM61 TDEMI BOTTOM COIL RESULTS-DIKE PRE-DESIGN INVESTIGATION STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

T:\4725A\2104F6-6.DWG EJL 1=100

**TABLE 5-1**
**EXPLORATION PROGRAM SUMMARY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| AREA | NUMBER OF BORINGS | NUMBER OF TEST PITS[1] | NUMBER OF HAND AUGER BORINGS | NUMBER OF SUBSURFACE SOIL SAMPLES[2] | NUMBER OF MONITORING WELLS INSTALLED |
|---|---|---|---|---|---|
| Causeway | 15 | 10 | 0 | 48 | 4 |
| Dike | 18 | 0 | 5 | 41 | 0 |
| Totals | 33 | 10 | 5 | 89 | 4 |

Notes:

[1] Samples were collected from eight out of a total of 10 test pit explorations.
[2] This number includes samples collected from borings, test pits, and hand auger locations.

**TABLE 5-2**
**SUMMARY OF CONTRACT LABORATORY ANALYTICAL SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (FEET BGS) | VOC | SVOC | TAL METALS | PCB | SPLP | ASBESTOS | GRAIN SIZE |
|---|---|---|---|---|---|---|---|---|
| **CAUSEWAY BORINGS** | | | | | | | | |
| CB-99-01 | 0' - 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 9' - 11' | ✓ | ✓ | ✓ | | | | |
| CB-99-02 | 0' - 2' | ✓ | ✓/✓[2] | ✓[2] | ✓ | ✓ | ✓ | |
| | 5' - 7' | ✓ | ✓ | ✓ | | | | |
| CB-99-03 | 2' - 4' | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓[1] | |
| | 4' - 6' | ✓ | ✓ | ✓ | | ✓ | | |
| CB-99-04 | 0' - 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 5' - 7' | ✓/✓ | ✓/✓ | ✓ | | | | |
| CB-99-05 | 0' - 2' | ✓/✓ | ✓/✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 4' - 6' | ✓ | ✓ | ✓ | | | | |
| CB-99-07 | 0' - 2' | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓ | ✓[1] | |
| | 4' - 6' | ✓/✓ | ✓/✓ | ✓ | | ✓ | | ✓ |
| CB-99-08 | 1' - 3' | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓ | ✓[1] | |
| | 3' - 5' | ✓ | ✓ | ✓ | | ✓ | | |
| CB-99-09 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 10' – 12' | ✓/✓ | ✓/✓ | ✓ | | | | |
| | 20' – 22' | ✓ | ✓ | ✓ | | | | |
| | 40' – 42' | ✓ | ✓ | ✓ | | | | |
| | 60' – 62' | ✓ | ✓ | ✓ | | | | |
| | 80' – 82' | ✓ | ✓ | ✓ | | | | |
| | 100' – 102' | ✓ | ✓ | ✓ | | | | |
| CB-99-11 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 5' – 7' | ✓ | ✓ | ✓ | | | | |
| CB-99-12 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 2' – 3' | ✓[1] | | | | | | |
| | 8' – 10' | ✓/✓ | ✓/✓ | ✓ | | | | ✓ |
| CB-99-13 | 1' – 3' | ✓[1] | ✓ | ✓ | ✓ | ✓ | ✓ | |

**TABLE 5-2**
**SUMMARY OF CONTRACT LABORATORY ANALYTICAL SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (FEET BGS) | VOC | SVOC | TAL METALS | PCB | SPLP | ASBESTOS | GRAIN SIZE |
|---|---|---|---|---|---|---|---|---|
| CB-99-13 (cont). | 7' – 9' | ✓[1] | ✓ | ✓ | | | | |
| CB-99-14 | 1' –3' | ✓/✓[1] | ✓/✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓ |
| | 10' – 12' | ✓ | ✓ | ✓ | | | | |
| | 30' – 32' | ✓ | ✓ | ✓ | | | | |
| | 50' – 52' | ✓ | ✓ | ✓ | | | | |
| | 70' – 72' | ✓ | ✓ | ✓ | | | | |
| | 90' – 92' | ✓ | ✓ | ✓ | | | | |
| CB-99-15 | 1' – 3' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 7' – 9' | ✓ | ✓ | ✓ | | | | |
| CB-99-16 | 1' – 3' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 7' – 9' | ✓/✓ | ✓/✓ | ✓ | | | | |
| CB-99-17 | 1' – 3' | ✓[1] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 6' – 8' | ✓ | ✓ | ✓ | | | | |
| **CAUSEWAY TEST PITS** | | | | | | | | |
| TP-99-06 | 6' – 8' | ✓/✓ | ✓/✓ | ✓ | ✓ | ✓ | ✓ | |
| TP-99-10 | 3' – 5' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| TP-99-22 | 1' - 3' | ✓[2] | ✓/✓[2] | ✓[2] | ✓[2] | ✓[2] | ✓ | |
| TP-99-23 | 1' – 3' | ✓/✓[1] | ✓/✓[1] | ✓[1] | ✓ | ✓ | ✓ | |
| TP-99-24 | 8' – 10' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| TP-DEP-11 | 0' – 1' | ✓/✓ | ✓/✓ | ✓ | ✓ | ✓ | ✓ | |
| TP-DEP-12 | 1' – 3' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| TP-DEP-17 | 1' – 3' | ✓[1] | ✓[1] | ✓[1] | ✓ | ✓ | ✓ | |
| **DIKE BORINGS** | | | | | | | | |
| DB-99-01 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-02 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-03 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-04 | 2' – 4' | ✓[2] | ✓[2] | ✓[2] | ✓[2] | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |

**TABLE 5-2**
**SUMMARY OF CONTRACT LABORATORY ANALYTICAL SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (FEET BGS) | VOC | SVOC | TAL METALS | PCB | SPLP | ASBESTOS | GRAIN SIZE |
|---|---|---|---|---|---|---|---|---|
| DB-99-05 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-06 | 2' – 4' | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓[1] | ✓[1] | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-07 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 8' – 10' | ✓ | ✓ | ✓ | | | | |
| DB-99-08 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-09 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-10 | 2' – 4' | ✓[1] | ✓[1] | ✓[1] | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-11 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | | | |
| DB-99-12 | 2' – 4' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 9' – 11' | ✓[1] | ✓[1] | ✓[1] | | | | |
| DB-99-13 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | 9' – 11' | ✓ | ✓ | ✓ | | ✓ | | |
| DB-99-14 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | 8' – 10' | ✓ | ✓ | ✓ | | ✓ | | |
| DB-99-15 | 0' – 2' | ✓[2] | ✓[2] | ✓[2] | ✓ | ✓ | ✓ | |
| | 8' – 10' | ✓ | ✓ | ✓ | | | | |
| DB-99-16 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 8' – 10' | ✓ | ✓ | ✓ | | | | |
| DB-99-17 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | 10' – 12' | ✓[1] | ✓[1] | ✓[1] | | ✓[1] | | |
| DB-99-18 | 0' – 2' | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | 11' – 13' | ✓ | ✓ | ✓ | | | | |
| HAND AUGER BORINGS | | | | | | | | |
| HA-99-01 | | ✓[2] | ✓[2] | ✓[2] | ✓[2] | ✓ | ✓ | |
| HA-99-02 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

**TABLE 5-2**
**SUMMARY OF CONTRACT LABORATORY ANALYTICAL SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (FEET BGS) | VOC | SVOC | TAL METALS | PCB | SPLP | ASBESTOS | GRAIN SIZE |
|---|---|---|---|---|---|---|---|---|
| HA-99-03 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| HA-99-07 | | ✓/✓ | ✓/✓ | ✓ | ✓ | ✓ | ✓ | |
| HA-99-08 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Subtotal | | 89/11 | 88/13 | 88 | 46 | 49 | 46 | 9 |
| Duplicates | | 14 | 10 | 10 | 5 | 3 | 5 | 0 |
| MS/MSD | | 5/5 | 5/5 | 5/5 | 4/4 | 1/1 | 0/0 | 0/0 |
| Field Blanks | | 8 | 8 | 8 | 8 | 0 | 0 | 0 |
| Trip Blanks | | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 128 | 116 | 116 | 67 | 54 | 51 | 9 |

Notes:

| | |
|---|---|
| ✓/✓ | Indicates samples requested to include tentatively identified compound |
| [1] | Samples collected in duplicate |
| [2] | Samples collected for matrix spike and matrix spike duplicates |
| CB | Causeway Boring |
| DB | Dike Boring |
| HA | Hand Auger |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| PCBs | Polychlorinated Biphenyls |
| SPLP | Synthetic Precipitation Leaching Procedure |
| SVOCs | Semivolatile Organic Compounds |
| TAL | Target Analyte List |
| VOCs | Volatile Organic Compounds |

**TABLE 5-3**
**SUMMARY OF OFF-SITE ANALYTICAL LABORATORY METHODS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| PARAMETER | METHOD |
|---|---|
| Soil | |
| VOCs | USEPA Method 8260B |
| SVOCs | USEPA Method 8270C |
| PCBs | USEPA Method 8082 |
| Metals | USEPA Method 6010 B except mercury which uses USEPA Method 7470A, or 7471A |
| Cyanide | USEPA Method 9012A |
| SPLP Metals | USEPA Method 1312/6010B/7470A |
| Asbestos | Polarizing Light Microscope Method |
| Grain Size Analysis | ASTM Method D 422 |
| Water for Field Blanks | |
| VOCs | Same as above |
| SVOCs | Same as above |
| PCBs | Same as above |
| Total Metals | Same as above |
| Cyanide | Same as above |

Notes:

ASTM = American Society for Testing and Materials
PCB = polychlorinated biphenyl
SPLP = Synthetic Precipitation Leaching Procedure
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

Analytical methods are from USEPA SW-846, "Test Methods for Evaluating Solid Waste, Chemical/Physical Methods SW-846, Final Update III", revised 1993 or most recent edition unless otherwise indicated.

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| VOC ANALYTES 8260B | REPORTING LIMIT µg/kg | METHOD DETECTION LIMIT (µg/kg) |
|---|---|---|
| Acetone | 1000 | 88 |
| Benzene | 250 | 71 |
| Bromodichloromethane | 250 | 71 |
| Bromoform | 250 | 66 |
| Bromomethane | 250 | 61 |
| 2-Butanone | 1000 | 77 |
| Carbon disulfide | 250 | 69 |
| Carbon tetrachloride | 250 | 64 |
| Chlorobenzene | 250 | 72 |
| Dibromochloromethane | 250 | 75 |
| Chloroethane | 250 | 68 |
| Chloroform | 250 | 65 |
| Chloromethane | 250 | 58 |
| 1,1-Dichloroethane | 250 | 70 |
| 1,2-Dichloroethane | 250 | 70 |
| 1,1-Dichloroethene | 250 | 67 |
| cis-1,2-Dichloroethene | 250 | 76 |
| trans-1,2-Dichloroethene | 250 | 76 |
| 1,2-Dichloropropane | 250 | 70 |
| cis-1,3-Dichloropropene | 250 | 69 |
| trans-1,3-Dichloropropene | 250 | 71 |
| Ethylbenzene | 250 | 60 |
| 2-Hexanone | 1000 | 67 |
| Methylene chloride | 250 | 78 |
| 4-Methyl-2-pentanone | 1000 | 74 |
| Styrene | 250 | 59 |
| 1,1,2,2-Tetrachloroethane | 250 | 60 |
| Tetrachloroethene | 250 | 68 |
| Toluene | 250 | 75 |
| 1,1,1-Trichloroethane | 250 | 67 |
| 1,1,2-Trichloroethane | 250 | 67 |
| Trichloroethene | 250 | 69 |
| Vinyl chloride | 500 | 59 |
| Xylenes (total) | 250 | 62 |

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| TCL SVOC ANALYTES 8270C | REPORTING LIMIT µg/kg |
|---|---|
| Acenapthene | 330 |
| Acenapthylene | 330 |
| Anthracene | 330 |
| Benzo(a)anthracene | 330 |
| Benzo(b)fluoranthene | 330 |
| Benzo(k)fluoranthene | 330 |
| Benzo(ghi)perylene | 330 |
| Benzo(a)pyrene | 330 |
| bis(2-Chloroethoxy)metha | 330 |
| bis(2-Chloroethyl)ether | 330 |
| bis(2-Ethylhexyl)phthala | 330 |
| 4-Bromophenyl-phenylethe | 330 |
| Butylbenzylphthalate | 330 |
| Carbazol | 330 |
| 4-Chloroaniline | 330 |
| 4-Chloro-3-methylphenol | 330 |
| 2-Chloronapthalene | 330 |
| 2-Chlorophenol | 330 |
| 4-Chlorophenyl-phenyleth | 330 |
| Chrysene | 330 |
| Dibenz(a,h)anthracene | 330 |
| Dibenzofuran | 330 |
| Di-n-butylphthalate | 330 |
| 1,2-Dichlorobenzene | 330 |
| 1,3-Dichlorobenzene | 330 |
| 1,4-Dichlorobenzene | 330 |
| 3,3'-Dichlorobenzidine | 1600 |
| 2,4-Dichlorophenol | 330 |
| Diethylphthalate | 330 |
| 2,4-Dimethylphenol | 330 |
| Dimethylphthalate | 330 |
| 4,6-Dinitro-2-methylphen | 1600 |
| 2,4-Dinitrophenol | 1600 |
| 2,4-Dinitrotoluene | 330 |
| 2,6-Dinitrotoluene | 330 |

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| TCL SVOC ANALYTES 8270C | REPORTING LIMIT µg/kg |
|---|---|
| Di-n-octylphthalate | 330 |
| Fluoranthene | 330 |
| Fluorene | 330 |
| Hexachlorobenzene | 330 |
| Hexachlorobutadiene | 1600 |
| Hexachlorocyclopentadien | 330 |
| Hexochloroethane | 330 |
| Indeno(1,2,3-cd)pyrene | 330 |
| Isophorone | 330 |
| 2-Methylnaphthalene | 330 |
| 2-Methylphenol | 330 |
| -Methylphenol & 4-Methy | 330 |
| 3Napthalene | 330 |
| 2-Nitroaniline | 1600 |
| 3-Nitroaniline | 1600 |
| 4-Nitroaniline | 1600 |
| Nitrobenzene | 330 |
| 2-Nitrophenol | 330 |
| 4-Nitrophenol | 1600 |
| n-Nitrosodiphenylamine | 330 |
| N-Nitroso-di-n-propylami | 330 |
| 2,2'-oxybis(1-Chloroprop | 330 |
| Pentachlorophenol | 1600 |
| Phenanthrene | 330 |
| Phenol | 330 |
| Pyrene | 330 |
| 1,2,4-Trichlorobenzene | 330 |
| 2,4,5-Trichlorophenol | 1600 |
| 2,4,6-Trichlorophenol | 330 |

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| PCB ANALYTES 8082 | REPORTING LIMIT µg/kg |
|---|---|
| Aroclor 1016 | 36 |
| Aroclor 1221 | 36 |
| Aroclor 1232 | 36 |
| Aroclor 1242 | 36 |
| Aroclor 1248 | 36 |
| Aroclor 1254 | 36 |
| Aroclor 1260 | 36 |

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| TAL METALS 6010B | LABORATORY REPORTING LIMITS (RLs) mg/kg | METHOD DETECTION LIMIT (MDL) mg/kg |
|---|---|---|
| Aluminum | 20 | 0.541 |
| Antimony | 10 | 0.211 |
| Arsenic | 1 | 0.2 |
| Barium | 1 | 0.035 |
| Beryllium | 1 | 0.005 |
| Boron | 10 | 1.133 |
| Cadmium | 1 | 0.025 |
| Calcium | 100 | 16.193 |
| Chromium | 1 | 0.038 |
| Cobalt | 2 | 0.143 |
| Copper | 2 | 0.001 |
| Cyanide | -- | -- |
| Iron | 20 | 0.652 |
| Lead | 1 | 0.109 |
| Magnesium | 100 | 1.501 |
| Manganese | 1 | 0.106 |
| Mercury | .1 | 0.009449 |
| Nickel | 5 | 0.81 |
| Potassium | 500 | 35.416 |
| Selenium | 1 | 0.136 |
| Silver | 2 | 0.071 |
| Sodium | 100 | 2.281 |
| Thallium | 1 | 0.353 |
| Vanadium | 1 | 0.412 |
| Zinc | 2 | 0.612 |

Note:
Laboratory reports detected values between RLs and MDLs.
Total cyanide analyzed by Method 9012A.
Mercury analyzed by Method 7470A, or 7471A.

**TABLE 5-4**
**ANALYTICAL REPORTING LIMITS**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| SPLP METALS 1312 | LABORATORY REPORTING LIMITS (RLs) mg/L | METHOD DETECTION LIMIT mg/L |
|---|---|---|
| Antimony | .5 | 0.003 |
| Arsenic | .5 | 0.002 |
| Barium | 10 | 0.0002 |
| Beryllium | .005 | 0.0002 |
| Cadmium | .1 | 0.0003 |
| Chromium | .5 | 0.0005 |
| Copper | .5 | 0.008 |
| Lead | .5 | 0.002 |
| Nickel | .04 | 0.001 |
| Selenium | .25 | 0.002 |
| Silver | .5 | 0.0008 |
| Thallium | .5 | 0.004 |
| Vanadium | .05 | 0.0007 |
| Zinc | .02 | 0.007 |
| Mercury | .0002 | 0.00005 |

Note:

Laboratory reports detected values between RLs and MDLs.

| | |
|---|---|
| PCB | Polychlorinated Biphenyl |
| RL | Reporting Limit |
| SPLP | Synthetic Precipitation Leaching Procedure |
| SVOCs | Semivolatile Organic Compounds |
| TAL | Target Analyte List |
| TCL | Target Compound List |
| VOCs | Volatile Organic Compounds |
| mg/kg | milligrams per kilogram |
| µg/kg | micrograms per kilogram |
| mg/L | milligrams per liter |

**TABLE 5-5**
**SUMMARY OF QUALITY ASSURANCE LABORATORY ANALYTICAL SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (feet bgs) | VOC | SVOC | TAL METALS | PCB |
|---|---|---|---|---|---|
| DB-99-09 | 2' – 4' | | ✓ | ✓ | ✓ |
| DB-99-07 | 2' - 4' | ✓ | ✓ | ✓ | ✓ |
| DB-99-13 | 9' – 11' | ✓ | ✓ | ✓ | |
| DB-99-16 | 8' – 10' | ✓ | ✓ | ✓ | |
| CB-99-05 | 0' – 2' | ✓ | ✓ | ✓ | ✓ |
| CB-99-12 | 1' – 2' | | ✓ | ✓ | ✓ |
| CB-99-15 | 1' – 3' | ✓ | ✓ | ✓ | ✓ |
| TP-99-24 | 8' – 10' | ✓ | ✓ | ✓ | |
| HA-99-01 | 0' – 1' | ✓ | ✓ | ✓ | |
| CB-99-09 | 10' – 12' | ✓ | ✓ | ✓ | |
| CB-99-12 | 1' – 3' | ✓ | | | |
| Trip Blanks | | 5 | | | |
| Totals | | 16 | 10 | 10 | 5 |

Note: Samples were collected for analysis by USACE New England District Quality Assuarance Laboratory Subcontractor (Severn Trent)

**TABLE 5-6**
**SUMMARY OF RESAMPLED VOC SAMPLES**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| EXPLORATION LOCATION | SAMPLE DEPTH (feet bgs) | NOTES ON RESAMPLING |
|---|---|---|
| CB-99-01 | 9' – 11' | Sample collected at 7 feet bgs due to obstruction at 7 feet. |
| CB-99-02 | 0' – 2' | Collected sample and MS/MSD samples. |
| | 5' – 7' | Collected sample. |
| CB-99-11 | 0' – 2' | Collected sample. |
| CB-99-12 | 1' – 3' | Collected sample and duplicate sample. Collected QA sample |
| | 8' – 10' | Collected sample. |
| CB-99-13 | 1' – 3' | Collected sample and duplicate sample. |
| | 7' – 9' | Collected sample and duplicate sample. |
| CB-99-17 | 1' – 3' | Collected sample and duplicate sample. |
| TP-DEP-11 | 0' – 1' | Collected sample. |

Notes:

VOC = Volatile Organic Compounds
MS = Matrix Spike
MSD = Matrix Spike Duplicate

**TABLE 6-1**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD army ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-02 | | CB-99-05 | | CB-99-07DUP | | CB-99-07 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 0-2 | | 0-2 | | 0-2 | | 0-2 | |
| | SAMPLE COLLECTION | | 9/20/99 | | 9/21/99 | | 9/21/99 | | 9/21/99 | |
| **Analyte** | **RSR Value** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| Vinyl Chloride | 0.32 | mg/kg | | | | | | | | |
| **SVOCs** | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | | | | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | | | | | | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | | | | | | |
| **PCBs** | | | | | | | | | | |
| Aroclor-1016 | 1 | mg/kg | | | | | | | | |
| Aroclor-1260 | 1 | mg/kg | 2.1 | | | | | | | |
| **Inorganics** | | | | | | | | | | |
| Arsenic | 10 | mg/kg | | | | | 10.9 | | 10.7 | |
| Beryllium | 2 | mg/kg | | | 3.2 | | | | | |
| Cadmium | 34 | mg/kg | | | | | | | | |
| Lead | 500 | mg/kg | | | | | | | | |
| Thallium | 5.4 | mg/kg | | | | | | | | |
| Vanadium | 470 | mg/kg | | | | | | | | |

Notes:

These are exceedances of RSRs only. Full results are included in Appendix I.

RSR = Remediation Standard Regulation

mg/kg = microgram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

**TABLE 6-1**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD army ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-08 DUP | | CB-99-08 | | CB-99-08 | | CB-99-11 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 1-3 | | 1-3 | | 3-5 | | 0-2 | |
| | SAMPLE COLLECTION | | 9/21/99 | | 9/21/99 | | 9/21/1999-5 | | 9/21/99 | |
| **Analyte** | **RSR Value** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| Vinyl Chloride | 0.32 | mg/kg | | | | | | | | |
| **SVOCs** | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | | | | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | | | | | | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | | | | | | |
| **PCBs** | | | | | | | | | | |
| Aroclor-1016 | 1 | mg/kg | | | | | | | | |
| Aroclor-1260 | 1 | mg/kg | | | | | | | | |
| **Inorganics** | | | | | | | | | | |
| Arsenic | 10 | mg/kg | 19.8 | | 34.5 | | | | | |
| Beryllium | 2 | mg/kg | 2.3 | | 2.3 | | 2.1 | | 2.6 | |
| Cadmium | 34 | mg/kg | | | 43.9 | | | | | |
| Lead | 500 | mg/kg | 1,250 | J | 1,380 | J | | | | |
| Thallium | 5.4 | mg/kg | 5.4 | | 8.3 | | 5.4 | | | |
| Vanadium | 470 | mg/kg | | | | | | | | |

Notes:

These are exceedances of RSRs only. Full results are included in Appendix I.

RSR = Remediation Standard Regulation

mg/kg = microgram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

**TABLE 6-1**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-14 | | CB-99-14DUP | | CB-99-15 | | CB-99-16 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 1-3 | | 1-3 | | 1-3 | | 1-3 | |
| | SAMPLE COLLECTION | | 9/22/99 | | 9/22/99 | | 9/21/99 | | 9/21/99 | |
| **Analyte** | **RSR Value** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| Vinyl Chloride | 0.32 | mg/kg | | | | | | | | |
| **SVOCs** | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | 1.5 | | 2.2 | | 50 | | | |
| Benzo(a)Pyrene | 1 | mg/kg | 2.3 | | 3.3 | | 43 | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | 2.4 | | 3.2 | | 35 | | | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | | | | | 32 | J | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | 2.2 | | 2.6 | | 30 | | | |
| **PCBs** | | | | | | | | | | |
| Aroclor-1016 | 1 | mg/kg | | | | | | | | |
| Aroclor-1260 | 1 | mg/kg | | | | | | | | |
| **Inorganics** | | | | | | | | | | |
| Arsenic | 10 | mg/kg | | | | | | | 15.7 | |
| Beryllium | 2 | mg/kg | | | | | | | | |
| Cadmium | 34 | mg/kg | | | | | | | | |
| Lead | 500 | mg/kg | | | | | | | 721 | J |
| Thallium | 5.4 | mg/kg | | | | | | | | |
| Vanadium | 470 | mg/kg | | | | | | | | |

Notes:

These are exceedances of RSRs only. Full results are included in Appendix I.

RSR = Remediation Standard Regulation

mg/kg = microgram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

**TABLE 6-1**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | TP-99-10 | | TP-99-22 | | TP-99-23 | | TP-DEP-11 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 3-5 | | 1-3 | | 1-3 | | 0-1 | |
| | SAMPLE COLLECTION | | 9/21/99 | | 9/22/99 | | 9/22/99 | | 9/21/99 | |
| **Analyte** | **RSR Value** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| Vinyl Chloride | 0.32 | mg/kg | | | | | | | | |
| **SVOCs** | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | 9.4 | | | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | 8 | | | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | 7.2 | | | | | | | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | 1.4 | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | 4.8 | | | | | | | |
| **PCBs** | | | | | | | | | | |
| Aroclor-1016 | 1 | mg/kg | | | 1.2 | J | | | | |
| Aroclor-1260 | 1 | mg/kg | 1.8 | | 1.7 | J | 2.2 | | 1.6 | |
| **Inorganics** | | | | | | | | | | |
| Arsenic | 10 | mg/kg | 10.7 | | | | | | 11.7 | |
| Beryllium | 2 | mg/kg | | | | | | | 13.1 | |
| Cadmium | 34 | mg/kg | | | | | | | 94.7 | |
| Lead | 500 | mg/kg | | | | | | | 1,510 | J |
| Thallium | 5.4 | mg/kg | | | | | | | 6.6 | |
| Vanadium | 470 | mg/kg | | | | | | | 2,640 | |

Notes:

These are exceedances of RSRs only. Full results are included in Appendix I.

RSR = Remediation Standard Regulation

mg/kg = microgram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

**TABLE 6-1**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD army ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | TP-DEP-12 |
|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 1-3 |
| | SAMPLE COLLECTION | | 9/21/99 |
| **Analyte** | **RSR Value** | **Units** | |
| **VOCs** | | | |
| Vinyl Chloride | 0.32 | mg/kg | 1.9 J |
| **SVOCs** | | | |
| Benzo(a)Anthracene | 1 | mg/kg | |
| Benzo(a)Pyrene | 1 | mg/kg | |
| Benzo(b)Fluoranthene | 1 | mg/kg | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | |
| Hexachlorobenzene | 1 | mg/kg | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | |
| **PCBs** | | | |
| Aroclor-1016 | 1 | mg/kg | |
| Aroclor-1260 | 1 | mg/kg | |
| **Inorganics** | | | |
| Arsenic | 10 | mg/kg | |
| Beryllium | 2 | mg/kg | 3.9 |
| Cadmium | 34 | mg/kg | |
| Lead | 500 | mg/kg | |
| Thallium | 5.4 | mg/kg | |
| Vanadium | 470 | mg/kg | 970 |

Notes:

These are exceedances of RSRs only. Full results are included in Appendix I.

RSR = Remediation Standard Regulation

mg/kg = microgram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

**TABLE 6-2**
**SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-01 | | CB-99-01 | | CB-99-02 | | CB-99-03DUP | | CB-99-03 | | CB-99-03 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SAMPLE DEPTH (bgs) | 0-2 | | 9-11 | | 5-7 | | 2-4 | | 2-4 | | 4-6 | |
| | | SAMPLE COLLECTION DATE | 9/20/99 | | 9/20/99 | | 10/12/99 | | 9/20/99 | | 9/20/99 | | 9/20/99 | |
| **Analyte** | **RSR Values** | **Units** | | | | | | | | | | | | |
| **VOCs** | | | | | | | | | | | | | | |
| cis-1,2-Dichloroethene | 14 | mg/kg | | | | | 100 | | | | | | | |
| Methylene Chloride | 1 | mg/kg | 1.4 | | 1.9 | | | | 3.3 | J | 1 | J | | |
| Tetrachloroethene | 1 | mg/kg | | | | | 81 | | | | | | | |
| Trichloroethene | 1 | mg/kg | | | 3 | J | 4.3 | J | | | | | | |
| Vinyl Chloride | 0.4 | mg/kg | | | | | | | | | | | | |
| **SVOCs** | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 9.8 | mg/kg | | | | | | | | | | | 45 | |
| Acenaphthene | 84 | mg/kg | | | | | | | | | | | | |
| Anthracene | 400 | mg/kg | | | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | | | | | | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | | | | | | | | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | | | | | | | | | | |
| Benzo(k)Fluoranthene | 1 | mg/kg | | | | | | | | | | | | |
| Carbazole | 1 | mg/kg | | | | | | | | | | | | |
| Chrysene | 1 | mg/kg | | | | | | | | | | | | |
| Dibenz(a,h)Anthracene | 1 | mg/kg | | | | | | | | | | | | |
| Dibenzofuran | 5.6 | mg/kg | | | | | | | | | | | | |
| Fluoranthene | 56 | mg/kg | | | | | | | | | | | | |
| Fluorene | 56 | mg/kg | | | | | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | | | | | | | | | | |
| Naphthalene | 56 | mg/kg | | | | | | | | | | | | |
| Phenanthrene | 40 | mg/kg | | | | | | | | | | | | |
| Pyrene | 40 | mg/kg | | | | | | | | | | | | |
| **SPLP Metals** | | | | | | | | | | | | | | |
| Vanadium | 0.5 | mg/L | | | | | | | | | | | 5.92 | |

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligrams per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

**TABLE 6-2**
**SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-04 | | CB-99-04 | | CB-99-08DUP | | CB-99-08 | | CB-99-09 | | CB-99-11 | | CB-99-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 0-2 | | 5-7 | | 1-3 | | 3-5 | | 10-12 | | 0-2 | | 8-10 |
| | SAMPLE COLLECTION DATE | | 9/20/99 | | 9/20/99 | | 9/21/99 | | 9/21/99 | | 9/23/99 | | 9/21/99 | | 9/21/99 |
| **Analyte** | **RSR Values** | **Units** | | | | | | | | | | | | | |
| **VOCs** | | | | | | | | | | | | | | | |
| cis-1,2-Dichloroethene | 14 | mg/kg | | | 120 | | | | | | | | | | |
| Methylene Chloride | 1 | mg/kg | | | | | | | | | | | | | |
| Tetrachloroethene | 1 | mg/kg | | | 2.7 | J | | | | | | | | | |
| Trichloroethene | 1 | mg/kg | 3.4 | J | 1.2 | J | 8.4 | J | | | | | 2 | J | |
| Vinyl Chloride | 0.4 | mg/kg | | | 24 | | | | | | | | | | |
| **SVOCs** | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 9.8 | mg/kg | | | | | | | | | | | | | |
| Acenaphthene | 84 | mg/kg | | | | | | | | | | | | | |
| Anthracene | 400 | mg/kg | | | | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | | | | | | | 1.2 | J | | | 22 |
| Benzo(a)Pyrene | 1 | mg/kg | | | | | | | | | 1 | J | | | 19 |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | | | | | | | 1 | J | | | 17 |
| Benzo(k)Fluoranthene | 1 | mg/kg | | | | | | | | | | | 1.1 | J | 18 |
| Carbazole | 1 | mg/kg | | | | | | | | | | | | | |
| Chrysene | 1 | mg/kg | | | | | | | | | 1.3 | | | | 20 |
| Dibenz(a,h)Anthracene | 1 | mg/kg | | | | | | | | | | | | | 8.1 |
| Dibenzofuran | 5.6 | mg/kg | | | | | | | | | | | | | |
| Fluoranthene | 56 | mg/kg | | | | | | | | | | | | | 58 |
| Fluorene | 56 | mg/kg | | | | | | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | | | | | | | | | | | |
| Naphthalene | 56 | mg/kg | | | | | | | | | | | | | |
| Phenanthrene | 40 | mg/kg | | | | | | | | | | | | | 60 |
| Pyrene | 40 | mg/kg | | | | | | | | | | | | | 46 |
| **SPLP Metals** | | | | | | | | | | | | | | | |
| Vanadium | 0.5 | mg/L | | | | | | | | | | | | | |

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligrams per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

**TABLE 6-2**
**SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | CB-99-13DUP | | CB-99-13 | | CB-99-14DUP | | CB-99-14 | | CB-99-15 | | CB-99-15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SAMPLE DEPTH (bgs) | 7-9 | | 7-9 | | 1-3 | | 1-3 | | 1-3 | | 7-9 | |
| | | SAMPLE COLLECTION DATE | 10/12/99 | | 10/12/99 | | 9/22/99 | | 9/22/99 | | 9/21/99 | | 9/21/99 | |
| **Analyte** | **RSR Values** | **Units** | | | | | | | | | | | | |
| **VOCs** | | | | | | | | | | | | | | |
| cis-1,2-Dichloroethene | 14 | mg/kg | | | | | | | | | | | | |
| Methylene Chloride | 1 | mg/kg | | | | | | | | | | | | |
| Tetrachloroethene | 1 | mg/kg | | 28 | | 37 | | | | | | | | |
| Trichloroethene | 1 | mg/kg | | | | | | | | | | | | |
| Vinyl Chloride | 0.4 | mg/kg | | | | | | | | | | | | |
| **SVOCs** | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 9.8 | mg/kg | | | | | | | | | | | | |
| Acenaphthene | 84 | mg/kg | | | | | | | | | | | 190 | |
| Anthracene | 400 | mg/kg | | | | | | | | | | | 520 | J |
| Benzo(a)Anthracene | 1 | mg/kg | J | | | | 2.2 | | 1.5 | | 50 | | 1,200 | J |
| Benzo(a)Pyrene | 1 | mg/kg | J | | | | 3.3 | | 2.3 | | 43 | | 880 | J |
| Benzo(b)Fluoranthene | 1 | mg/kg | J | | | | 3.2 | | 2.4 | | 35 | | 940 | J |
| Benzo(k)Fluoranthene | 1 | mg/kg | J | | | | 2.9 | | 1.4 | | 32 | J | 880 | J |
| Carbazole | 1 | mg/kg | | | | | | | | | 6.9 | | 310 | |
| Chrysene | 1 | mg/kg | | | | | 2.4 | | 1.6 | | 46 | | 1200 | |
| Dibenz(a,h)Anthracene | 1 | mg/kg | | | | | | | | | | | | |
| Dibenzofuran | 5.6 | mg/kg | | | | | | | | | 6.9 | | 130 | |
| Fluoranthene | 56 | mg/kg | | | | | | | | | 120 | | 2,700 | |
| Fluorene | 56 | mg/kg | | | | | | | | | | | 250 | J |
| Hexachlorobenzene | 1 | mg/kg | | | | | | | | | | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | | | 2.6 | | 2.2 | | 30 | | 350 | |
| Naphthalene | 56 | mg/kg | | | | | | | | | | | 97 | J |
| Phenanthrene | 40 | mg/kg | | | | | | | | | 100 | | 2,400 | |
| Pyrene | 40 | mg/kg | | | | | | | | | 93 | | 1,800 | J |
| **SPLP Metals** | | | | | | | | | | | | | | |
| Vanadium | 0.5 | mg/L | | | | | | | | | | | | |

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligrams per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

**TABLE 6-2**
**SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | TP-99-06 | | TP-99-10 | | TP-DEP-11 | | TP-DEP-12 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) | | 6-8 | | 3-5 | | 0-1 | | 1-3 | |
| | SAMPLE COLLECTION DATE | | 9/21/99 | | 9/21/99 | | 9/21/99 | | 9/21/99 | |
| **Analyte** | **RSR Values** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| cis-1,2-Dichloroethene | 14 | mg/kg | | | | | | | | |
| Methylene Chloride | 1 | mg/kg | | | | | | | | |
| Tetrachloroethene | 1 | mg/kg | | | 2.1 | J | 2.9 | | | |
| Trichloroethene | 1 | mg/kg | 1.2 | J | 2.3 | J | 8.8 | | 4 | J |
| Vinyl Chloride | 0.4 | mg/kg | | | | | | | 1.9 | J |
| **SVOCs** | | | | | | | | | | |
| 2-Methylnaphthalene | 9.8 | mg/kg | | | | | | | | |
| Acenaphthene | 84 | mg/kg | | | | | | | | |
| Anthracene | 400 | mg/kg | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | 9.4 | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | | | 8 | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | 7.2 | | | | | |
| Benzo(k)Fluoranthene | 1 | mg/kg | | | 7.2 | | | | | |
| Carbazole | 1 | mg/kg | | | 1.6 | | | | | |
| Chrysene | 1 | mg/kg | | | 9.2 | | | | | |
| Dibenz(a,h)Anthracene | 1 | mg/kg | | | | | | | | |
| Dibenzofuran | 5.6 | mg/kg | | | | | | | | |
| Fluoranthene | 56 | mg/kg | | | | | | | | |
| Fluorene | 56 | mg/kg | | | | | | | | |
| Hexachlorobenzene | 1 | mg/kg | | | | | 1.4 | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | 9.2 | | | | | |
| Naphthalene | 56 | mg/kg | | | | | | | | |
| Phenanthrene | 40 | mg/kg | | | | | | | | |
| Pyrene | 40 | mg/kg | | | | | | | | |
| **SPLP Metals** | | | | | | | | | | |
| Vanadium | 0.5 | mg/L | | | | | 0.807 | | 1.07 | |

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligrams per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

**TABLE 6-3**
**SUMMARY OF CTDEP RADIOLOGICAL TESTING**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| CTDEP SAMPLE NUMBER | LABORATORY NUMBER | APPROXIMATE CORRESPONDING EXPLORATION LOCATION | NUCLIDE AND ACTIVITY IN pCi/g | |
|---|---|---|---|---|
| | | | TH-234 | RA-226 |
| SAEP-A1 | 19223 | CB-99-05 | 1.3 | 1.47 |
| SAEP-A1 | 19224 | CB-99-05 | 0.65 | 0.65 |
| SAEP-A2 | 19225 | CB-99-12 | 0.689 | 1.05 |
| SAEP-A3 | 19226 | CB-99-02 | 1.88 | 5.17 |
| SAEP-A4 | 19227 | TP-99-10 | 3.02 | 10.8 |
| SAEP-A5 | 19228 | CB-99-11 | 0.8 | 0.91 |
| SAEP-A6 | 19229 | TP-DEP-11/12 | 28.3 | 80.7 |
| SAEP-A7 | 19230 | TP-DEP-15 | 11.2 | 68.5 |

Note:

CTDEP = Connecticut Department of Environmental Protection
See Appendix I For Full Results
See Figure 1-3 for Exploration Locations
*pCi*/g = picocuri per gram

**TABLE 6-4**
**SUMMARY OF ALLIED SIGNAL RADIOLOGICAL TESTING**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| ALLIED SIGNAL SAMPLE NUMBER | APPROXIMATE CORRESPONDING EXPLORATION LOCATION | NUCLIDE AND ACTIVITY IN pCi/g | | |
|---|---|---|---|---|
| | | TH-234 | TH-228 | RA-226 |
| AS-97 | CB-99-14 | 17.53 | 30.49 | 53.18 |
| AS-109 | TP-DEP-11/12 | 23.97 | 55.83 | 108.2 |
| AS-114 | TP-DEP-15 | 15.30 | 34.92 | 43.24 |
| AS-121-4 | CB-99-09 | NI | 68.05 | 14.56 |

Notes:

NI = not identified
pCi/g = picouri per gram
See Appendix I for full results
See Figure 1-3 for exploration locations.

**TABLE 6-5**
**SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - DIKE**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | DB-99-08 | | HA-99-03 | | HA-99-07 | | HA-99-08 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SAMPLE DEPTH (bgs) | 2-4 | | 0-1 | | 0-1 | | 0-1 | |
| | | SAMPLE COLLECTION | 9/14/99 | | 9/23/99 | | 9/23/99 | | 9/23/99 | |
| **Analyte** | **RSR Value** | **Units** | | | | | | | | |
| **VOCs** | | | | | | | | | | |
| 1,1-Dichloroethene | 1 | mg/kg | | | | | 12 | J | | |
| cis-1,2-Dichloroethene | 500 | mg/kg | | | | | 3,300 | | | |
| Tetrachloroethene | 12 | mg/kg | | | | | 1,200 | | | |
| Trichloroethene | 56 | mg/kg | | | | | 560 | | | |
| Vinyl Chloride | 0.32 | mg/kg | | | | | 36 | J | | |
| **SVOCs** | | | | | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | | | 13 | | | | | |
| Benzo(a)Pyrene | 1 | mg/kg | | | 13 | | | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | | | 9.9 | | | | | |
| Benzo(k)Fluoranthene | 8.4 | mg/kg | | | 12 | | | | | |
| bis(2-Ethylhexyl)Phthalate | 44 | mg/kg | | | | | 96 | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | | | 9 | | | | | |
| **PCBs** | | | | | | | | | | |
| Aroclor 1260 | 1 | mg/kg | 3.7 | | | | | | | |
| Arsenic | 10 | mg/kg | | | | | | | 15.7 | |

Notes:

DUP = duplicate sample

J = estimated values

mg/kg = milligram per kilogram

RSR = Remediation Standard Regulation

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

VOCs = volatile organic compounds

**TABLE 6-6**
**SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - DIKE**

**PRE-DESIGN INVESTIGATION REPORT**
**CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION**
**STRATFORD ARMY ENGINE PLANT**
**STRATFORD, CONNECTICUT**

| | | | HA-99-03 HA9903001XX 0-1 9/23/99 | | HA-99-07 HA9907001XX 0-1 9/23/99 | |
|---|---|---|---|---|---|---|
| | SAMPLE DEPTH (bgs) SAMPLE COLLECTION | | | | | |
| **Analyte** | **RSR Value** | **Units** | | | | |
| **VOCs** | | | | | | |
| 1,1,1-Trichloroethane | 40 | mg/kg | | | 340 | |
| 1,1-Dichloroethane | 14 | mg/kg | | | 120 | J |
| 1,1-Dichloroethene | 1.4 | mg/kg | | | 12 | J |
| Benzene | 0.2 | mg/kg | | | 3.8 | J |
| cis-1,2-Dichloroethene | 14 | mg/kg | | | 3,300 | |
| Tetrachloroethene | 1 | mg/kg | | | 1,200 | |
| Toluene | 67 | mg/kg | | | 180 | J |
| Trichloroethene | 1 | mg/kg | | | 560 | |
| Vinyl Chloride | 0.4 | mg/kg | | | 36 | J |
| Xylene (total) | 19.5 | mg/kg | | | 26 | J |
| **SVOCs** | | | | | | |
| Benzo(a)Anthracene | 1 | mg/kg | 13 | | | |
| Benzo(a)Pyrene | 1 | mg/kg | 13 | | | |
| Benzo(b)Fluoranthene | 1 | mg/kg | 9.9 | | | |
| Benzo(k)Fluoranthene | 1 | mg/kg | 12 | | | |
| bis(2-Ethylhexyl)Phthalate | 11 | mg/kg | | | 96 | |
| Carbazole | 1 | mg/kg | 4.2 | | | |
| Chrysene | 1 | mg/kg | 14 | | | |
| Indeno(1,2,3-CD)Pyrene | 1 | mg/kg | 9 | | | |
| 2-Methylnaphthalene | 9.8 | mg/kg | | | 25 | |

Notes:

DUP = duplicate sample

J = estimated values

mg/kg = microgram per kilogram

RSR = Remediation Standard Regulation

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

VOCs = volatile organic compounds

# SECTION 2.0 OF URSGWCFS RI WORKPLAN

The description and history of the SAEP site has been divided into four categories: land use assessment; physical setting; ecological setting; and, site history. Each of these categories is described below.

## 2.1 LAND USE ASSESSMENT

### 2.1.1 SAEP Facility

SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (Figure 1). The plant lies on the borderline of the Bridgeport and Milford Quadrangles. Latitudinal and longitudinal coordinates of SAEP are approximately 41'-10' North and 73'-07' West.

SAEP consists of approximately 124 acres, of which about 76 acres are improved land and 48 acres are riparian rights. (A riparian right is a right of access to, or use of, the shore, bed, or water of land on the bank of a natural watercourse.) The 76 acres of improved land consist of 49 buildings, paved roadway and grounds, and five paved parking lots. Included in the improved land are an estimated 10 acres along the Housatonic River where fill was placed over tidal flats during the early development of SAEP. The 48 acres of riparian rights property consist of intertidal flats of the Housatonic River. An estimated 2 acres of this property comprise a causeway constructed in the 1930s to provide access to the river channel. A site map is provided in Figure 2.

The SAEP property is zoned light industrial. Since 1929, the SAEP site has been used for the development, manufacture, and assembly of aircraft or engines. A discussion of historical operations at SAEP is provided in Section 2.4. Access to SAEP is restricted with a perimeter fence and security guards. Boaters, fishermen, and shell fishers could potentially access unrestricted intertidal flats within SAEP property.

Future land use at the Site has been the subject of intensive study by the SAEP Local Redevelopment Authority (LRA). As reported in "SAEP Redevelopment Plan and Implementation Strategy and Homeless Assistance Submission," the preferred land use plan developed by the LRA includes the development of approximately 800,000 square feet of building space for office, research and development, and "flex space." In addition, 100,000 square feet of museum space and almost 16 acres of park land along the Housatonic River waterfront are proposed (SAEP LRA, 1997). A final decision regarding future use of the Site has not yet been attained.

### 2.1.2 Adjacent Land

SAEP is bounded by a paved parking lot and wetlands to the north; the Housatonic River to the east; an open field, a drainage channel, and small commercial businesses to the south; and hangar buildings, the Sikorsky Memorial Airport, several small businesses, and Frash Pond to the west.

Historically, land in the SAEP vicinity was used for agricultural and residential purposes. At present, local agricultural activities are minimal. The primary agricultural (aquaculture) activity in the area involves growing oysters in shallow waters of the Housatonic River. Oysters are

seeded in areas of the Housatonic River in the spring, collected in the fall, and placed in Long Island Sound to mature. The seed oyster beds are carefully managed by the State of Connecticut Department of Agriculture because of concerns regarding bioaccumulation of contaminants from the Housatonic River.

Land in the vicinity of SAEP is zoned light industrial, business, commercial, or residential. There are several businesses located west of Main Street, across from SAEP, including a small strip mall, several gas stations, and a restaurant.

SAEP is located about 3/4-mile southeast of Johnson Junior High School and Birdseye School.

Recreational facilities in the area include Short Beach Park and nearby public wildlife areas, including Nells Island and the Great Meadow Salt Marsh. SAEP is located about 1/2-mile northwest of Short Beach Park, which had over 80,000 users reported for the year 1991.

### 2.1.3 Local Demographics

The Greater Bridgeport Regional Planning Agency's population census of Stratford was 49,389 people in 1990. Slow population growth has been a trend in Stratford for nearly two decades, and the Connecticut Office of Policy and Management anticipates a continued slow or declining growth rate for Stratford through the end of the century, with a population projection of 48,650 for the year 2000, and 45,800 for the year 2010 (W-C, 1991).

The age of the population in Stratford is older than the state average. The town's median age in 1980 was 38.2, compared to 32 for the State of Connecticut. The Connecticut Office of Policy and Management anticipates the median age of Stratford to be 45.7 by the year 2010. Nearly 23 percent of Stratford's population had reached age 60 by 1980, compared to the state average of 17 percent.

The population of Stratford represents various races and nationalities. More than 8 percent of the 1980 population in Stratford was non-white. This compares closely to a non-white population of 9.9 percent for the State of Connecticut (W-C, 1991).

## 2.2 PHYSICAL SETTING

### 2.2.1 Topography

SAEP is located in the Western Highlands of Connecticut part of the New England Physiographic Province. The local area is part of a coastal belt of dissected hilly country that extends along the coast of Connecticut. The coastal belt is characterized by uplands that range from mean sea level (MSL) to 650 feet above MSL, with an irregular, rocky coastline. Within the coastal belt, hilltops slope southward at a rate of about 50 feet per mile. Topographic features in the area mostly trend in the north-south or northeast-southwest direction, reflecting the structural trends of the local bedrock (Flint, 1968).

SAEP is situated on the Stratford Point peninsula that extends into Long Island Sound. The peninsula is relatively flat with a slight slope toward the sound. Almost all the land at SAEP is less than 10 feet above MSL. The exception to this is a dike that was constructed along the

Housatonic River in 1951 for flood protection. SAEP is within the 100-year flood plain of the Housatonic River; wetland areas surround the plant.

### 2.2.2 Local Climate and Rainfall

The climate of the SAEP area is strongly influenced by a land-sea breeze, which is most pronounced from spring to early autumn. The sea breeze promotes air mixing that results in slightly higher amounts of precipitation and slightly cooler temperatures at SAEP than inland. The prevailing wind is from the southwest at an average speed of about 11 miles per hour.

Precipitation averages about 44 inches per year, with about 16 inches per year of snowfall. Average monthly temperatures range from a low of about 28 degrees Fahrenheit (°F) in January to a high of about 73°F in July. Detailed information on the monthly and annual climatic averages at SAEP is listed in Table 3-8 of the EBS (ABB-ES, 1996).

### 2.2.3 Surface Water Drainage

Surface water bodies in the site vicinity include: Long Island Sound, the Housatonic River, Frash Pond, and the Marine Basin and drainage channel (Figure 1). The coastal and marine surface waters have been classified by CDEP Water Quality Standard regulations as SC/SB (NUS, 1990). The SC indicates that the CDEP recognizes existing water quality problems in the coastal waters; however, the SB classification indicates CDEP's goal of improving the water quality conditions. Frash Pond is not currently classified. According to CDEP, unclassified surface waters default to an A classification, which designates the following water uses: potential drinking, agricultural, or industrial water supply; fish and wildlife habitat; and recreational.

Long Island Sound receives all of the region's drainage, in large part via the Housatonic River. Water discharges from the Housatonic River range from 40 to over 100,000 cubic feet per second (cfs) and average 3,000 cfs (USGS, 1989). Reported tidal levels for the Housatonic River at Stratford are:

| | |
|---|---|
| Low tide level | 0.8 feet MSL |
| Mean tide level | 2.9 feet MSL |
| High tide level | 5.5 feet MSL |

Most of the SAEP surface is paved or covered with buildings. Typical coefficients of runoff for paved surfaces range from 0.8 to 0.9 (i.e., 80 or 90 percent runoff), and runoff from building rooftops is expected to be equal, if not higher. Thus, runoff during storm events is heavy. Most of the precipitation that falls on SAEP is treated and drained to the Housatonic River; two exceptions are small roof areas of B-2 that drain to either Frash Pond or to the airport.

Runoff at SAEP is currently collected by one of a network of six storm drainage systems. Each of the storm drain systems is equipped with a pumping station because of the low elevation of the plant and proximity of the Housatonic River and Long Island Sound. Effluent from the storm drainage system is pumped through the Oil Abatement Treatment Plant (OATP), except in times of heavy precipitation, when some runoff is pumped directly to the Housatonic through individual outfalls.

Based on historical site photographs and plans, the Site once had a low-lying area at the head of the drainage channel that is connected to the Marine Basin (in the vicinity of B-3 and B-6). The drainage channel abuts a portion of the plant's property line (Figure 2).

SAEP is located within the 100-year flood plain of the Housatonic River (CDEP, 1979). The Site is partially protected from flooding by a dike that runs the entire length of the property abutting the Housatonic River; however, the dike is not tied into high ground, which would prevent floodwaters from going around the dike. The Site was flooded in 1951 when the Housatonic River flooded, and again in 1968.

## 2.2.4 Geology and Hydrogeology

### *2.2.4.1 Regional Geology and Hydrogeology*

The bedrock geology underlying SAEP is reported to consist of lower Ordovician age metamorphic schists, phyllites, and paragneisses of the Oronoque Member of the Derby Hill Schist (Fritts, 1965). Flint (1968) identifies these rocks as the Orange Formation. Exposures of bedrock do not occur in the SAEP vicinity. Borings made along the Housatonic River (Flint, 1968) and borings completed on-site (ESE, 1991) reportedly encountered bedrock at depths ranging from about 100 to 150 feet below the land surface.

Recent deposition of alluvium, estuarine, tidal marsh, beach sediments, and man-placed artificial fill occur along the Housatonic River. The surficial unconsolidated sediments reported near SAEP are Stratford Outwash, tidal marsh peat, and artificial fill (Flint, 1968; U.S. Department of Agriculture, 1981). Lordship Outwash sediments are found south of the SAEP (Flint, 1968).

Stratified drift, consisting of sorted sediments deposited in streams formed by the meltwater of glaciers, is the main water-bearing hydrogeologic unit in the site area. The stratified drift forms two depositional facies, known as ice-contact stratified drift and outwash (Flint, 1968). Ice-contact stratified drift is defined as "sediments deposited in streams and other bodies of water against, upon, beneath, or otherwise in immediate contact with melting glacier ice", and is characteristically poorly sorted, and contains irregular beds with large and abrupt changes in grain sizes ranging from clay to boulders. Conversely, outwash is defined as "sediments deposited by streams beyond the glacier, and free of any influence of buried ice", and is generally well sorted sand to fine gravel with lenticular beds.

Borings completed near the mouth of the Housatonic River encountered post-glacial estuarine mud unconformably overlying stratified drift at depths as great as 60 feet below MSL (Flint, 1968). The estuarine sediment is described as a gray mud consisting of silt and clay with organic matter. It has a maximum reported thickness of about 60 feet.

The tidal marsh and swamp deposits in the area consist of decayed plant matter, peat, and mixtures of silt and clay with high amounts of peat. These deposits may be as thick as 15 feet. The SAEP area is influenced by tidal marsh sediments deposited at and upstream from the mouths of tidal inlets (due to rise in sea level since the last glaciation and daily tides) that discharge to the ocean (Flint, 1968). Tidal marsh sediments consist of peat and very organic silt

or clay that form wedge-shaped deposits, which become thicker towards the ocean or mouth of the streams.

Stratford Outwash is found along the fringes of the Housatonic River and consists of well sorted sand with small amounts of gravel. Borings completed for the Washington Bridge (Highway 1, about 2 miles north of SAEP) encountered outwash sand underlying more recent alluvium, tidal marsh and swamp peat, and estuarine sediments to an elevation of about 115 feet below MSL (Flint, 1968). This indicates that the outwash had filled the entire valley of the Housatonic, but after extensive erosion by the river and rise in sea level, only remnants of the deposit remain. In some exposures along the Housatonic River north of the Site, the Stratford Outwash is found overlying ice-contact stratified drift (Flint, 1968).

### 2.2.4.2 Site Geology and Hydrogeology

The following assessment of the geology and hydrogeology at the SAEP is summarized from the Phase II Report (W-C, 1996) in which generalized geologic cross-sections were developed from previous engineering reports as well as from boring logs prepared as part of Phase I and Phase II Investigations conducted by W-C and presented in the Phase II Report (W-C, 1996). The cross-sections show that the shallow geology is characterized by four distinct units: fill material, estuarine silt, peat, and glacial deposits. These unconsolidated deposits overlie the bedrock unconformably. A description of these units and their distribution across the SAEP follows.

Fill

Fill material is found throughout most of the SAEP. Fill was used for road construction, site grading, and as foundation material for buildings. Fill material consists of fragments of concrete, brick, asphalt, wood, cinders, copper wire, and rebar. Fill in areas along the shoreline is reported to consist of materials hydraulically dredged from the Housatonic River. The composition of the fill is variable, but most of it is described as a granular material that was placed to promote drainage.

Fill also consists of glacial material deposited on the surface from cut-and-fill operations made during facility development between 1940 and 1960. The glacial fill material generally consists of brown medium to fine sand and gravelly sand.

The thickness of the fill is generally about 5 ft, although it may reach a thickness of up to 19 ft. The fill appears to thin somewhat with distance away from the river. This may be a result of more extensive historical filling operations along the river in order to bring the shoreline up to grade with the rest of the Site.

Estuarine Silt

A thick silt deposit underlies the fill at the northern edge of the facility along the Housatonic River. This deposit consists of black organic silt containing occasional shell and sand layers. This material is an estuarine sediment deposited by the Housatonic River and subsequently topped with fill (both artificial and glacial fill) during enlargement of the facility property.

This silt stretches from piezometer PZ-7D (northeastern corner of building B-2) eastward to monitoring well MW-4 (just south of the Causeway) at a depth of approximately 1 to 9 ft below

sea level (8 to 15 feet below ground surface). The thickness of the estuarine silt layer ranges from 2 ft to 30 ft and it extends landward 150 to 250 ft. The silt layer is thickest at location piezometer PZ-5D (30 ft deep at Building B-37) and pinches out at the edges near piezometer PZ-7D (northeast corner of Building B-2) and monitoring well MW-4 (just south of the Causeway).

**Peat**

A deposit of brown and black peat with some organic silt was encountered in the eastern portion of the SAEP in the vicinity of the former lagoons (impoundment area). It's extent is roughly circular which indicates that it was probably formed by a marsh or swamp. Older USGS quadrangle maps show that this area was formerly a tidal marsh that was subsequently filled. In the former lagoon area, the peat forms a continuous concave layer, approximately 7 ft thick which deepens to the west - northwest. The peat lies directly beneath fill material in this area at depths ranging from 3 to 20 ft bgs. Portions of the upper peat layer may have been excavated prior to fill placement.

Peat material was also encountered at the location of monitoring well WC-8S (at Building B-8) and monitoring well WC-2D (just south of the Causeway) at depths of 5 ft bgs and 30 ft bgs and thicknesses of 2 ft and 5 ft respectively. These two peat deposits are apparently small, isolated pockets and are not a part of the continuous deposit in the lagoon area.

**Glacial Sediments**

A thick deposit of glacial sediments underlies the fill, estuarine silt, and peat deposits at the Site, and unconformably overlies the bedrock. The total thickness of the glacial sediments is between 148 ft and 156 ft thick, based on boring logs from monitoring wells WC-9D2, WC-20D2 and WC-21D2 (generally off-site to the west of the SAEP) installed during Phase II. The glacial deposits consist of sands, silty sands, and gravelly sands with occasional boulders and varved silt. The glacial deposits can be generally grouped into three layers: 1) a layer of gray to brown, medium to coarse sand with varying amounts of gravel, underlain by 2) light to medium-brown, medium to fine sand and silty sand with occasional clay stringers, followed by 3) another layer of brown to gray sand and gravel immediately above the bedrock.

There are variations in this general sequence, however. For example, in the eastern portion of the Site, a silty sand layer overlies the first layer of sand and gravel and a distinct gravel deposit, approximately 2 to 5 ft thick, is locally extensive in the vicinity of piezometer PZ-13D (near Building B-4), and monitoring wells WC-2D and WC-3S (both near the Causeway).

A glacial varved silt unit had been reported to occur only locally in the vicinity of Building B-65 (Haley and Aldrich, 1987). Varved silt layers were encountered at a depth of 60 ft bgs in monitoring well WC-9D2 and are described as 2 millimeter bands of red clay interlayered with orange sand layers. At other depths in monitoring well WC-9D2 (northwest corner of Building B-2) and in monitoring well WC-20D2 (off-site to the west of Building B-2) red clay stringers were observed. It is unclear as to whether the red clay stringers represent a portion of a larger varved sequence.

Bedrock

A competent amphibole-mica schist bedrock was reported at monitoring well locations LW-5D, LW-9D and LW-10D (in the vicinity of the former lagoons south of the main Plan) at depths of 163 ft, 151.5 ft, and 103 ft below grade, respectively. Bedrock was encountered at three locations during the drilling of Phase II monitoring wells WC-9D2, WC-20D2 and WC-21D2 (generally off-site the west of SAEP); at respective depths of 156 ft, 150 ft and 148 ft below grade. The bedrock is described as a black schist with greenstone.

A nineteenth century report of massive serpentinite consisting of antigorite with accessory magnetite and carbonate was reported at the SAEP (Crowley, 1968). No contemporary confirmation of this report exists.

If the locally N35oE trending trace of the Mixville Fault (Flint, 1968) is extrapolated to the southwest (Rodgers, 1985), across the Housatonic River, it would pass directly under the SAEP. However, there is no confirmation of the existence of this fault southwest of its mapped terminus.

Hydrogeology

During Phase I and Phase II investigations, shallow and intermediate wells were installed at the water table and 30 to 50 ft below the ground surface in the overburden aquifer, respectively. Deep overburden wells were screened just above the bedrock. Data from these monitoring wells, as well as from monitoring wells previously installed at SAEP, established an easterly groundwater flow direction towards the Housatonic River, a northwesterly flow towards Frash Pond, and flow toward the drainage channel in the southern portion of SAEP. There may be a groundwater divide and buried tidal inlets on SAEP, and other buried outlets from Frash Pond may pass under SAEP (Envirosphere, 1984). These types of features appear to be a factor controlling groundwater movement patterns and fate of potential contaminants. Very little flow reversal, as related to tidal influences, were measured. Groundwater contour maps are presented in the Phase II Report (W-C, 1996).

Groundwater flow at the SAEP facility is influenced by three surface water features. The primary influence is that of the intertidal flats. Groundwater flow in the northern half of the facility is in the direction of the intertidal flats at low tide. An average low tide hydraulic gradient was calculated to be 0.0012 for both the shallow and intermediate portions of the aquifer. Because the incoming tide exerts pressure on the water table aquifer, the hydraulic gradients at high tide will be lower than those at low tide.

A second surface water body influencing the groundwater flow at the facility is Frash Pond, located approximately 300 feet from the northwest corner of the facility. Frash Pond appears to be located downgradient of the northwest portion of the SAEP facility. The airport, as well as other off-site properties, are also located upgradient of Frash Pond. Water elevations measured in monitoring wells suggest that groundwater from off-site locations south and west of the SAEP are flowing toward the SAEP. Average groundwater hydraulic gradients in the direction of Frash Pond were calculated to be 0.0012 for the shallow wells and 0.0018 for the intermediate wells in the vicinity of the pond.

The third surface water body influencing the groundwater flow at the facility is the drainage channel located in the southern portion of the SAEP. The presence of groundwater mounds in the shallow portion of the aquifer in this area of the facility is due to the existence of a peat layer that causes a perched water condition above the peat. An average hydraulic gradient in the direction of the drainage channel was calculated to be 0.0073 for the shallow portion of the aquifer above the peat and 0.0018 for the intermediate portion of the aquifer below the peat layer. The area of the facility influenced by groundwater flow to the drainage channel is limited to the lagoon area in the vicinity of the channel.

Hydraulic conductivities calculated from slug tests performed in Phase II investigation monitoring wells indicate that hydraulic conductivities are generally from 12 to 15 feet per day (ft/day) for shallow wells, 0.01 to 2.7 ft/day for intermediate wells and 2.5 to 6.0 ft/day for deep wells.

## 2.3 ECOLOGICAL SETTING

This section of the RIWP describes the ecological resources on and in the vicinity of SAEP. For the purposes of the RI, ecological habitats are present at the following three areas:

- Intertidal Mudflats;
- Marine Basin/Outfall 008 area; and,
- Causeway.

Information on critical habitats and wetland areas in the vicinity is also summarized. Much of the information in this section is summarized from Section 2.0 of the Phase II investigation Work Plan (W-C, 1994) and the Draft Baseline Ecological Risk Assessment for the SAEP (W-C, 1996). These documents should be consulted for more detailed information and discussion of the area.

### 2.3.1 Surface Water Bodies

The SAEP is located on the tidal portion of the Housatonic River less than one mile upstream from the Long Island Sound (Figure 1). As such, the habitats and biota which occur in the site vicinity are largely dictated by diurnal fluctuations in water level, salinity and surface water chemistry, and are influenced by the Sound. The Housatonic River is approximately one quarter mile wide in the site vicinity and conveys most of the region's drainage to the Long Island Sound. Currents in the river proper are variable in this area due to the fluctuating tides.

In the tidal mudflat area adjacent to the Site, local currents flow toward land into the sheltered cove on a flooding tide. In the absence of current on a slack tide, suspended fine sediments settle out of the water column and contribute to the sediment accumulation in the mudflat area. The mudflat is exposed twice daily at low tide when all water recedes from the area except for flow in several rivulets near the outfalls.

Marine Basin is located about 1,000 feet southeast of SAEP on the Housatonic River (Figure 1). It is a shallow, permanently inundated, tidal embayment which receives some drainage from the drainage into which Outfall 008 feeds, but mostly from the Housatonic River.

### 2.3.2 Surface Water Chemistry

Characterization of surface water chemistry in the vicinity of the SAEP site is based on data collected as part of the previous investigations at the Site (W-C, 1993). Generally, surface water pH ranged from 7.4 to 8.5, and was typically approximately 8.1. Similarly, salinity ranged from 11.8 parts per thousand (ppt) to 27 ppt, typical of estuarine waters. Conductivity ranged from 14,500 umhos to 33,000 umhos.

Surface water temperatures at the time of sampling ranged from 10.5 degrees Celsius to 25.0 degrees C. Most values were in the low 20s degrees C. Temperatures were approximately five to ten degrees lower at the tidal flat and intertidal background locations than at the tidal flat outfall locations and at Outfall 008.

### 2.3.3 Intertidal Mudflats

The intertidal mudflats adjacent to the SAEP are a generally level to gently sloping area that is subject to alternating periods of tidal inundation and exposure. Sediments in the mudflats are primarily fine silt and mud transported from the Housatonic River and deposited here. The mudflats are nutrient enriched and support populations of macroinvertebrates which are important food sources for fish and shorebirds. The northwest portion of the mudflats support some emergent vegetation. The following paragraphs describe biota which utilize the Intertidal Mudflat for habitat and feeding.

#### *2.3.3.1 Benthos*

The intertidal mudflats adjacent to the SAEP provide a nutrient rich habitat for a variety of invertebrate forms. Information on indigenous benthic fauna in the vicinity of the SAEP site is based on extensive data collected in December 1994 as part of the Phase II effort and a field reconnaissance performed in May 1995 (W-C, 1996).

A total of 49 different macroinvertebrate taxa occur in the site vicinity. The taxa present are common to estuarine systems, with polychaetes (especially Streblospio benedicti, which was present at all stations) and oligochaetes predominating. As a group, deposit-feeding oligochaetes, and polychaetes were by far the dominant component of all samples. Individually, oligochaete densities ranged from 2 to 67 percent, and polychaetes from 26 to 97 percent of the total number of individuals at all stations sampled.

At most stations, Streblospio benedicti was the dominant polychaete. Its presence alone accounted for 12 to 89 percent of all individuals at the ten mud flat stations. At five locations, the capitellid, Mediomastus ambiseta, exceeded or equaled the Streblospio densities. Amphipods were recovered from most stations. The most common species were Leptocheirus plumulosus and Gammarus palustris. Similarly, molluscs, usually Littorina sp. juveniles (a gastropod), or Gemma gemma (a bivalve), were present in most samples.

In addition to the infaunal invertebrates described above, the site vicinity supports dense beds of oysters. Although Crassostrea virginica, the Eastern oyster, is the primary species of shellfish harvested from the area, other shellfish that are fished for include the hard clam (quahog), bay scallop, soft-shelled clam, blue mussel, and razor clam. Observations were made of benthic

macroinvertebrates inhabiting the rocky intertidal zone around the mudflats which has formed as a result of rip-rap placement. The following species were observed on the rocky intertidal zone: Ovalipes ocellatus (calico crab), Mytilus edulis (blue mussel), Modiolus demissus (ribbed mussel), Mercenaria mercenaria (hard clam), and Squilla empusa (mantis shrimp).

#### *2.3.3.2 Fish*

A number of fish species are common to the Long Island Sound and Housatonic River in the vicinity of the SAEP. The principal species include: Atlantic herring (Clupeas harengus), American shad (Alosa sapidissima), Atlantic silverside (Menidia menidia), mummichog (Fundulus heteroclitus), American eel (Anguilla rostrata), winter flounder (Pseudopleuronectes americanus), bluefish (Potamus saltatrix), and tautog (Tautoga onitis).

The mudflats adjacent to the SAEP site do not represent an important fish habitat owing largely to the hydrology in this area. At low tide, virtually all of the surface water recedes out of the area for several hours. Hence, at best, this area represents an intermittent feeding habitat for fish such as silversides and other omnivorous species feeding on small crustaceans, worms, and insects.

#### *2.3.3.3 Avifauna*

There have been approximately 220 bird species observed in the site area (W-C, 1991). Shore birds and waterfowl constitute the majority of bird life in the SAEP vicinity. The wetlands near SAEP are known breeding grounds for transitory birds such as the great egret (Casmerodius albus), snowy egret (Nyctanassa vidacea), black-crowned night heron (Nycticorax nycticorax), glossy ibis (Plegadis falcinellus), and fish crow (Corvus ossifragus).

Two bird species that nest in the general vicinity of the Site are the least tern (Sterna antillarum) and piping plover (Charadrius melodus). Both species would use tidal marshes as feeding areas during the breeding season.

During the field reconnaissance of the Site performed in May 1995 (W-C, 1996), a variety of species were observed from the Site including: great blue heron (Ardea herodias), American black ducks (Anas rubripes), sandpipers or "peeps" (Calidris sp.), herring gull (Larus argentatus), and mute swans (Cygnus olor).

The United States Fish and Wildlife Service (USF&WS) conducted bird surveys in the vicinity of the Site in 1997. Results of these recent surveys will be included in the RI report.

### 2.3.4 Marine Basin/Outfall 008 Area

SAEP Outfall 008 discharges into a drainageway which travels several hundred feet to its confluence with the Marine Basin. The channel of the "008 drainageway" is approximately 10 to 12 feet wide and generally less than 2 feet deep. The downstream portion is tidally influenced. The adjacent land area is generally disturbed and vegetated primarily with Phragmites. While documentation is somewhat limited, the drainageway is generally low quality habitat based on visual observation and sediment chemical and benthic community data.

Marine Basin is a tidal, permanently inundated shallow embayment surrounded primarily by stands of Phragmites. Little, if any, emergent vegetation exists. Benthic macroinvertebrates which colonize the Basin likely represent typical estuarine communities observed in the Intertidal Mudflat.

### 2.3.5 The Causeway

Due to the industrial nature of the SAEP site, there is no terrestrial habitat on the Site with the exception of the limited area on top of the Causeway. Where vegetated, the surface of the Causeway is primarily covered with herbaceous species, limited scrubby vegetation and several trees. Species observed include: clover, ragweed (Ambrosia sp.), jewelweed (Impatiens sp.), smartweed (Polygonum sp.), several tree of heaven (Ailanthus altissima), and willow (Salix sp.). This area is small, one to two acres in size, and does not represent valuable habitat. Since it is isolated from other nondeveloped areas and generally disturbed, it provides limited habitat, at best, to biota. Terrestrial species which may use the Causeway from time to time are likely to include some birds and small rodents which inhabit other disturbed lots in this portion of Stratford.

### 2.3.6 Critical Habitats and Species

Critical habitats in the vicinity of the Site include extensive tracts of salt marshes, saltwater intertidal flats and shores, and coastal sand dunes which provide habitat for a variety of biota. The intertidal mudflats in the vicinity of SAEP are located in a band along the shoreline of the Housatonic River and Long Island Sound. SAEP's riparian rights encompass the intertidal mudflats area. Plant life in the vicinity of SAEP is limited to the tidal marshes.

The tidal marsh plant life consists primarily of soft-stemmed plants such as sedges, rushes, and grasses. Cordgrass (Spartina patens) and common reed (Phragmites) are the dominant species in the marshes. A number of southeastern Piedmont and Coastal Plain plant species reach their northern native range limits in this region.

Tidal marshes provide habitat for mammals such as rodents and insectivores. The primary mammal species include muskrats (Ondatra zibethica), cottontail (Sylvilagus sp.), and raccoons (Procyon lotor). Cordgrass provides an ideal forage and building material for muskrats. Raccoons feed on crustaceans and small rodents.

A detailed description of the federal- and state-listed threatened, endangered, or special concern species that have the potential to occur in the vicinity of SAEP and the status of each is provided in the Preliminary Assessment Screening (W-C, 1991). A list of these species is provided in Table 3-3 of the Preliminary Assessment Screening (additional information from the field reconnaissance and recent U.S. Fish and Wildlife Service survey will be included in the RI report).

No federally listed threatened or endangered plant species have been reported to occur in the vicinity of the SAEP with the exception of the New England Blazing Star (Liatris borealis), which is a candidate for the list. Two federally-listed and an additional 14 state-listed threatened,

endangered or special concern birds have the potential to occur in the vicinity of the SAEP. The two federally-listed species include the piping plover and the Roseate tern.

The piping plover nests in the vicinity of the SAEP; nesting habitat is located on Short Beach, Long Beach, and Milford Point. These areas are extremely important to the continued survival of the piping plover and select areas of these beaches are closed to public activity during the nesting and rearing period. These beach areas utilized as nesting habitat by the piping plover are probably used by the least tern also, which is a state-listed threatened species.

## 2.4 SITE HISTORY

### 2.4.1 Operational History

The SAEP site has been used for development, manufacture, and assembly of aircraft or engines since 1929. The plant history has been categorized into the following periods:

1929 to 1939: Sikorsky Aero Engineering Corporation developed and manufactured sea planes at the Stratford plant.

1939 to 1948: Chance Vought Aircraft located its operations at the Stratford plant in 1939, and the company became known as Vought-Sikorsky Aircraft Division. Sikorsky developed the helicopter and left the plant in 1943 because of overcrowding. Chance Vought developed the "Corsair" for the U.S. Navy, and mass produced Corsairs during World War II. Chance Vought vacated the Stratford plant in 1948.

1948 to 1951: The Stratford plant was idle.

1951 to 1976: The U.S. Air Force procured the Stratford plant in 1951 and named it Air Force Plant No. 43. The Avco Corporation (AVCO) was contracted by the Air Force to operate the plant. AVCO manufactured radial engines for aircraft in the 1950s, and developed and manufactured turbine engines, primarily for aircraft, in the 1960s and 1970s.

1976 to Present: The plant was transferred from the U.S. Air Force to the U.S. Army in 1976. At that time, the plant was re-named the Stratford Army Engine Plant, although it continued under AVCO operations. AVCO was contracted by the Army to develop the AGT-1500 engine to power the Abrams tank. AVCO also developed and manufactured marine and industrial engines. AVCO merged with Textron in December 1985, and subsequently formed the Textron Lycoming Stratford Division. The contract for operation of SAEP was transferred from Textron Lycoming to Allied-Signal in 1994. Allied-Signal continued to develop, manufactured and test turbine engines at SAEP for both military and commercial aircraft and land vehicles until 1997. Since the cessation of Allied-Signal operations, the focus of activities at SAEP has been completion of an environmental assessment of the Site and the potential for re-development.

1986 or 1987: Historical state order issued to AVCO Lycoming regarding RCRA groundwater monitoring in the lagoon area.

### 2.4.2 Waste Disposal

The primary types of industrial waste generated at SAEP prior to the 1950s are reported to have been waste oils, fuels, solvents, and paints (W-C, 1991). Since 1951, most of the wastes generated at SAEP have resulted from engine production operations such as plating, metal working, and finishing, as well as cleaning operations. Wastes were also generated as a result of engine and engine component testing, research and development, raw materials testing, vehicle and other maintenance, and on-site waste treatment.

### 2.4.3 Environmental Regulatory Compliance

The EBS (ABB-ES, 1996) contains a review of SAEP's environmental compliance history and permit status, its current compliance status, and future compliance issues. Specifically, the EBS assesses SAEP in relation to: Resource Conservation and Recovery Act (RCRA); CERCLA; Emergency Planning and Community Right-to-Know (SARA Title III); Clean Water Act; Clean Air Act (CAA); Toxic Substances Control Act (TSCA); Safe Drinking Water Act; Federal Insecticide, Fungicide and Rodenticide Act; endangered species; radioactive materials; and, National Environmental Policy Act (NEPA). The EBS noted that SAEP has experienced some violations in the past, but, as of December 1996, was in compliance with environmental regulations (ABB-ES, 1996).

The EBS identified the following recorded deficiencies in hazardous waste management practices at SAEP.

- Manifest warning letters for deficiencies in completion of hazardous waste manifests. Deficiencies included missing analytical results, transporter name or identification (ID) number, manifest document numbers, waste ID numbers, and waste quantities; un-specified container type; incorrect USEPA generator ID number; point of departure from the United States not specified for international shipments; failure to sign and date manifest; illegible manifest; and failure to respond to manifest warning letter. To the best of SAEP's knowledge, all prior warning letters were resolved.
- Warning letters issued by CDEP for failure to submit hazardous waste biennial reports on a timely basis or submission of an unacceptable report. SAEP subsequently submitted acceptable reports.
- Several orders issued by CDEP to bring SAEP into compliance with RCRA hazardous waste management regulations. For example, updating the site contingency plan, waste analysis plan, and preparedness and prevention plan.
- Order issued by CDEP to make modifications to OATP in order to bring Outfall 007 into compliance with the National Pollutant Discharge Elimination System (NPDES) permit by "proper treatment of oily wastewaters." SAEP reportedly complied with this order.
- Records indicate that frequent and severe violations of NPDES permit limitations (i.e., effluent concentrations more than five times the permit limit) occurred prior to the mid-1980s. In a Consent Decree dated April 10, 1984, SAEP agreed to use "best reasonable efforts" to achieve compliance with the permit and to complete upgrading

of the Chemical Wastewater Treatment Plant (CWTP). Violations have occurred since that time less frequently and with less severity. Since November 1994, the only violation has been associated with the failure to meet aquatic toxicity criteria. Upon retesting of the sample, the parameter in question was found to be in compliance.

- Inspection reports indicate occasional violations of CAA requirements such as: fumes escaping from vapor degreasers; failure to notify CDEP of modifications to or additions of processes that could increase emissions; and, excess emissions of chromic acid.
- In response to findings that SAEP failed to maintain adequate inspection and maintenance records for 20 polychlorinated biphenyls (PCBs) transformers in accordance with TSCA, SAEP agreed to subsequently ensure that transformers would be inspected and that records of inspections and maintenance history of the transformers would be maintained.
- SAEP does not appear to be in compliance with the requirement of NEPA that environmental evaluations be conducted prior to beginning construction projects since 1970.

The EBS also identified several spills of hazardous materials that resulted in discharges to surface water in the SAEP site vicinity.

October 29, 1981: Approximately 20 gallons of fluorescent metal penetrant, a dye used for nondestructive inspection of metal parts, was spilled into a storm drain and discharge from Outfall 007.

July 29, 1979: Approximately 75 gallons of oil sludge from the OATP bypassed clogged skimmers and discharged from Outfall 007. SAEP was notified of the problem by the U.S. Coast Guard, which was searching for the source of an oil slick on the Housatonic River. (SAEP was apparently the sole source.)

May 8, 1978: Twenty-five to 30 pounds of chromic acid was spilled, and most flushed into a storm drain. About 50,000 gallons of diluted acid was intercepted in the drain and pumped into a holding tank. Remaining pools of the diluted acid were pumped to the CWTP. Acid that was not intercepted or contained was discharged to the Housatonic River from Outfall 007. Chromium concentrations of effluent from Outfall 007 were measured at 30 milligrams per liter (mg/l) on May 8, 1978, 2.5 mg/l on May 10, 1978, and were not detectable by May 11, 1978.

August 1978: CDEP was advised by SAEP that a yellow plume with a pH of 2.9 and 64 parts per million (ppm) of hexavalent chromium was extending approximately 200 yards from Outfall 007 into the Housatonic River (CDM, 1992).

No records of enforcement actions or fines relating to these releases were found or reported in the EBS.

# BORING LOGS

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: CB-99-01 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: Mod. D | |
| Contractor: NFE | Date Started: 9-30-99 | Completed: 9-30-99 | |
| Method: HSA | Casing Size: 4 1/4" | PI Meter: TE 580 B | |
| Ground Elev.: 10.4 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. Noonan F.W. | Checked by: T. Loyley HLA&B | ▽ Below Ground: ~10' | |
| Screen: (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0' | CB990102XX | 24" | 9.0 | BROWN MED.-TO COARSE SAND AND GRAVEL DAMP (SW) | | 12 | | | |
| 2 | | 2' | | | | ALL FILL | | 15 | | | |
| 3 | | | | | | 3" S. Spoon 13:30 | | 13 | | | |
| 4 | | | | | | | | 13 | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | 0 | — | NO SAMPLE - Auger Refusal to 9' TAKE 9'-11" Sample | | 100/5" | | | |
| 9 | | | | | | ALL FILL (SW) 13:45 | | | | | |
| 10 | S-2 | | CB990101KX | 14" | 6.7 | Brown-to-Black, Fine-to-med. SAND, wet, Sl. plastic W/GRAVEL, ANGULAR Fn-to-med. wet 2" S. Spoon | | 49 34 17 13 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: CB-99-02 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: Mod. D | |
| Contractor: NFE | Date Started: 9-20-99 | Completed: 9-20-99 | |
| Method: HSA | Casing Size: 4¼" | PI Meter: TE 580B | |
| Ground Elev.: 6-2 | Soil Drilled: 7' | Total Depth: 7' | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: ~5' | |
| Screen: / (ft.) | Riser: / (ft.) Diam: / (ID) Material: / | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB9902002XX | 20" | 1.2 | Brown, F.-to-Med. SAND Moist, SL. PLASTIC, W/ Some GRAVEL TO 2½", W/ Concrete pieces ALL FILL (SP) | | 9 | | | |
| 2 | | | | | | 3" SPOON 14:35 | | 11 | | | |
| 3 | | | | | | COLLECTED MS & MSD AT CB9902002XX | | 10 | | | |
| 4 | | | | | | | | 13 | | | |
| 5 | S-2 | 5'-7' | CB9902007XX | 24" | 135.9 | BR. F.-to-med. SAND W/ Little F-to-med. GRAVEL, WET, NO Headspace over, DK. BRN. to Black Fine SAND W/ Some Med. SAND, Some GRAVEL, Some organic matter, wet, slight odor, W/ 2" piece of cored Asphalt. (SP) | | 14 | | | |
| 6 | | | | | | | | 17 | | | |
| 7 | | | | | | ALL FILL Used 3" SPOON 14:45 | | 13 | | | |
| 8 | | | | | | | | 8 | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: CB-99-03 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-20-99 | Completed: 9-20-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: TE 580 B | |
| Ground Elev.: 6.9 | Soil Drilled: 6' | Total Depth: 6' | |
| Logged by: B. NOONAN | Checked by: T. Longley | ▽ Below Ground: ~7' | |
| Screen: – (ft.) | Riser: – (ft.) | Diam: – (ID) | Material: – |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | CB99030044XX | 15" | 5.6 | TAN-TO-BROWN FINE SAND W/ SOME MED. SAND, TRACE GRAVEL, DAMP, NON-PLASTIC ALL FILL (SP) 15:00 COLLECTED SAMPLE + DUPLICATE | | 5 7 9 18 | | | |
| 4 | | | | | | | | | | | |
| 5 | S-2 | 4'-6' | CB99030066XX | 24" | 3.5 18.1 | BROWN MED. COARSE SAND MOIST OVER DK. BR. FINE SAND, W/ TRACE GRAVEL, SL. PLASTIC, OVER (SP) FINE SAND ? SILT, SL. PLASTIC (SP/SM) STRONG ODOR, SOME VISIBLE PRODUCT ? METAL SHAVINGS AT BASE. ALSO ORGANIC MATTER (PT) ALL FILL ON TOP OF PEAT AT BOTTOM OF SPOON | PT. | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-20-99 | Boring No.: CB-99-04 | |
| Method: HSA | Casing Size: 4.25" | Protection: MoD. D | |
| Ground Elev.: 7.9 | Soil Drilled: 7' | Completed: 9-20-99 | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | PI Meter: 580 B OVM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Total Depth: 7' | |
| | | ▽ Below Ground: ~7' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB9904003-XX | 20" | 4.5 | BROWN SORTED FINE SAND, W/ TRACE GRAVEL, TOP 4" W/ ROOTS, DAMP ALL FILL (SP) 3" SPOON 16:05 | | 2<br>5<br>11<br>13 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | S-2 | 5'-7' | CB9904007-XX | 8" | >1024 | BROWN, MEDIUM WELL-SORTED SAND, MOIST OVER BLACK FINE SAND W/ SOME SILT & TRACE FINE GRAVEL, STRONG ODOR, MOIST 2" SPOON ALL FILL (SP) 16:15 | | 11<br>18<br>12<br>17 | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | NO PID - POURING RAIN | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

| ABBREVIATIONS | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | | Study Area: Dike/Causeway |
| | | | Boring No.: CB-99-05 |
| Contractor: NFE | Date Started: 9-21-99 | | Protection: MOD. D. |
| Method: HSA | Casing Size: 4.25" | | Completed: 9-21-99 |
| Ground Elev.: 6.2 | Soil Drilled: 6' | | PI Meter: 580 B OVM |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | | Total Depth: 6 |
| | | | ▽ Below Ground: ~6' |
| Screen: — (ft.) Riser: — (ft.) | Diam: — (ID) | Material: — | Page 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB990502XX | 22" | | GRAVEL, Fine-to-Med. ANGULAR W/ Concrete & Debris, SOME VEGETATION, some SAND & SILT ALL FILL (GW) 3" Spoon 08:30 | | 19 | | | |
| 2 | | | | | | | | 74 | | | |
| 3 | | | | | | | | 91 | | | |
| 4 | | | | | | | | 69 | | | |
| 5 | S-2 | 4'-6' | CB990502XX | 19" | | 4" SAME AS ABOVE then 15" BROWN MED, SAND, (GW) well-sorted W/ TRACE GRAVEL FILL (SP) 3" Spoon 08:45 | | 8 | | | |
| 6 | | | | | | | | 13 | | | |
| 7 | | | | | | | | 10 | | | |
| 8 | | | | | | | | 14 | | | |
| 9 | | | | | | NO PID - POURING RAIN | | | | | |
| 10 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | CB-99-07 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | MOD. D |
| Contractor: NFE | Date Started: 9-21-99 | Completed: | 9-21-99 |
| Method: HSA. | Casing Size: 4.25" | PI Meter: | 580 BOVM |
| Ground Elev.: 6 | Soil Drilled: 6' | Total Depth: | 6' |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: | ~ 6' |
| Screen: — (ft.) Riser: — (ft.) Diam: — (ID) Material: — | | Page | 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB990700?XX | 20" | | BRN. FN-TO-MED. SAND, WELL SORTED, W/ TRACE GRAVEL OVER ~ 5" GRAVEL, MED, ANGULAR (GP) (GP) 3" Spoon w/ Duplicate sample 09:10 | | 1<br>2<br>11<br>20 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | S-2 | 4'-6' | CB990700?XX | 16" | | SAND & GRAVEL, FINE-TO-COARSE, ANGULAR FILL GP 09:25 | | 11<br>85<br>100/6 | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | NO PID - POURING RAIN | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-21-99 | Boring No.: CB-99-08 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 6.2 | Soil Drilled: 5' | Completed: 9-21-99 | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | PI Meter: 580 BORM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Total Depth: 5 | |
| | | ▽ Below Ground: 5-6 | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 1'-3' | CB990803XX | | | BROWN-TO-BLACK SAND, FINE-TO-COARSE GRAINED & GRAVEL, FINE-TO-COARSE SAND, ANGULAR - LOOKS BURNED THROUGH A 3" ZONE, DAMP FILL (SW) DUPLICATE SAMPLE 3" SPOON 09:55 | | 28 | | | |
| 2 | | | | | | | | 69 | | | |
| 3 | | | | | | | | 40 | | | |
| 4 | S-2 | 3'-5' | CB990805XX | 12" | | BLACK GRAVEL AND SAND OVER 3" BROWN, MED. WELL SORTED SAND, DAMP, NO ODOR, NO RADIATION 2" SPOON FILL (SW/GW) THEN (SP) 10:10 | | 75 | | | |
| 5 | | | | | | | | 37 | | | |
| 6 | | | | | | | | 32 | | | |
| 7 | | | | | | | | 16 | | | |
| 8 | | | | | | NO PID - POURING RAIN | | 14 | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: CB-99-09 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: Mod. D | |
| Contractor: NFE | Date Started: 9-23-99 | Completed: 9-23-99 | |
| Method: H.S.A. | Casing Size: | PI Meter: 580 B OVM | |
| Ground Elev.: 8.6 | Soil Drilled: 102' | Total Depth: 102' | |
| Logged by: B. NOONAN | Checked by: T. Longley | ▽ Below Ground: ~9' | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Page 1 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB490903XX | 24" | 1.3 | 12" brown SAND, medium-to-fine, w/ 2" piece of concrete FILL (SP) | | 2 7 18 15 | | | |
| 2 | | | | | 30.1 | 2" core of asphalt<br>10" brown SAND, medium-to-fine, well sorted<br>3" spoon Strong odor 07:30 | | | | | |
| 3 | | | | | | | | | | | |
| ≷ | | | | | 14.4 | ON CUTTINGS | | | | | |
| 10 | S-2 | 10'-12' | CB490912XX | 12" | 2.6 | 10" black SAND, fine-to-coarse, Angular w/ concrete chips, wet fill (SW) FILL | | 5 15 | | | |
| 11 | | | | | | 2" dark gray SILT, NATIVE w/ very fine SAND, micaceous, plastic, soft, well sorted 2" spoon 08:00 | ML | 2 1 | | | |
| 12 | | | | | | | | | | | |
| ≷ | | | | | | | | | | | |
| 20 | S-3 | 20'-22' | CB490922XX | 8" | 1.3 | dark brown SILT & very fine SAND same as above, sulfur odor, trace of fine gravel 2" Spoon (TIDAL FLAT deposits?) 08:30 | ML/MH | WOH/12 | | | |
| 21 | | | | | | | | 1 | | | |
| 22 | | | | | | | | 1 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| | | Boring No.: CB-99-09 | |
| Contractor: NFE | Date Started: 9-23-99 | Protection: MOD. D | |
| Method: H.S.A. | Casing Size: | Completed: 9-23-99 | |
| Ground Elev.: 8.6 | Soil Drilled: 102' | PI Meter: 580 B OVM | |
| Logged by: B. NOONAN | Checked by: T. Longley | Total Depth: 102' | |
| Screen: (ft.) Riser: (ft.) Diam: (ID) Material: | | ▽ Below Ground: 9' | |
| | | Page 2 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | | | | | | dark brown SILT, plastic, sticky, micaceous, strong sulfur odor, trace vegetation, will not yield water | MH | 1 | | | |
| 31 | S-4 | 30'-32' | | 24" | 15.2 | 2" Spoon 09:15 | | 0 | | | |
| 32 | | | | | | | | 1 | | | |
| ≈ | | | | | | | | 1 | | | |
| 40 | | | | | | dark brown SILT, slightly plastic | | WOH/12 | | | |
| 41 | S-5 | 40'-42' | CB990904 XX | 24" | 0.0 | Less plastic than above, trace vegetation, trace SAND, slightly coarser than above 2" Spoon VOC, SVOC 09:30 | ML | 1 | | | |
| 42 | | | | | | | | 1 | | | |
| ≈ | | | | | | | | | | | |
| 50 | | | | | | 2" Spoon 10:00 | | | | | |
| | | | | | | 4" Dark V. Fine SAND & SILT, some vegetation | ML | 1 | | | |
| 51 | S-6 | 50'-52' | | 24" | 0.0 | 10" dk brown, water yielding organic SILT/PEAT | PT | 0 | | | |
| | | | | | | | | 2 | | | |
| | | | | | | | | 5 | | | |
| 52 | | | | | | 4" Gray SAND, med-to-fine, well sorted, fining up-gravel @ bottom of spoon | SP | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-23-99 | Boring No.: CB-99-09 | |
| Method: H.S.A. | Casing Size: | Protection: MOD. D | |
| Ground Elev.: 8.6 | Soil Drilled: 102' | Completed: 9-23-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 BOVM | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Total Depth: 102' | |
| | | ▽ Below Ground: 9' | |
| | | Page 3 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | | | | | | | | | | | |
| 61 | S-7 | 60'-62' | CB990962XX | 24" | 0.0 | gray SAND, fine & medium, very well sorted, coarser @ bottom, No visible bedding, med. gravel @ bottom of spoon 2" Spoon VOC, SVOC 10:15 | SP | 10 12 8 8 | | | |
| 62 | | | | | | | | | | | |
| 70 | S-8 | 70'-72' | | 24" | 0.0 | Brown SAND, medium, well sorted over Brown-gray SILT, some fine sand laminae, well sorted, tr. gravel (well rounded) yields water, over | SP ML | 2 2 11 18 | | | |
| 72 | | | | | | Light brown/gray SAND, fine, well sorted, some bedding, (<½") visible by color change 2" spoon 10:45 | SP | | | | |
| 80 | S-9 | 80'-82' | CB990908XX | 20" | 0.0 | brown medium SAND, bedded (¼"-1" beds) visible by grain size, tr. gravel, fine, rounded 2" Spoon VOC, SVOC 11:20 | SP | 2 3 5 9 | | | |
| 82 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-23-99 | Boring No.: CB-99-09 | |
| Method: H.S.A. | Casing Size: | Protection: MOD. D | |
| Ground Elev.: 8.6 | Soil Drilled: 102' | Completed: 9-23-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 B OVM | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Total Depth: 102' | |
| | | ▽ Below Ground: 9' | |
| | | Page 4 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 | S-10 | 90'-92' | | 24" | 1.3 | 12" brown/gray SAND, fine-to-coarse IN horizons, beds ~3" gradational contacts, some gravel up to 1" dia. | SP | 12 9 9 11 | | | |
| 91 | | | | | | | | | | | |
| 92 | | | | | | 3" GRAVEL, fine-to-med., sub-rounded, CLASTS are metamorphic rocks, Chips black ~~chips~~, schist, quartzite, iron staining on SAND | GW | | | | |
| 99 | | | | | | 9" brown SAND, fine, some silt thinly bedded, fining upward sequences, some horizons are micaceous, no staining | SP | | | | |
| 100 | S-11 | 100'-102' | CB990910ZXX | 24" | | olive gray SAND, med., mica-schist frags (~2mm) no visible bedding. Angular metamorphic (QTZite) gravel clast @ bottom of spoon - also clayey, weathered gravel or angular, weathered bedrock | SP | 8 12 15 100/4 | | | |
| 101 | | | | | | | | | | | |
| 102 | | | | | | 2" Spoon VOC, SVOC 12:15 | | | | | |
| 103 | | | | | | AUGER REFUSAL AT 102.25' ON PRESUMED BEDROCK | | | | | |
| 104 | | | | | | | | | | | |
| 105 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-21-99 | Boring No.: CB-99-11 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 7 | Soil Drilled: 7' | Completed: 9-21-99 | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | PI Meter: 580B OVM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Total Depth: 7' | |
| | | ▽ Below Ground: ~7-8' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | CB99111007XX | 16" | | BLACK-TO-BROWN GRAVEL, FINE-TO-COARSE, ANGULAR, SOME CONCRETE, SOME BRICK FRAGS, SOME V. PLASTIC BLACK (TAR) MATERIAL - NO ODOR, DAMP FILL (GW) 10:30 | | 71 | | | |
| 2 | | | | | | | | 98 | | | |
| 3 | | | | | | 3" to 4" of asphalt over yellow brown gravelly SAND To ~1' bgs over very dense & very hard slag material | | 50 | | | |
| 4 | | | | | | | | 89 | | | |
| 5 | | | | | | | | | | | |
| 6 | S-2 | 5'-7' | CB99111007XX | 4" | | brown Medium SAND w/ Some GRAVEL, Metal FRAGS. V. Dense (Lead?) NO RADIATION Detected MOIST FILL (SP) 10:55 | | 20 | | | |
| 7 | | | | | | | | 22 | | | |
| 8 | | | | | | | | 10 | | | |
| 9 | | | | | | NO PID - POURING RAIN | | 7 | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| | | Boring No.: CB-99-12 | |
| Contractor: NFE | Date Started: 9-21-99 | Protection: MoD. D | |
| Method: HSA | Casing Size: 4.25" | Completed: 9-21-99 | |
| Ground Elev.: 8.8 | Soil Drilled: 10' | PI Meter: 580 B OVM | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | Total Depth: 10' | |
| | | ▽ Below Ground: ~8' | |
| Screen: — (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 6" BLACK COARSE SAND & MED. | | | | | |
| 2 | S-1 | 1'-3' | CB991200 3XX | 12" | | GRAVEL, ANGULAR W/ Roots OVER 6" TAN MED. SAND, WELL SORTED FILL (SW/SP) | | 6, 12, 9, 12 | | | |
| 3 | | | | | | DUPLICATE SAMPLE 3" SPOON 11:40 | | | | | |
| 4 | | | | | | Rubble begins @ ~3' w/ STONES, concrete, Re-bar, etc. | | | | | |
| 5 | | | | | | NO PID POURING RAIN | | | | | |
| 6 | | | | | | NO RADIATION DETECTED | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | GRAIN SIZE | | | | | |
| 9 | S-2 | 8'-10' | CB991201 0XX | 20" | | BLACK SAND, SILT, AND GRAVEL W/ 4" PIECES OF WOOD, SATURATED, BEHAVES LIKE LIQUID IN THE BOWL 2" SPOON | | 4, 5, 6, 4 | | | |
| 10 | | | | | | FILL (GM) | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| | | Boring No.: CB-99-13 | |
| Contractor: NFE | Date Started: 9-21-99 | Protection: MOD. D | |
| Method: HSA | Casing Size: 4.25" | Completed: 9-21-99 | |
| Ground Elev.: 8.6 | Soil Drilled: 9' | PI Meter: 580 B OVM | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | Total Depth: 9' | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | ▽ Below Ground: -9' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | S-1 | 1'-3' | CB991300 3XX | 18" | | BROWN MEDIUM SAND W/ CORED pieces of ASPHALT up TO 3" LONG, OVER 3" OF TAN MED. SAND, WELL-SORTED 3" Spoon FILL(SP) 12:25 | | 7<br>10<br>15<br>13 | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | Asphalt Rubble to ~3' bgs Then yellow brown gravelly SAND w/ Rubble & Metal pieces | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | S-2 | 7'-9' | CB991300 9XX | 12" | | BROWN-RED BROWN, MEDIUM SAND W/ LARGE ROOT. OVER (SP) 6" BLACK ANGULAR GRAVEL & COARSE SAND, MOIST (GW) 2" Spoon FILL 12:30 | | 2<br>6<br>7<br>5 | | | |
| 9 | | | | | | DUPLICATE SAMPLE @ 9' NO PID - POURING RAIN | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: CB-99-14 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-22-99 | Completed: 9-22-99 | |
| Method: H.S.A. | Casing Size: | PI Meter: 580 B OVM | |
| Ground Elev.: 8.4 | Soil Drilled: 110' | Total Depth: 110' | |
| Logged by: B. NOONAN | Checked by: T. Longley | ▽ Below Ground: ng- | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Page 1 of: 4 | |

This location is same location as for MWCD-99-02A & MWCD-99-02B

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | S-1 | 1'-3' | CB991400 3XX | 20" | 0.6 | 10" TAN-BLACK STAINED COARSE SAND W/ SOME FINE-TO-COARSE GRAVEL, W/ SOME GLASS SHARDS & CONCRETE FRAGS., DRY FILL (SW) (3" SPOON FULL SUITE SAMPLE COLLECTED DUPLICATE HERE) | | 7 11 22 45 | | | |
| 3 | | | | | | OVER 10" TAN/BROWN FINE SAND WELL-SORTED, SL. PLASTIC/COHESIVE W/ TRACE FINE GRAVEL, DAMP FILL 0915 ~~0945~~ 0815 (SP) | | | | | |
| 10 | S-2 | 10'-12' | CB991401 3XX | 5" | 0.0 | BROWN FINE SAND W/ SOME SILT & FINE-TO-MED. ~~SAND~~ GRAVEL, ANGULAR W/ CHIPS OF CONCRETE, SATURATED - AT BASE OF FILL (GM) VOC+SVOC FILL 2" SPOON ~~1010~~ 0830 | | 6 8 8 11 | | | |
| 12 | | | | | | NATIVE | | | | | |
| 20 | S-3 | 20'-23' | | 24" | 0.0 | 09:20 ~~10:25~~ 4" OLIVE GRAY SAND, FINE-TO-MED W/ SOME SILT, TR. GRAVEL, SUB-ANGULAR ROCKS, QTZ. FRAGS. WET | SW | 2 1 | | | |
| 21 | | | | | | 20" OLIVE GRAY FINE SAND W/ SOME SILT, STICKY, PLASTIC, TR. GRAVEL, SULFUR ODOR, WET, MICA FLECKS | SM/ ML | 1 1 | | | |
| 22 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | CB-99-14 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | MOD. D |
| Contractor: NFE | Date Started: 9-22-99 | Completed: | 9-22-99 |
| Method: H.S.A. | Casing Size: 4 | PI Meter: | 580 B OVM |
| Ground Elev.: 8.4 | Soil Drilled: 110' | Total Depth: | 110' |
| Logged by: B. NOONAN | Checked by: T. Longley | Below Ground: | ~9' |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Page | 2 of: 4 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | S-4 | 30'-32' | CB9914032XX | 24" | 0.0 | 8" med. brown-to-gray SAND w/ 1" beds of fine SAND to SILT, fining upward, mica, slightly plastic, wet | SP | 1 1 1 | | | |
| 31 | | | | | | 16" olive gray SILT w/ some fine SAND, micaceous, plastic, does not readily yield water | MH | | | | |
| 32 | | | | | | VOC+SVOC 2" spoon 09:45 | | | | | |
| 33 | | | | | | | | | | | |
| 40 | S-5 | 40'-42' | | 24" | 0.0 | brown SILT/V. FINE SAND, micaceous well sorted, slightly plastic, crumbles when rolled, little root material, wet holds water 2" spoon - lithology only 10:00 | ML | 1 0 1 2 | | | |
| 41 | | | | | | | | | | | |
| 42 | | | | | | | | | | | |
| 50 | S-6 | 50'-52' | CB9914052XX | 20" | 0.0 | 10" gray SAND, fine-to-med., well sorted w/ ½" bed brown SILT over 10" gray med-to-coarse SAND, wet, very well sorted VOC+SVOC fining upwards 2" Spoon 10:25 | SP<br>SP | 1 2 3 2 | | | |
| 51 | | | | | | | | | | | |
| 52 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-22-99 | Boring No.: CB-99-14 | |
| Method: H.S.A. | Casing Size: | Protection: MOD. D | |
| Ground Elev.: 8.4 | Soil Drilled: 110' | Completed: 9-22-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 B OVM | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Total Depth: 110' | |
| | | ▽ Below Ground: ~9' | |
| | | Page 3 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | | | | | | | | | | | |
| 61 | S-7 | 60'-62' | | 24" | 0.0 | 8" Tan-to-gray medium SAND well sorted | SP | 6 | | | |
| 62 | | | | | | 16" Tan/white/brown coarse SAND w/ gravel (QTz., well rounded) at bottom, trace fine sand, fining up | SW | 10 | | | |
| 63 | | | | | | 2" Spoon 10:50 | | 18 | | | |
| 69 | | | | | | | | 17 | | | |
| 70 | | | | | | | | | | | |
| 71 | S-8 | 70'-72' | CB991407272XX | 16" | 0.0 | Light gray fine SAND, very well sorted, non-plastic, wet, no visible bedding, medium stiff | SP | 13 | | | |
| 72 | | | | | | 2" Spoon VOC + SVOC 11:10 | | 15 | | | |
| | | | | | | | | 11 | | | |
| | | | | | | | | 13 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-22-99 | Boring No.: CB-99-14 | |
| Method: H.S.A. | Casing Size: | Protection: MOD. D | |
| Ground Elev.: 8.4 | Soil Drilled: 10' | Completed: 9-22-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 B OVM | |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Total Depth: 110' | |
| | | ▽ Below Ground: ~9' | |
| | | Page 4 of: 4 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 80 | | | | | | | | 6 | | | |
| 81 | S-9 | 80'-82' | | 20" | 0.0 | Greenish gray v. fine SAND, very well sorted, saturated, non-plastic, subtle laminae visible at bottom based on sl. color change, sticky | SP | 5 6 7 | | | |
| 82 | | | | | | 2" Spoon 11:45 | | | | | |
| 90 | S-10 | 90'-92' | CB99140092-XX | 24" | 0.0 | Same as above, slightly plastic | SP | 3 4 3 6 | | | |
| 92 | | | | | | 2" Spoon VOC + SVOC 12:15 | | | | | |
| 100 | S-11 | 100'-102' | | 24" | 0.0 | Same as above laminations visible, yields water, slightly plastic-to-med. plastic when wet | SP | 2 4 5 7 | | | |
| 102 | | | | | | 2" Spoon 12:45 | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

(*) Note: AUGERED DOWN TO 110' - NO bedrock - OUT OF AUGERS

Harding Lawson Associates

9912003(a) L7

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-21-99 | Boring No.: CB-99-15 | |
| Method: HSA | Casing Size: 4.25" | Protection: MoD. D | |
| Ground Elev.: 8.5 | Soil Drilled: 9' | Completed: 9-21-99 | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | PI Meter: 580 B OVM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Total Depth: 9' | |
| | | ▽ Below Ground: ~9' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | S-1 | 1'-3' | CB991500 3XX | 12" | | BLACK TO FINE COARSE GRAVEL W/ COARSE SAND, MOIST NO ODOR FILL (GW) 3" Spoon 14:15 | | 4 5 6 8 | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | S-2 | 7'-9' | CB991500 9XX | 15" | | BLACK GRAVEL, FINE, ANGULAR, W/ BITUMINOUS BLACK LUSTROUS MATERIAL, SOME ASPHALT W/ FIBROUS MAT'L. (POSS. CARDBOARD) - 2" ZONE OF TAN WHITE CONTAMINATION DAMP AT TOP, MOIST AT BOTTOM FILL (GW) 2" SPOON 14:30 NO PID POURING RAIN | | 5 5 5 6 | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | Boring No.: CB-99-16 |
| Contractor: NFE | Date Started: 9-21-99 | Protection: MoD. D | Completed: 9-21-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | Total Depth: 9' |
| Ground Elev.: 4 | Soil Drilled: 9' | | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: 2.8' | |
| Screen: — (ft.) Riser: — (ft.) Diam: — (ID) Material: — | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | S-1 | 1'-3' | CB991600 3XX | 12" | | TAN SAND, MED.-COARSE, AND GRAVEL, SUBANGULAR TO SUB-ROUNDED (FILL-SW) OVER 7" BLACK GRAVEL, COARSE, ANGULAR SOME COARSE SAND, SOME WELL-SORTED, GRANULAR, Cemented White med. SAND CLASTS, SOME BLACK PLASTIC/STICKY MATL. NO ODOR FILL (GW) 3" Spoon 15:30 | | 10<br>21<br>42<br>31 | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | NO RADIATION DETECTED | | | | | |
| 7 | S-2 | 7'-9' | CB991600 9XX | 5" | | MEDIUM ANGULAR GRAVEL, TRACE SAND, WET, NO ODOR. FILL (GP) 15:45 | | 5<br>28<br>51<br>59 | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | NO PID - POURING RAIN | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | CB-99-17 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | MOD. D |
| Contractor: NFE | Date Started: 9-21-99 | Completed: | 9-21-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: | 580 B OVM |
| Ground Elev.: 5.6 | Soil Drilled: 8' | Total Depth: | 8' |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: | 6-8' |
| Screen: (ft.) | Riser: (ft.) Diam: (ID) Material: | Page | 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | S-1 | 1'-3' | CB9917003XX | 20" | | BROWN TO TAN SAND, MED-TO-CRS. AND GRAVEL, FINE-TO-MED., SUBROUNDED, DAMP, NO ODOR<br>3" SPOON<br>GRAIN SIZE FILL (SW) 14:55 | | 4<br>10<br>11<br>7 | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | DUPLICATE SAMPLE @ 3'<br>THIS AREA of causeway has Asphalt covering w/ fill over top of this - below Asphalt is clean SAND. | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | S-2 | 6'-8' | CB9917008XX | 8" | | TAN, BROWN SAND, MEDIUM-COARSE, AND GRAVEL, WET<br>NO ODOR<br>FILL (SW)<br>2" SPOON 15:10 | | 1<br>1<br>2<br>4 | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | NO PID - POURING RAIN | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | Boring No.: DB-99-01 |
| Contractor: NFE | Date Started: 9-13-99 | Protection: MOD. D | Completed: 9-13-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | Total Depth: 11' |
| Ground Elev.: 13 | Soil Drilled: 11' | | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | Below Ground: ~10' | |
| Screen: / (ft.) | Riser: / (ft.) | Diam: / (ID) | Material: / |

Page 1 of: 1

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB99010004XX | 16" | 0 | Brown Med. SAND w/ GRAVEL up to 3 cm., Medium to Round FILL (SW) 16:15 | | 6 4 3 4 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | 2" Spoon used | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | DB99010011XX | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | S-2 | 9'-11' | | 20" | 0 | TAN FINE Med. SAND, WET, NON-PLASTIC, STRATIFIED, WATER BOTTOM ALLUVIUM 16:25 | SP | 4 6 7 7 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | DB-99-02 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | Mod. D. |
| Contractor: NFE | Date Started: 9-13-99 | Completed: | 9-13-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: | 580 B OVM |
| Ground Elev.: 12.8 | Soil Drilled: 11' | Total Depth: | 11' |
| Logged by: B. NOONAN | Checked by: T. LOWELEY | Below Ground: | |
| Screen: — (ft.) Riser: — (ft.) Diam: — (ID) Material: — | | Page | 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 6" ASPHALT | | | | | |
| 2 | S-1 | 2'-4' | DB990200 4XX | 23" | 0.0 | BROWN TO TAN SAND, FINE, WELL SORTED GRAVEL SUBGRADE BELOW ASPHALT FILL (SP) 3" SPOON 16:45 | | 5 | | | |
| 3 | | | | | | | | 6 | | | |
| 4 | | | | | | | | 6 | | | |
| 5 | | | | | | | | 5 | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | S-2 | 9'-11' | DB990201 1 XX | 10" | 0.0 | 2" Brown Fine SAND, well SORTED, over DARK GRAY Peat W/ FIBROUS ORGANIC material, PLASTIC, wet 2" spoon 17:00 | SP | 2 | | | |
| 10 | | | | | 140 IN PE | | PT | 0 | | | |
| 11 | | | | | | | | 0 | | | |
| | | | | | | | | 0 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-13-99 | Boring No.: DB-99-03 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 12.8 | Soil Drilled: 11' | Completed: 9-13-99 | |
| Logged by: B. NOONAN | Checked by: T. LANGLEY | PI Meter: 580 B OVM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: —(ID) | Material: — |
| | | Total Depth: 11' | |
| | | ▽ Below Ground: ~10.5' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0-6" Asphalt/SUBGRADE | | | | | |
| 2 | S-1 | 2'-4' | DB990300?XX | 14" | 0.0 | Brown MED SAND, W/SOME gravel, little SILT, over (SW) | | 4 | | | |
| 3 | | | | | | 3" TAN well sorted fine-to-med. SAND FILL (SP) | | 6 | | | |
| 4 | | | | | | 17:20 | | 16 | | | |
| 5 | | | | | | | | 19 | | | |
| 6 | | | | | | Dike is approx. 10'-12' high - TIDE IS CLOSE TO HIGH & GOING OUT - Water TABLE AT BASE OF DIKE | | | | | |
| 9 | S-2 | 9'-11' | DB990301XX | | 0.0 | Brown SAND, MEDIUM, well sorted, wet | SP | 1 | | | |
| 10 | | | | | | 17:30 | | 1 | | | |
| 11 | | | | | | | | 2 | | | |
| | | | | | | | | 1 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: DB-99-04 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 BOVM | |
| Ground Elev.: 12.8 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: ~10' | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0-6" Asphalt/SUBGRADE FILL - Brown Gravelly SAND | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 9'-11' | DB990400XX | 20" | 0.0 | Brown-to-tan SAND, W/ GRAVEL & SOME SILT FILL (SW/GC) COLLECTED MS/MSD HERE 08:25 | | 7<br>10<br>7<br>9 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings - Brown Fine SAND w/ Little SILT, V. well sorted FILL (SP) | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | 10" of 08:40 BROWN Fine-to-med SAND, Some SILT, TRACE GRAVEL, well sorted FILL (SP), OVER NATURAL (3") | | | | | |
| 10 | S-2 | 9'-11' | DB990401XX | 13" | 95.0<br>2000 | GRAY TO BLACK Med. SAND W/ FIBROUS ORGANIC MATERIAL, Some Peat HIGH ODOR | SM/PT | 3<br>3<br>2<br>1 | | | |
| 11 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | DB-99-05 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | MOD. D |
| Contractor: NFE | Date Started: 9-15-99 | Completed: | 9-15-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: | 580 B OVM |
| Ground Elev.: 12.6 | Soil Drilled: 11' | Total Depth: | 11' |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | Below Ground: | ~10' |
| Screen: / (ft.) Riser: / (ft.) Diam: / (ID) Material: / | | Page | 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | DB990502XX | 4" | 0.0 | MED-to-COARSE BROWN SAND W/ SOME FINE-to-COARSE GRAVEL, DAMP FILL (SW) 3" SPOON 12:00 | | 10 20 15 14 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | HEAVY RAIN | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | TAN BROWN SAND, MED.-to-COARSE, WELL SORTED, W/ LITTLE GRAVEL FILL (SP) 2" SPOON 12:15 | | 4 3 3 3 | | | |
| 10 | S-2 | 9'-11' | DB990502011XX | 15" | 0.0 | | | | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: Dike/Causeway | |
| | | Boring No.: DB-99-06 | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580B OVM | |
| Ground Elev.: 11.6 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: ~10' | |
| Screen: — (ft.) Riser: — (ft.) Diam: — (ID) Material: — | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0"-6" Asphalt<br>6"-2' SANDY GRAVEL SUBGRADE, poorly sorted, DRY ROUND ANGULAR GRAVEL up TO 3" | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB990600XX | 24" | 0.0 | BROWN MED-to-FINE SAND, LV SOME GRAY LITTLE SILT, MOIST NON-PLASTIC, LESS GRAVEL in BOTTOM 6" FILL TOP 18" (SW) BOTTOM 6" (SP) 09:15<br>3" SPOON<br>COLLECTED DUPLICATE here @ SHALLOW DEPTH | | 9<br>10<br>7<br>14 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 8 | | | | | | LOW TIDE NOW<br>CUTTINGS = MED-to-COARSE GRAVEL W/ SAND, BECOMING SANDIER W/ LITTLE GRAVEL @ DEPTH | | | | | |
| 9 | | | | | | | | | | | |
| 10 | S-2 | 9'-11' | DB990601XX | 10" | 0.0 | BROWN, MED. SAND W/ LITTLE GRAVEL, WET W/ ROCK FRAGS. FILL (SW) 09:30<br>2" SPOON | | 11<br>36<br>15<br>4 | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: DB-99-07 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 58 B OVM | |
| Ground Elev.: 11.6 | Soil Drilled: 10' | Total Depth: 10' | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | ▽ Below Ground: ~10' | |
| Screen: — (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0-2' CUTTINGS - 6" Asphalt GRAVEL SUBGRADE | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB990704XX | 24" | 0.0 | Brown SAND, Fine-to-COARSE, 60% Med SAND w/ some GRAVEL up to 2" DIA. FILL (SW) 2" spoon 09:55 | | 12<br>14<br>14<br>11 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: Brown SAND, Med.-to-coarse, w/ some GRAVEL, some Boulders FILL (SW) | | | | | |
| 6 | | | | | | Coarse GRAVEL @ 7.5' w/ TRACE-to-little SAND to 8' FILL (GP) | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | LOW TIDE | | | | | |
| 9 | S-2 | 8'-10' | DB990710XX | 14" | | Brown-to-gray SAND, w/ some gravel/little SILT, broken rock up to dia. of spoon, some ash, DAMP @ bottom, U. poorly sorted FILL 2" spoon 10:15 | | 38<br>86<br>38<br>36 | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: Dike/Causeway | |
| | | Boring No.: DB-99-08 | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580B OVM | |
| Ground Elev.: 11.5 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. NOONAN | Checked by: T. Longley | ▽ Below Ground: ~11' | |
| Screen: — (ft.) Riser: — (ft.) | Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | Cuttings: 3" Asphalt, SUBGRADE of Brown SAND w/ gravel up to COBBLES up to 5" TO 6" | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB990804XX | 20" | 0.0 | Reddish Brown fine SAND w/ some gravel, clasts up to 2" diam., some asphalt chips @ base FILL (SP) 3" spoon 10:55 | | 12 25 31 31 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: brown fine-to-med. SAND and coarse GRAVEL becoming less sandy w/ depth. GRAVEL is sub-rounded & well graded (fine-to-CRS) 2" metal washer from ~8.5'- GRAVEL becoming finer | | | | | |
| 8 | | | | | | Low tide - tide coming in | | | | | |
| 9 | | | | | | | | | | | |
| 10 | S-2 | 9'-11' | DB990801 1XX | 4" | 0.0 | Brown SAND, med.-to-coarse, med. @ bottom, coarsening up w/ some gravel & little silt, Damp FILL (GM) 11:10 2" spoon | | 2 1 0 2 | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | Boring No.: DB-99-09 |
| Contractor: NFE | Date Started: 9-14-99 | Protection: MOD. D | Completed: 9-14-99 |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | Total Depth: 11' |
| Ground Elev.: 11.4 | Soil Drilled: 11' | Logged by: B. NOONAN | Checked by: T. Longley |
| Below Ground: ~10' | Screen: (ft.) | Riser: (ft.) | Diam: (ID) |
| Material: | Page 1 of: 1 | | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | Cuttings: 3" Asphalt, coarse gravel sub-grade, Br. SAND, Medium w/ some fine SAND & GRAVEL - fine-to-COARSE | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 3'-4' | DB9909004XX | 20" | 0.4 | Red/Brown Med. Coarse SAND & GRAVEL - Fine-to-coarse - FILL (SW) 3" spoon 11:35 | | 24 20 10 5 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: Coarse gravel-to-Boulders | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | S-2 | 9'-11' | DB9909011XX | 11" | 0.0 | Brown Medium SAND & gravel, fine-to-coarse up to spoon diameter - wet @ bottom FILL (SW) 2" spoon 11:50 | | 5 2 3 2 | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: DB-99-10 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | |
| Ground Elev.: 11.6 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. NOONAN | Checked by: T. LONERGAN | Below Ground: ~10" | |
| Screen: — (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0-2' 2" Asphalt/SAND & GRAVEL SUBGRADE | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB991000 4 XX | 16" | 0.0 | Brown Med. SAND & GRAVEL FILL (SW) 3" Spoon Collected duplicate here 12:25 | | 14 20 13 12 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: Med. gravel w/ little coarse gravel & some brown Medium SAND GRAVEL: Subrounded-to broken More SANDY @ 6', then coarse gravel (up to 3" dia.) little SAND | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | 12:45 | | | | | |
| 10 | S-2 | 9'-11' | DB991001 1 XX | 11" | | Brown fine-to-med SAND w/ some GRAVEL & broken Boulders. SAND IS well sorted IN places w/ GRAVELLY SAND above & below wet @ base FILL (SW) 2" Spoon | | 8 7 8 14 | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-14-99 | Boring No.: DB-99-11 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 11.8 | Soil Drilled: 11' | Completed: 9-14-99 | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | PI Meter: 580 B OVM | |
| Screen: — (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Total Depth: 11' | |
| | | ▽ Below Ground: . | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 0'-2' Asphalt w/ SAND & gravel subgrade, w/ cobbles | | | | | |
| 2 | S-1 | 2'-4' | DB991100 4XX | 12" | 0 | Brn.-to-reddish brown Gravelly fine SAND (FILL) non-plastic damp to moist 3" Spoon 13:00 | | 11<br>8<br>4<br>1 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: As above - brn.-to-reddish brn. gravelly SAND w/ little cobbles | | | | | |
| 8 | | | | | | | | | | | |
| 9 | S-2 | 9'-11' | DB991101 1XX | | | (No log of spoon) 2" Spoon 13:20 | | 3<br>3<br>3<br>16 | | | |
| 11 | | | | | | | | | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | 0-10% |
| Little (ll) | 10-20% |
| Some (so) | 20-35% |
| and | 35-50% |

(-) AMOUNT (+)

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: DB 99 12 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD D | |
| Contractor: NFE | Date Started: 9-14-99 | Completed: 9-14-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | |
| Ground Elev.: 11.1 | Soil Drilled: 11' | Total Depth: 11' | |
| Logged by: B. NOONAN | Checked by: T. LONGLEY | Below Ground: ~10' | |
| Screen: — (ft.) | Riser: — (ft.) Diam: — (ID) Material: — | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 0-2' Asphalt over SAND & gravel subgrade | | | | | |
| 2 | | | | | | | | | | | |
| 3 | S-1 | 2'-4' | DB991200.4XX | 20" | 0.0 | Brown med. SAND w/ Fine-to-coarse gravel, Asphalt chips, Little fine SAND, pulverized ~~rock~~ rock, DRY FILL (SW) 3" Spoon 15:15 | | 19<br>35<br>23<br>13 | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | Cuttings: Coarse gravel & SAND | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | 15:20 3" of Brown med. SAND & gravel over GRAY-to-black fine sand, | | 7 | | | |
| 10 | S-2 | 9'-11' | DB991201.1XX | 20" | 215.0 | w/ Little gravel, little silt. STRONG odor, sheen on spoon Duplicate sample here 3" spoon | | 7<br>5<br>3 | | | |
| 11 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-14-99 | Boring No.: DB-99-13 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 10.8 | Soil Drilled: 11' | Completed: 9-14-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 B OVM | |
| Screen: / (ft.) | Riser: / (ft.) | Diam: / (ID) | Material: / |
| | | Total Depth: 11' | |
| | | ▽ Below Ground: ~9' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | DB991300ZXX | 14" | 78.5 | Br. Med. coarse SAND w/ little gravel | | 5 | | | |
| 2 | | | | | | 3" Fine SAND @ bottom | | 6 | | | |
| | | | | | | 2" Spoon FILL (SW) | | 7 | | | |
| | | | | | | 15:35 | | 22 | | | |
| 3 | | | | | | Cuttings: | | | | | |
| 4 | | | | | | Brown Med. SAND & GRAVEL - gravel clasts fine → cobble, some Fine sand, odor noted (0.4 PID) | | | | | |
| 5 | | | | | | gravel coarsening down up to 4" then getting into a SAND w/ Finer gravel FILL (SW) | | | | | |
| ≈ | | | | | | | | | | | |
| 8 | | | | | | TIDE is high - water ~9' bgs | | | | | |
| 9 | | | | | | 15:50 | | | | | |
| 10 | S-2 | 9'-11' | DB991301IXX | 5" | 0.0 | Brown fine SAND w/ little fine gravel, little silt, wet. Saturated @ bottom | | 7 | | | |
| | | | | | | 3" Spoon (FILL)(SW) grading to natural SLIGHT ODOR | | 5 | | | |
| | | | | | | | | 6 | | | |
| 11 | | | | | | | | 11 | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| Contractor: NFE | Date Started: 9-14-99 | Boring No.: DB-99-14 | |
| Method: HSA | Casing Size: 4.25" | Protection: MOD. D | |
| Ground Elev.: 10.8 | Soil Drilled: 10' | Completed: 9-14-99 | |
| Logged by: B. NOONAN | Checked by: T. Longley | PI Meter: 580 BOVM | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | Total Depth: 10' | |
| | | ▽ Below Ground: ~9' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0.5'-2.5' | DB991403 XX | 9" | 0.0 | Brown Fine-to-med SAND & gravel up to spoon dia. DRY 2" spoon 16:20 | | 7 9 11 20 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | TIDE IS High : ▽ ~9' | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | S-2 | 8'-10' | DB991401 XX | 9" | 0.0 | Brown Med. SAND, w/ some gravel up to 2" DIA., wet-to-saturated @ bottom 3" spoon 16:40 | | 4 3 3 7 | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| | | Boring No.: DB-99-15 | |
| Contractor: NFE | Date Started: 9-15-99 | Protection: MOD. D | |
| Method: HSA | Casing Size: 4.25" | Completed: 9-15-99 | |
| Ground Elev.: 10.7 | Soil Drilled: 10' | PI Meter: 580B OVM | |
| Logged by: B. NOONAN | Checked by: T. Longley | Total Depth: 10' | |
| | | ▽ Below Ground: ~10' | |
| Screen: / (ft.) | Riser: / (ft.) Diam: / (ID) Material: / | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | DB991500122 XX | 14" | 0.0 | Brown Medium-to-coarse SAND w/ some gravel - fine-to-coarse FILL (SW) 3" spoon collect MS/MSD here 08:45 | | 10 16 25 32 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | Cuttings Same as above w/ cobbles, Medium gravel w/ some SAND @ 5.5' | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | DEAD - Low TIDE | | | | | |
| 8 | | | | | | | | | | | |
| 9 | S-2 | 8'-10' | DB991500100 XX | 2" | 0.0 | Brown SAND & concrete chips w/ coarse gravel blocking Spoon FILL (SW) 09:15 | | | | | |
| 10 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Client: Stratford Army Engine Plant | Project No. 47254 | Study Area: Dike/Causeway | |
| | | Boring No.: DB-99-16 | |
| Contractor: NFE | Date Started: 9-15-99 | Protection: MOD. D | |
| Method: HSA | Casing Size: 4.25" | Completed: 9-15-99 | |
| Ground Elev.: 11.4 | Soil Drilled: 10' | PI Meter: 580 B OVM | |
| Logged by: B. NOONAN | Checked by: T. Longley | Total Depth: 10' | |
| Screen: — (ft.) Riser: — (ft.) Diam: — (IB) Material: — | | Below Ground: ~10' | |
| | | Page 1 of: 1 | |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0-2' | DB991600ZXX | 19" | 17.0 | Brown Medium-to-Coarse SAND & gravel, Fine-to-CRSE. Moist Fill (SW) 3" Spoon 0940 | | 6 | | | |
| 2 | | | | | | | | 22 | | | |
| 3 | | | | | | | | 26 | | | |
| 4 | | | | | | | | 25 | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | S-2 | 8-10' | DB991610XX | 10" | 10.0 | SAme As Above wet @ bottom 3" Spoon 09:50 | | 7 | | | |
| 9 | | | | | | | | 12 | | | |
| 10 | | | | | | | | 7 | | | |
| | | | | | | | | 5 | | | |

PROPORTIONS

| | |
|---|---|
| Trace (tr) | |
| Little (ll) | |
| Some (so) | |
| and | |

(-) AMOUNT (+)

| | |
|---|---|
| 0-10% | |
| 10-20% | |
| 20-35% | |
| 35-50% | |

ABBREVIATIONS

| | | |
|---|---|---|
| f = fine | gr = gray | MS = Split Spoon |
| m = medium | bn = brown | BW = Screened Auger |
| c = coarse | blk = black | HP = Hydropunch |

Harding Lawson Associates

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| Study Area: Dike/Causeway | | | |
| Boring No.: DB-99-17 | | | |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: MOD. D | |
| Contractor: NFE | Date Started: 9-15-99 | Completed: 9-15-99 | |
| Method: HSA | Casing Size: 4.25" | PI Meter: 580 B OVM | |
| Ground Elev.: 12.3 | Soil Drilled: 13' | Total Depth: 13' | |
| Logged by: B. NOONAN | Checked by: T. Longley | Below Ground: ~12' | |
| Screen: — (ft.) | Riser: — (ft.) | Diam: — (ID) | Material: — |
| | | | Page 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | DB991700?XX | 18" | 0.0 | Brown/tan Med. SAND w/ Little Fine SAND & some COARSE SAND & GRAVEL, Fine-to-COARSE, TRACE SILT, w/ brick FRAGMENTS 3" Spoon FILL (SW) 10:10 | | 11<br>25<br>18<br>20 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | 0.0 | CUTTINGS; COARSE GRAVEL W/ TRACE SAND, SOME BRICK & Metal WIRE, concrete chips FILL (GP) | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | LOW TIDE HOMOGENIZE SOIL FROM 12'TO13' TO 10'TO 12' for SAMPLE VOLUME | | | | | |
| 10 | | | | | | SAND & GRAVEL SAME AS ABOVE 3" Spoon | | | | | |
| 11 | S-2 | 10'-12' | DB991701?XX | 3" | 4.7 | Duplicate SAMPLE FILL (SW) 10:20 | | | | | |
| 12 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# SOIL BORING LOG

| | | | |
|---|---|---|---|
| | | Study Area: | Dike/Causeway |
| | | Boring No.: | DB-99-18 |
| Client: Stratford Army Engine Plant | Project No. 47254 | Protection: | MOD. D |
| Contractor: NFE | Date Started: 9-15-99 | Completed: | 9-15-99 |
| Method: H.S.A. | Casing Size: 4.25" | PI Meter: | 580 B OVM |
| Ground Elev.: 11.8 | Soil Drilled: 13' | Total Depth: | 13' |
| Logged by: B. NOONAN | Checked by: T. Langley | Below Ground: | |
| Screen: — (ft.) Riser: — (ft.) Diam: — (ID) Material: — | | Page | 1 of: 1 |

| DEPTH (FT) | SAMPLE NUMBER | SAMPLE DEPTH | CLP/SCREENING | RECOVERY | PID (ppm) | SOIL/ROCK DESCRIPTION | SOIL CLASS | BLOWS/6-IN. | WELL DATA | LITHOLOGY | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S-1 | 0'-2' | DB991800?XX | 15" | 0.0 | BROWN Fine & MED. SAND w/ Some gravel - med-to-coarse Some brick FRAGS. FILL (SW) 3" Spoon 11:05 | | 12 25 29 21 | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | S-2 | 9'-11' | — | 0 | | NO Recovery | | | | | |
| 11 | | | | | | | | | | | |
| 12 | S-3 | 11'-13' | 6" | DB991801?XX | 2.8 | GRAY to black, Fine, well-sorted SAND, SATURATED Little gravel AT TOP - probable base of fill/NATIVE SAND 2" Spoon 11:20 | SP | 5 6 2 1 | | | |
| 13 | | | | | | | | | | | |

| PROPORTIONS | (-) AMOUNT (+) | ABBREVIATIONS | | |
|---|---|---|---|---|
| Trace (tr) | 0-10% | f = fine | gr = gray | MS = Split Spoon |
| Little (ll) | 10-20% | m = medium | bn = brown | BW = Screened Auger |
| Some (so) | 20-35% | c = coarse | blk = black | HP = Hydropunch |
| and | 35-50% | | | |

# GRAIN SIZE ANALYSIS

INTERNATIONAL TECHNOLOGY CORPORATION

# GEOTECHNICAL LABORATORY

## CERTIFICATE OF ANALYSIS

Ron Martinez
Quanterra Environmental Services
13715 Rider Trail North
Earth City, Missouri 63045

November 3, 1999

This is the Certificate of Analysis for the following samples:

| | |
|---|---|
| Project ID: | **Quanterra St. Louis** |
| IT Project Number: | pending |
| Date Received by Lab: | October 13, 1999 |
| Number of Samples: | Nine (9) |
| Sample Type: | Soil |

## I. Introduction/Case Narrative

Nine soil samples were received by the IT Geotechnical Laboratory on October 13, 1999. Testing was performed at the ETDC Oak Ridge laboratory facilities. All samples were submitted for determination of particle-size distribution. Moisture content is reported as ancillary data.

Please see Appendix A, Sample Number Cross Reference List; Appendix B, Analysis Results; and, Appendix C, Chain-of-Custody and Request-for-Analysis Records.

Reviewed and Approved:

Ralph Cole
Laboratory Manager, Geotechnical Services

**IT GEOTECHNICAL LABORATORY**
**OAK RIDGE, TN**
**(423) 482-6497**

## II. Analytical Results/Methodology

REFERENCES:

- United States Army Corps of Engineers (USACE), Engineer Manual 1110-2-1906, *Laboratory Soils Testing*, appendix II, 1970
- United States Environmental Protection Agency, SW846, *Test Methods for Examining Solid Waste, Physical/Chemical Methods*, 3rd ed., Nov 1986 (EPA SW-846)
- Annual Book of ASTM Standards, Section 4, Construction, Volume 04.08, *Soil and Rock (I)*, and Volume 04.09, *Soil and Rock (II)*, 1999
- United Nations, Recommendations on the Transport of Dangerous Goods *Manual of Tests and Criteria*, 2nd ed., 1995.

Laboratory Determination of Water (Moisture) Content of Soil and Rock... **ASTM D 2216**
Particle-Size Analysis of Soils..... **ASTM D 422**

## III. Quality Control

Quality control checks such as duplicates and spikes (QC samples), are not normally applicable to geotechnical testing. This is due largely to the inability of obtaining samples with known characteristics, the heterogenous nature of the samples, and quality control procedures built-in to the analytical method.

QC measures to ensure accuracy and precision of test results include the following:

- 100% verification of all numerical results - raw data entries, transcriptions and calculations entered by lab technicians are checked, recalculated and verified. Most data calculations are performed by computer programs.

- Data validation through test reasonableness - summaries of all test results for individual reports are reviewed to determine the overall reasonableness of data and to determine the presence of any data that may be considered outliers.

- Quality control procedures are built into most standardized geotechnical procedures. For example, liquid limit and plastic limit analyses call for re-analyses and specify acceptance criteria.

- Routine instrument calibration - instruments, gauges and equipment used in testing are calibrated on a routine basis. All instrument calibration follows ASTM or manufacturer guidelines.

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- Maintenance of all past calibration records - calibration records and certification documents of all instruments, gauges and equipment are updated routinely and maintained in the Quality Control Coordinators Quality/Operations files.

- Certified and trained personnel - all technicians are certified by the National Institute for Certification of Engineering Technicians (NICET) in geotechnical soil testing, and are trained in the application of standard laboratory procedures for geotechnical analyses as well as the quality assurance measures implemented by IT.

## IV. Data Qualification

None.

# Appendix A

# Sample Number Cross-Reference

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# SAMPLE NUMBER CROSS-REFERENCE LIST

| LAB SAMPLE NO. | CLIENT SAMPLE NO. | MATRIX |
|---|---|---|
| ETDC-8457 | CB9901002XX | Soil |
| ETDC-8458 | CB9904002XX | Soil |
| ETDC-8459 | CB9905002XX | Soil |
| ETDC-8460 | CB9907006XX | Soil |
| ETDC-8461 | CB9911002XX | Soil |
| ETDC-8462 | CB9912010XX | Soil |
| ETDC-8463 | CB9917003XX | Soil |
| ETDC-8464 | TP9924010XX | Soil |
| ETDC-8465 | CB9914003XX | Soil |

# Appendix B

# Analysis Results

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

**IT GEOTECHNICAL LABORATORY**
**OAK RIDGE, TN**
**(423) 482-6497**

# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name: Quanterra St. Louis
Project No.: pending
Field Sample No.: CB9901002XX
IT Lab Sample No.: ETDC-8457

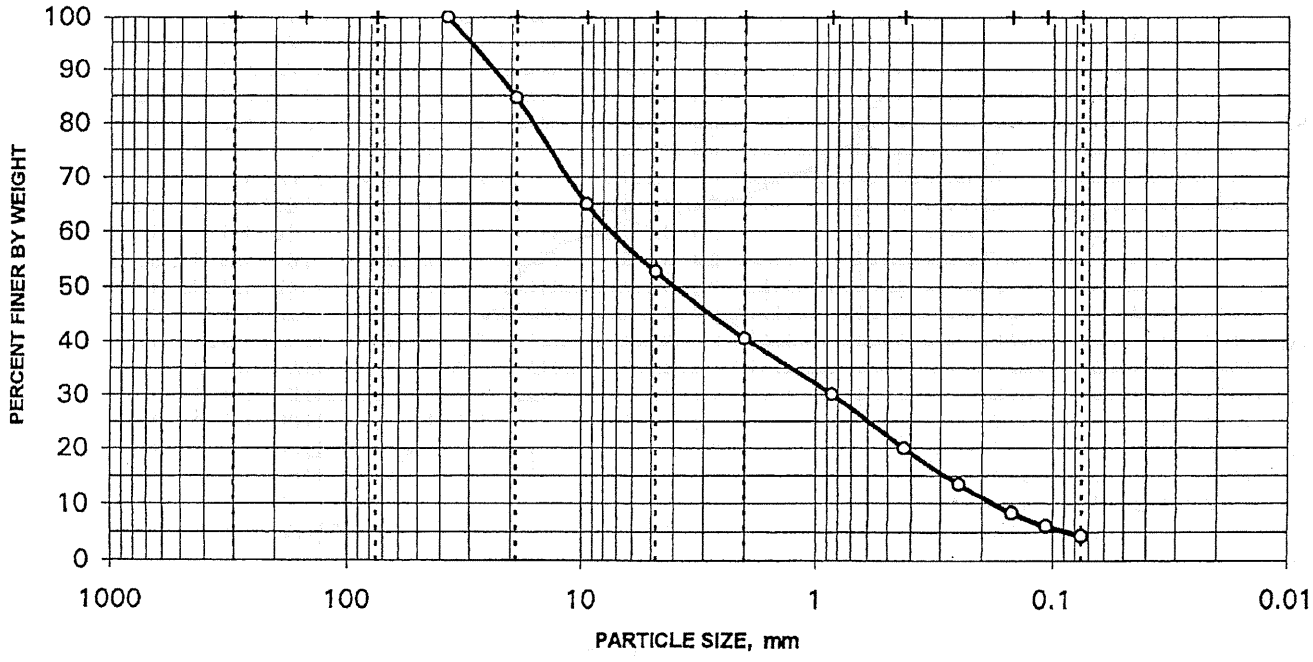
Moisture Content = 3.2%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 84.6% |
| | 0.375" | 9.500 | 64.9% |
| | #4 | 4.750 | 52.7% |
| | #10 | 2.000 | 40.5% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 30.0% |
| | #40 | 0.425 | 19.9% |
| | #60 | 0.250 | 13.4% |
| | #100 | 0.149 | 8.3% |
| | #140 | 0.106 | 6.0% |
| | #200 | 0.075 | 4.3% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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(423) 482-6497

# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name: Quanterra St. Louis
Project No.: pending
Field Sample No.: CB9904002XX
IT Lab Sample No.: ETDC-8458

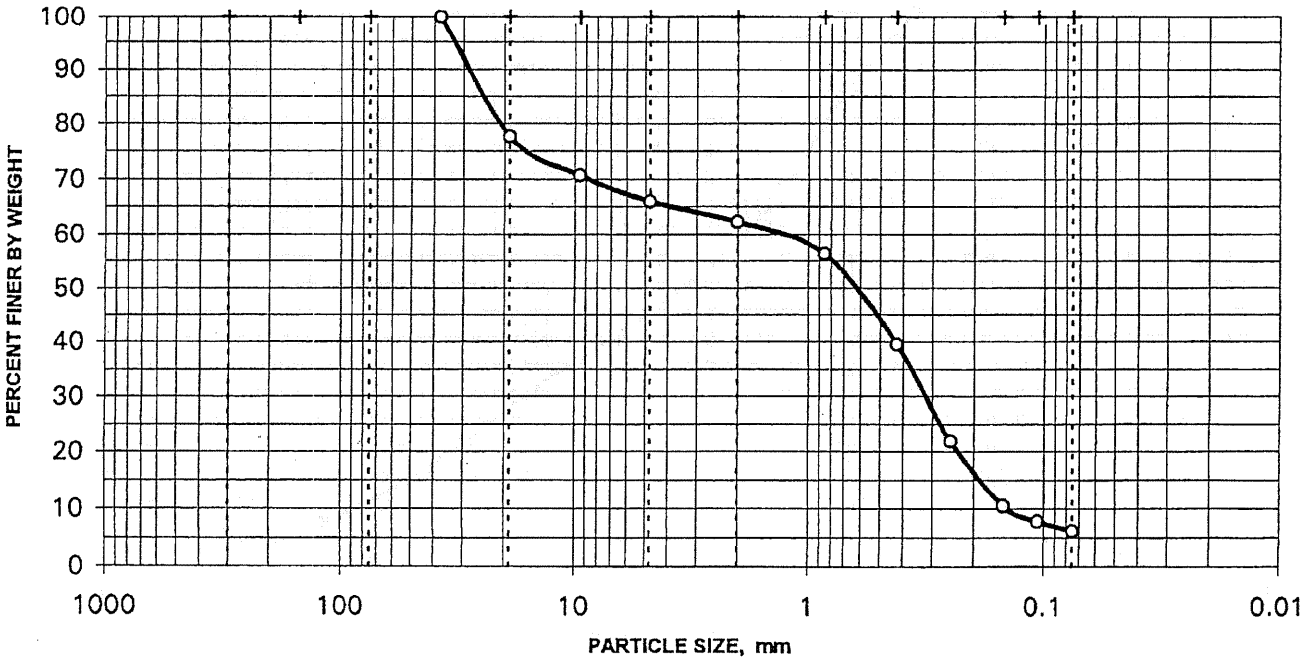
Moisture Content = 5.9%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 77.6% |
| | 0.375" | 9.500 | 70.6% |
| | #4 | 4.750 | 65.9% |
| | #10 | 2.000 | 62.2% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 56.3% |
| | #40 | 0.425 | 39.5% |
| | #60 | 0.250 | 21.9% |
| | #100 | 0.149 | 10.5% |
| | #140 | 0.106 | 7.8% |
| | #200 | 0.075 | 6.1% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name: Quanterra St. Louis
Project No.: pending

Field Sample No.: CB9905002XX
IT Lab Sample No.: ETDC-8459

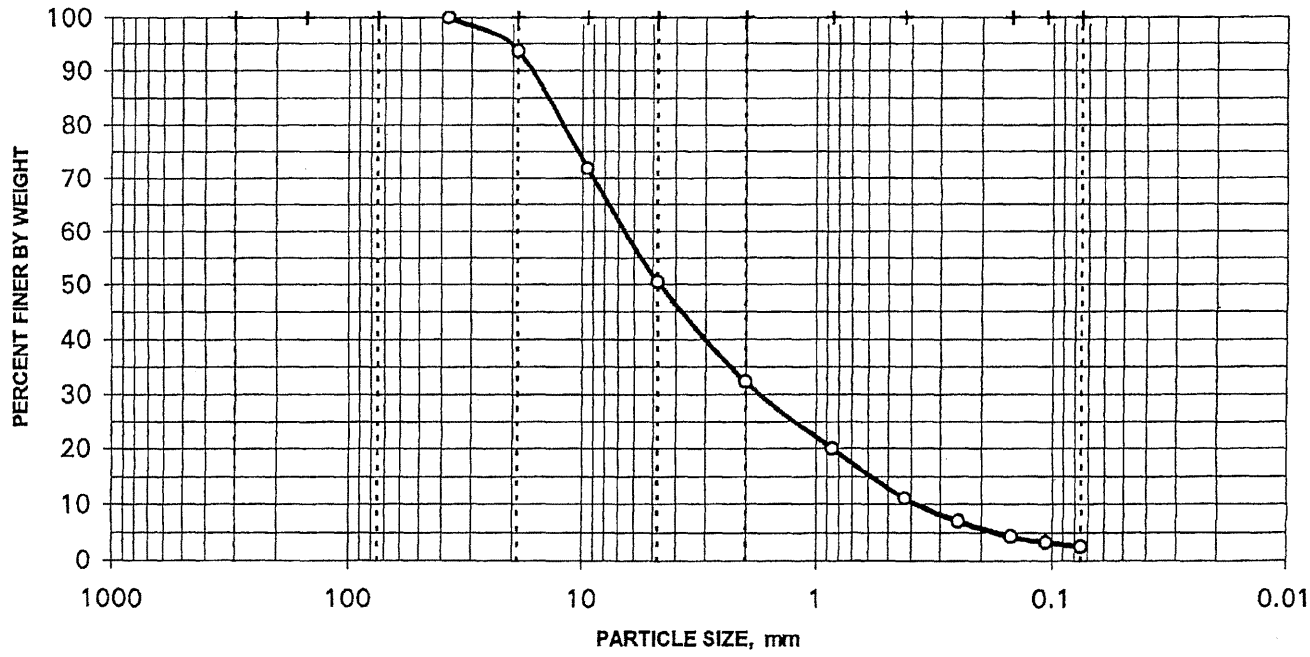
Moisture Content = 10.2%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 93.7% |
| | 0.375" | 9.500 | 71.7% |
| | #4 | 4.750 | 50.5% |
| | #10 | 2.000 | 32.2% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 20.0% |
| | #40 | 0.425 | 11.0% |
| | #60 | 0.250 | 6.9% |
| | #100 | 0.149 | 4.3% |
| | #140 | 0.106 | 3.2% |
| | #200 | 0.075 | 2.5% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name: Quanterra St. Louis
Project No.: pending
Field Sample No.: CB9907006XX
IT Lab Sample No.: ETDC-8460

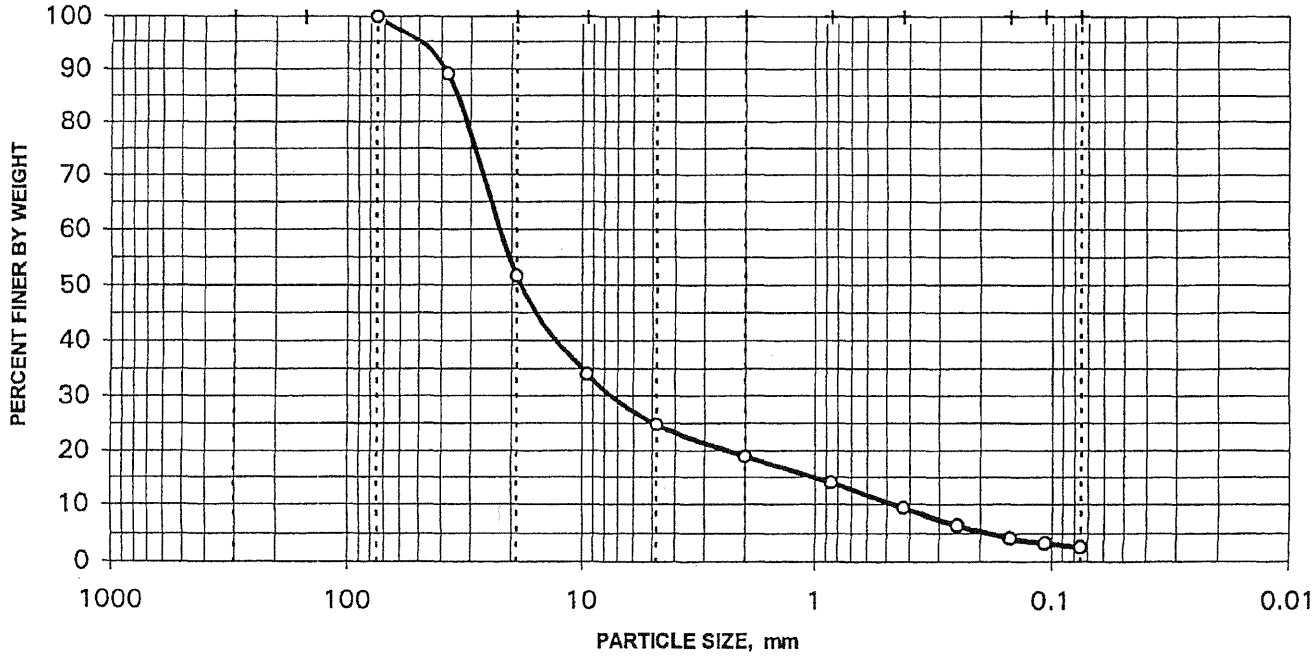
Moisture Content = 9.5%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 89.1% |
| | 0.75" | 19.000 | 51.5% |
| | 0.375" | 9.500 | 33.9% |
| | #4 | 4.750 | 24.7% |
| | #10 | 2.000 | 18.8% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 14.0% |
| | #40 | 0.425 | 9.3% |
| | #60 | 0.250 | 6.3% |
| | #100 | 0.149 | 4.0% |
| | #140 | 0.106 | 3.1% |
| | #200 | 0.075 | 2.5% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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(423) 482-6497

# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name Quanterra St. Louis

Project No. pending

Field Sample No. CB9911002XX

IT Lab Sample No. ETDC-8461

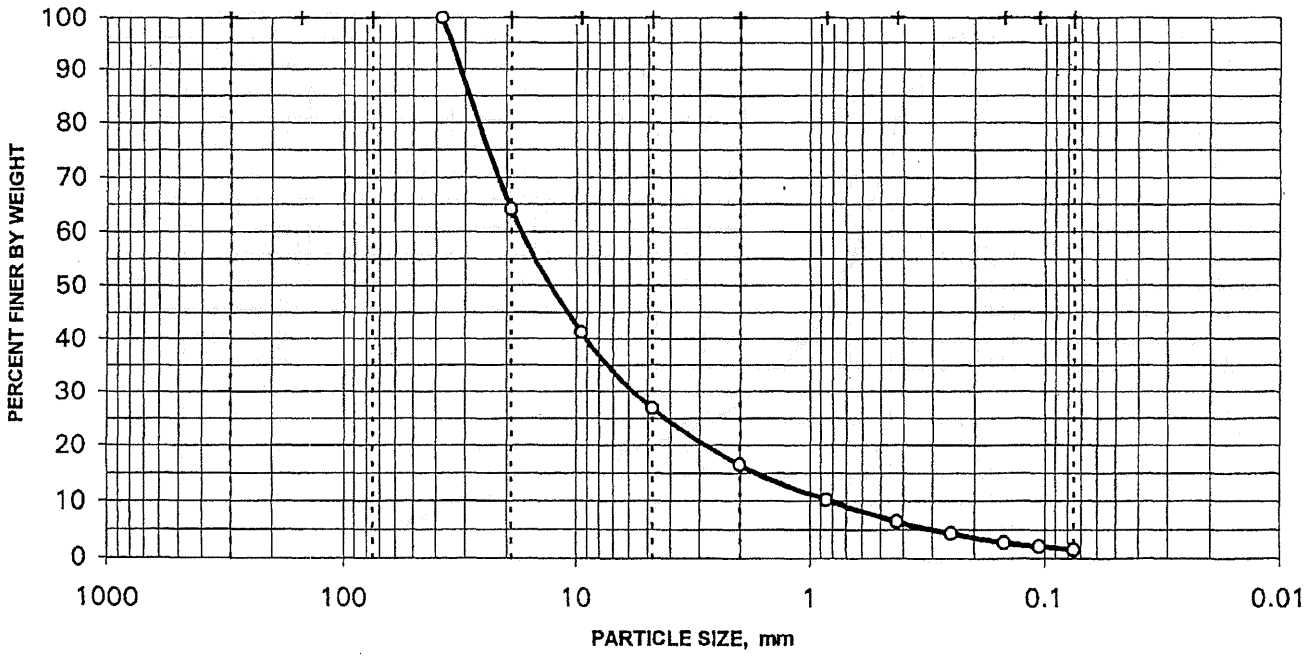
Moisture Content = 9.3%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 64.1% |
| | 0.375" | 9.500 | 41.1% |
| | #4 | 4.750 | 26.7% |
| | #10 | 2.000 | 16.5% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 10.3% |
| | #40 | 0.425 | 6.3% |
| | #60 | 0.250 | 4.3% |
| | #100 | 0.149 | 2.7% |
| | #140 | 0.106 | 2.0% |
| | #200 | 0.075 | 1.5% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

**IT GEOTECHNICAL LABORATORY**
**OAK RIDGE, TN**
**(423) 482-6497**

# *PARTICLE-SIZE ANALYSIS*
# *ASTM D 422*

| | | | |
|---|---|---|---|
| Project Name | Quanterra St. Louis | Client Sample No. | CB9912010XX |
| Project No. | pending | IT Lab Sample No. | ETDC-8462 |

Specific Gravity = 2.65
assumed for calculations

Moisture Content = 21.3%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 88.0% |
| | 0.75" | 19.000 | 78.7% |
| | 0.375" | 9.500 | 59.4% |
| | #4 | 4.750 | 47.2% |
| | #10 | 2.000 | 38.0% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 31.5% |
| | #40 | 0.425 | 23.4% |
| | #60 | 0.250 | 17.5% |
| | #100 | 0.149 | 13.1% |
| | #140 | 0.106 | 11.0% |
| | #200 | 0.075 | 9.3% |

## *HYDROMETER ANALYSIS*

| | Diameter mm | Percent Finer |
|---|---|---|
| HYDROMETER | | |
| | | |
| | 0.03489 | 6.7% |
| | 0.02239 | 5.3% |
| | 0.01321 | 3.3% |
| | 0.00940 | 2.8% |
| | 0.00660 | 2.2% |
| | 0.00471 | 1.4% |
| | 0.00328 | 0.8% |
| | 0.00142 | 0.8% |

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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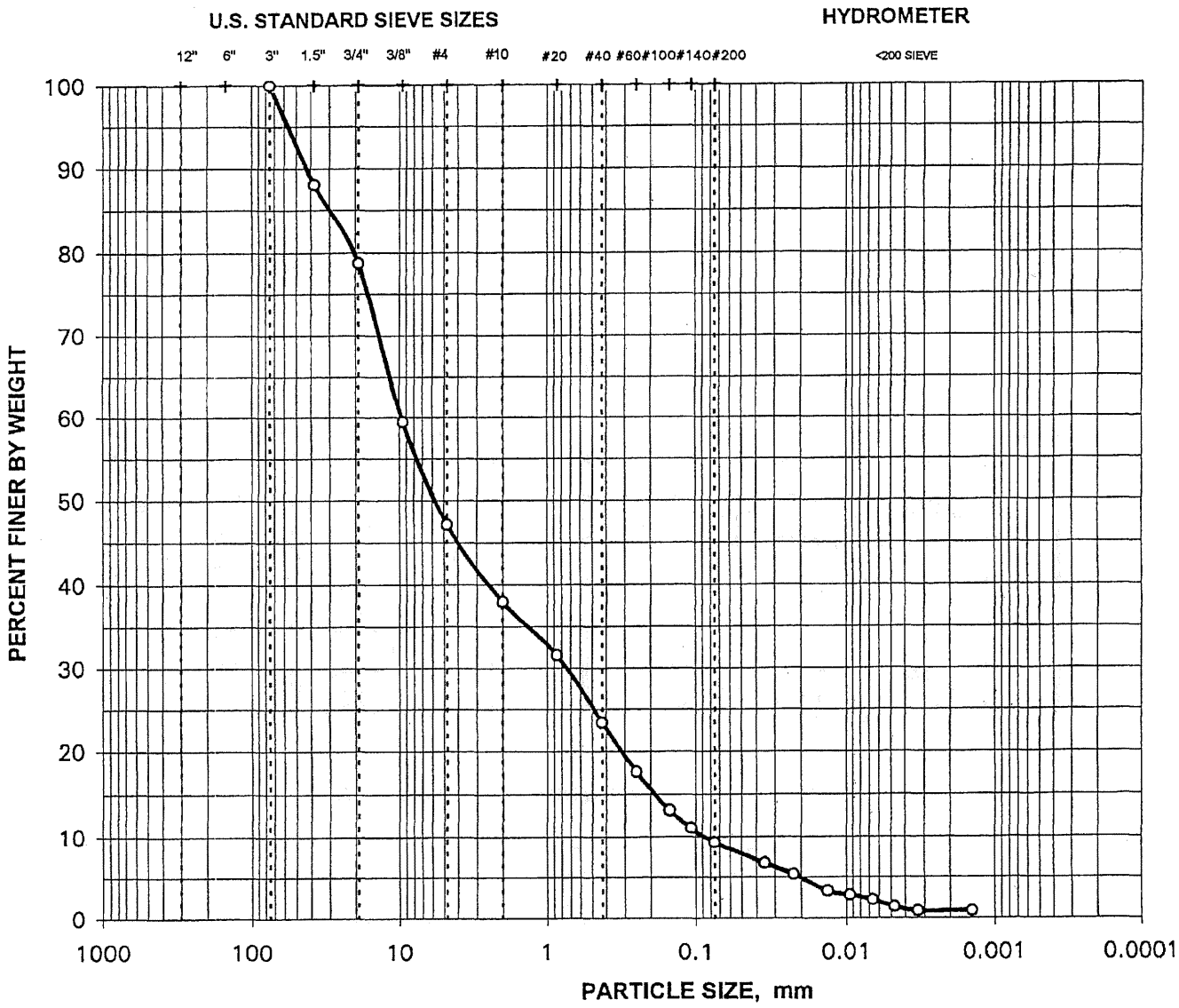
# Quanterra St. Louis




CLIENT SAMPLE NO.: CB9912010XX

IT LAB SAMPLE NO.: ETDC-8462

| BOULDERS | COBBLES | GRAVEL | | SAND | | | |
|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT 2 - 75 microns<br>CLAY <2 microns |

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

IT GEOTECHNICAL
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# *PARTICLE-SIZE DISTRIBUTION*
# *ASTM D 422*

Project Name Quanterra St. Louis

Project No. pending

Field Sample No. CB9917003XX

IT Lab Sample No. ETDC-8463

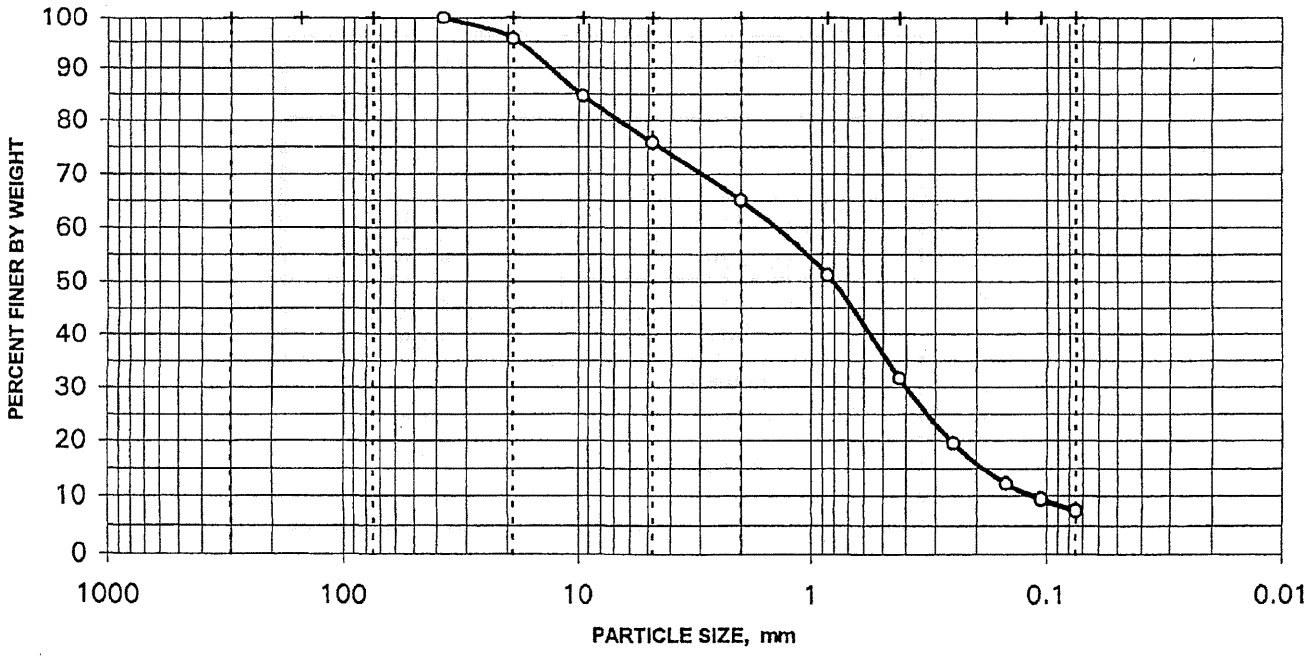
Moisture Content = 9.0%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 95.6% |
| | 0.375" | 9.500 | 84.6% |
| | #4 | 4.750 | 75.9% |
| | #10 | 2.000 | 65.0% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 51.1% |
| | #40 | 0.425 | 31.7% |
| | #60 | 0.250 | 19.5% |
| | #100 | 0.149 | 12.2% |
| | #140 | 0.106 | 9.5% |
| | #200 | 0.075 | 7.5% |

## DISTRIBUTION CURVE



Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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LABORATORY
OAK RIDGE, TN
(423) 482-6497

# *PARTICLE-SIZE ANALYSIS*
# *ASTM D 422*

| | | | |
|---|---|---|---|
| Project Name | Quanterra St. Louis | Client Sample No. | TP9924010XX |
| Project No. | pending | IT Lab Sample No. | ETDC-8464 |

Specific Gravity = 2.65
assumed for calculations

Moisture Content = 9.2%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 100.0% |
| | 0.75" | 19.000 | 93.9% |
| | 0.375" | 9.500 | 84.4% |
| | #4 | 4.750 | 76.5% |
| | #10 | 2.000 | 69.5% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 61.4% |
| | #40 | 0.425 | 42.6% |
| | #60 | 0.250 | 28.3% |
| | #100 | 0.149 | 20.6% |
| | #140 | 0.106 | 18.0% |
| | #200 | 0.075 | 15.9% |

## *HYDROMETER ANALYSIS*

| | Diameter mm | Percent Finer |
|---|---|---|
| HYDROMETER | | |
| | | |
| | 0.03528 | 6.9% |
| | 0.02256 | 5.6% |
| | 0.01316 | 4.3% |
| | 0.00934 | 2.6% |
| | 0.00664 | 2.0% |
| | 0.00473 | 1.3% |
| | 0.00328 | 1.0% |
| | 0.00142 | 1.0% |

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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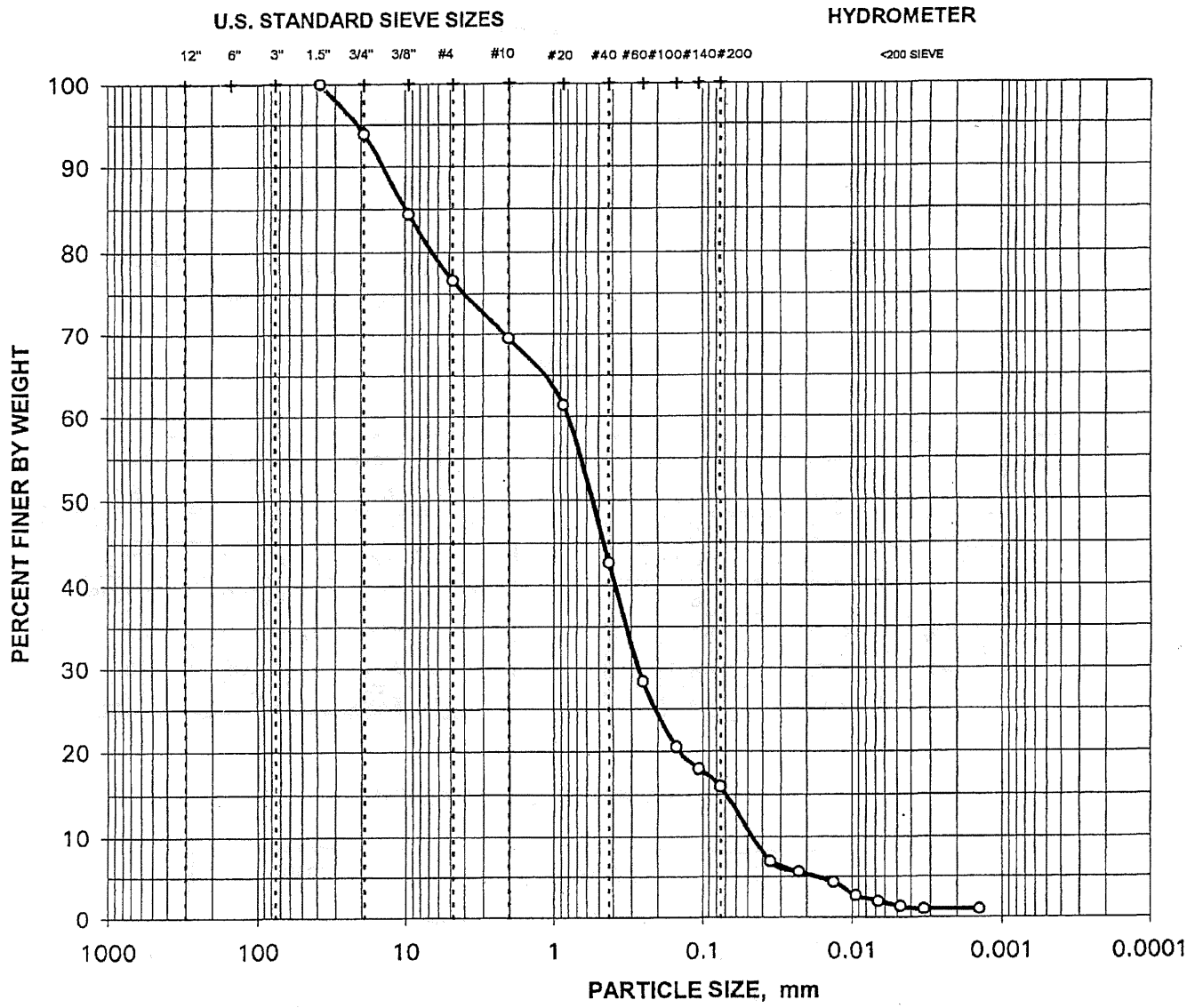
# Quanterra St. Louis




CLIENT SAMPLE NO.: TP9924010XX

IT LAB SAMPLE NO.: ETDC-8464

| BOULDERS | COBBLES | GRAVEL | | SAND | | | |
|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT 2 - 75 microns<br>CLAY <2 microns |

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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OAK RIDGE, TN
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# *PARTICLE-SIZE ANALYSIS*
# *ASTM D 422*

| | | | |
|---|---|---|---|
| Project Name | Quanterra St. Louis | Client Sample No. | CB9914003XX |
| Project No. | pending | IT Lab Sample No. | ETDC-8465 |

Specific Gravity = 2.65
assumed for calculations

Moisture Content = 6.9%
based on dry sample weight

## *SIEVE ANALYSIS*

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| COARSE | 3" | 75.000 | 100.0% |
| | 1.5" | 37.500 | 79.8% |
| | 0.75" | 19.000 | 58.4% |
| | 0.375" | 9.500 | 50.8% |
| | #4 | 4.750 | 48.7% |
| | #10 | 2.000 | 45.5% |

| | Sieve No. | Diameter mm | Percent Finer |
|---|---|---|---|
| FINE | #20 | 0.850 | 41.3% |
| | #40 | 0.425 | 33.3% |
| | #60 | 0.250 | 27.0% |
| | #100 | 0.149 | 22.1% |
| | #140 | 0.106 | 19.7% |
| | #200 | 0.075 | 17.2% |

## *HYDROMETER ANALYSIS*

| | Diameter mm | Percent Finer |
|---|---|---|
| HYDROMETER | | |
| | | |
| | 0.03260 | 9.6% |
| | 0.02148 | 7.1% |
| | 0.01284 | 4.7% |
| | 0.00913 | 3.4% |
| | 0.00650 | 2.8% |
| | 0.00465 | 2.1% |
| | 0.00324 | 1.5% |
| | 0.00141 | 1.3% |

Ron Martinez
Quanterra
November 3, 1999
IT Project ID: QUANTERRA ST. LOUIS
IT Project No.: pending

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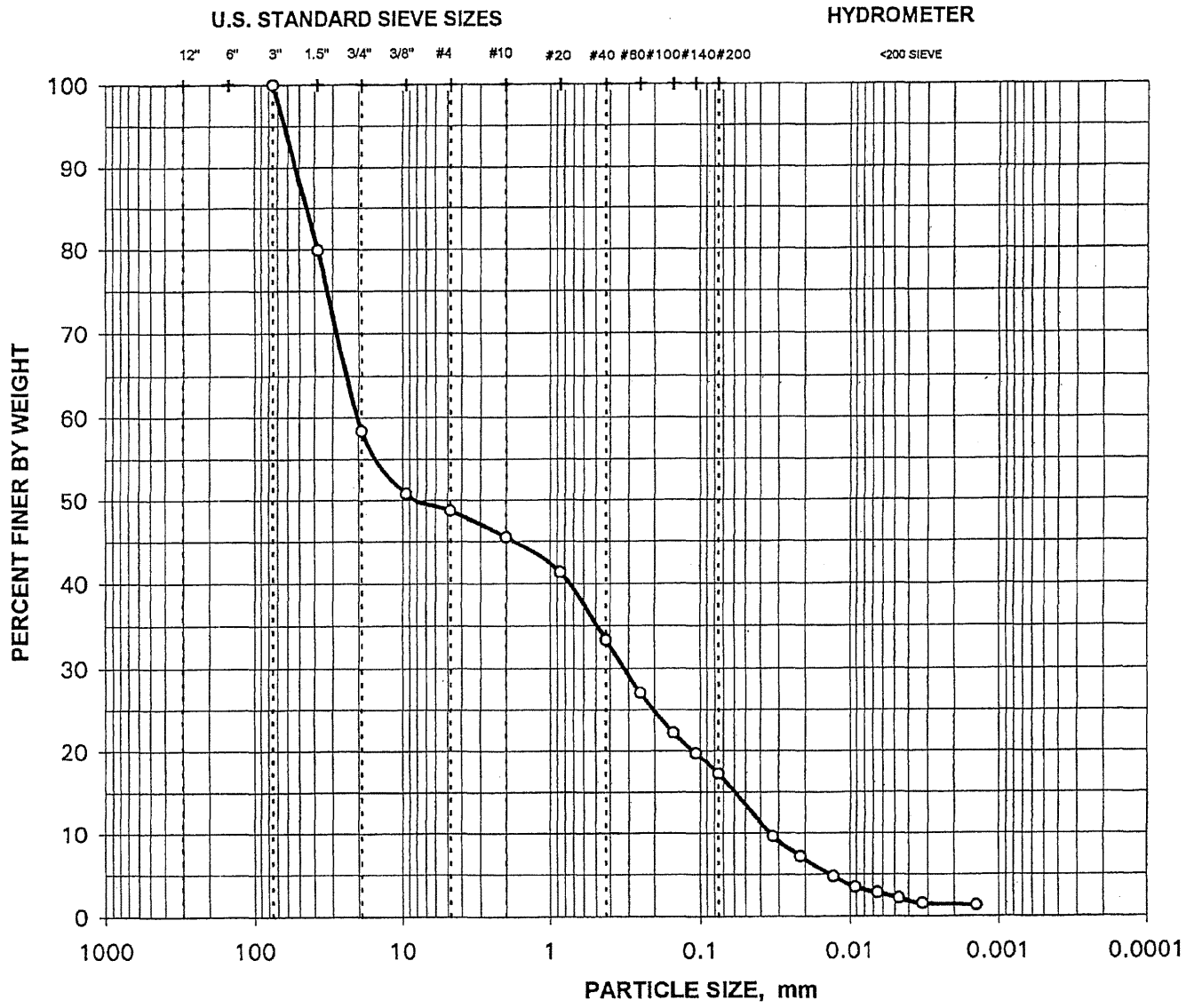
# Quanterra St. Louis




**CLIENT SAMPLE NO.:** CB9914003XX

**IT LAB SAMPLE NO.:** ETDC-8465

| BOULDERS | COBBLES | GRAVEL | | SAND | | | |
|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | |

SILT 2 - 75 microns

CLAY <2 microns

# Appendix C

# Chain-of-Custody & Request-for-Analysis

# Chain of Custody Record

temps cw 01252

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

QUA-4124

| | | | |
|---|---|---|---|
| Client: Foster Wheeler Harding, Lawson Associates | Project Manager: HLA - Rod Pendleton | Date: 9/22/99 9/20/99 SAP | Chain Of Custody Number: 63764 |
| Address: HLA - P.O. Box 7050 | Telephone Number (Area Code)/Fax Number: HLA - 207 775 5401 | Lab Number: | Page 1 of 1 |
| City: Portland / State: ME / Zip Code: 04112 | Site Contact: HLA - Rod Pendleton / Gina Rusted | | |
| Project Name: Stratford AEP | Carrier/Waybill Number: F.E. # 814773873055 | | |
| Contract/Purchase Order/Quote No.: Foster Wheeler P.O. | | | |

| | Sample I.D. No. and Description | Date | Time | Sample Type | Total Volume | Containers Type | Containers No. | Preservative | Condition on Receipt | Grain Size | Analysis | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CB990100 2XX | 9/20/99 | 13:30 | Soil | | 16 oz | 1 | | | X | ETDC 8457 | 1 |
| 2 | CB990400 2XX | 9/20/99 | 16:05 | Soil | | 16 oz | 1 | | | X | ETDC 8458 | 2 |
| 3 | CB990500 2XX | 9/21/99 | 8:30 | Soil | | 16 oz | 1 | | | X | ETDC 8459 | 3 |
| 4 | CB990700 6XX | 9/21/99 | 9:30 | Soil | | 16 oz | 1 | | | X | ETDC 8460 | 4 |
| 5 | CB991100 2XX | 9/21/99 | 10:40 | Soil | | 16 oz | 1 | | | X | ETDC 8461 | 5 |
| 6 | CB991201 0XX | 9/21/99 | | Soil | | 16 oz | 1 | | | X | ETDC 8462 | 6 |
| 7 | CB991700 3XX | 9/21/99 | 14:55 | Soil | | 16 oz | 1 | | | X | ETDC 8463 | 7 |
| 8 | ~~EB99~~ TP992401 0XX | 9/22/99 | 11:00 | Soil | | 16 oz | 1 | | | X | ETDC 8464 | 8 |
| 9 | CB991400 3XX | 9.22.99 | 0815 | Soil | | 16 oz | 1 | | | X | ETDC 8465 | 9 |

Special Instructions

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months

Turn Around Time Required
☒ Normal ☐ Rush

QC Level
☐ I. ☐ II. ☐ III.

Project Specific (Specify)

| | Relinquished By | Date | Time | Received By | Date | Time |
|---|---|---|---|---|---|---|
| 1. | | 9/22/99 | 1800 | | 9/23/99 | 0915 |
| 2. | | 10.12.99 | 1700 | | 10/13/99 | 1600 |
| 3. | | | | | | |

Comments
shipped to IT Knoxville for grain size. SAP 10/12/99 DUE NOV. 10, 1999

DISTRIBUTION: WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

# TEST PIT LOGS

# TEST PIT RECORD

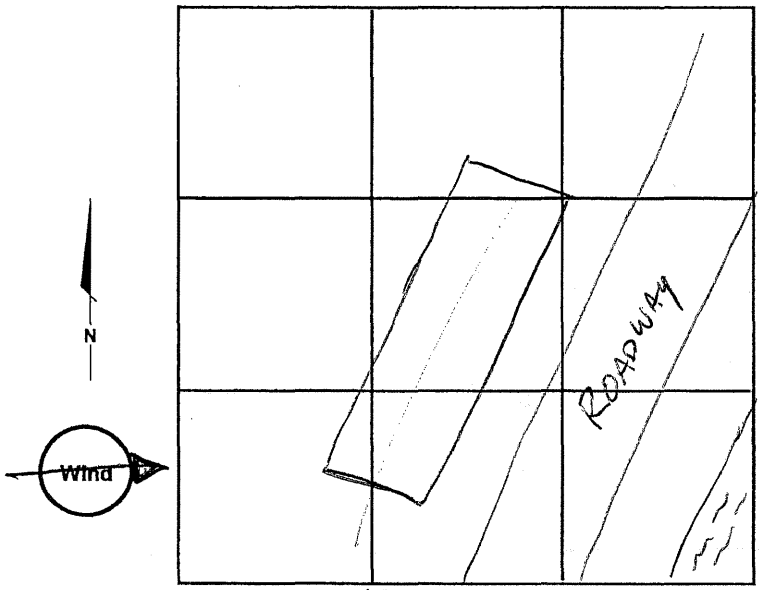


Site: **Stratford Army Engine Plant - Causeway**

Project No.: 47254 Date: 9-21-99

Test Pit ID: TP-DEP-11

**Sketch Map of Test Pit Site:**




Scale: 1"= 10 ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinhans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: see below | | |

NO PID - HEAVY RAIN

- FOSTER Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP Sodium Iodide (GAMMA SCINTILLATOR)

**Notes:**

THIS TEST PIT WAS PLACED BASED UPON GUIDANCE FROM CTDEP (FRED SCHERITZEL) (KEVIN SCOTT) THEIR CONCERN ARE 4 LOCATIONS ON THE CAUSEWAY; TP-DEP-11, TP-DEP-12, TP-DEP-15, & TP-DEP-17. These are so-named based on prior work performed by CTDEP WHEN TARGETS WERE IDENTIFIED AND NUMBERED. THESE LOCATIONS ARE FLAGGED AND IDENTIFIED IN THE FIELD. CTDEP & ALLIED SIGNAL COLLECT SAMPLES OF RADIOLOGICALLY ELEVATED SAMPLES. HLA COLLECTS LABORATORY SAMPLES OF MATERIAL OTHER THAN RADIOLOGICALLY ELEVATED SOILS, AND ONLY AFTER SAMPLES WERE SCREENED W/ PANCAKE PROBE.

CTDEP describes the 4 ELEVATED AREAS AS being "LINE" OR LINEAR ANOMALIES BECAUSE THEY ARE NARROW RELATIVE TO THEIR LENGTHS.

# TEST PIT RECORD

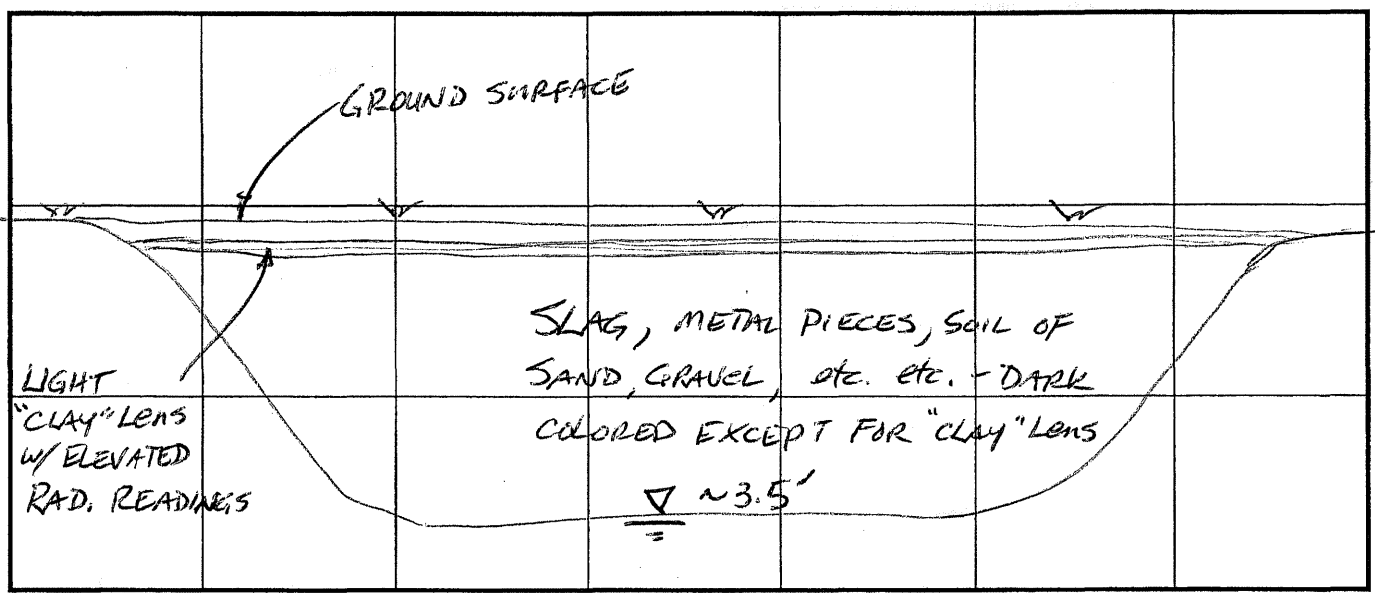


Site: **Stratford Army Engine Plant - Causeway**

Test Pit ID: TP-DEP-11

9-21-99

**Sketch Map of Test Pit Profile**




**Scale: 1"=** 2 **ft.**
**Depth:** _____ **ft.**

**Notes:**

SCRAPED 4"TO 6" DEEP & EXPOSED A GRAY COLORED "CLAY" LAYER W/ high READINGS ASSOCIATED W/ this LENS. Other SOILS ARE dark COLORED GRAVELLY SLAG, SOIL, FILL, etc. CLAY LENS = 1,000 counts per minute (CPM) other SOILS = 200 CPM. Light colored "CLAY" lens may be distinct IN the area & not spread throughout the Causeway & does not extend too deeply into profile. ~4' LONG X 8"/10" deep & oriented along axis of Causeway. The LAYER IS approx. 1"/2" Thick Took SAMPLE @ ~1' deep TPDEP11001XX from below the clay lens. Material here is SLAG/foundry waste W/ "CLAY" placed on top W/ thin SOIL cover. Strong fuel odor, ▽ 3.5' bgs. RADIATION Readings decrease w/ depth, & to much lesser degree than in the "CLAY" LENS.

Reference: Field Book #: H&S Pg.: #27

Attachments: _____

Signature: Thomas D. Tenfy

# TEST PIT RECORD

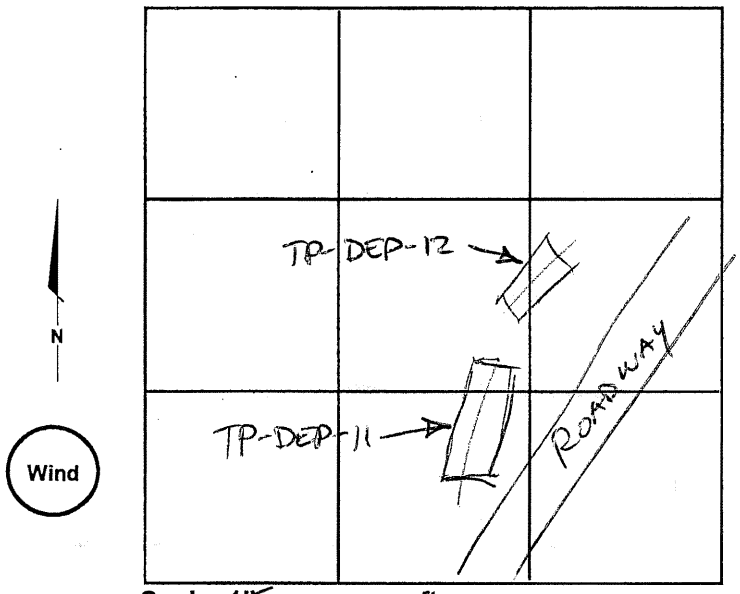


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-24-99

Test Pit ID: TP-DEP-12

**Sketch Map of Test Pit Site:**




Scale: ~~1"=~~ _____ ft.
AS SHOWN

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE backhoe
3. F. Scheritzel - CTDEP
4. K. Scott - CT DEP
5. K. KLEINMANS - F.W.
6. J. FLEMING - ALLIED SIGNAL

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: See below | | |

NO PID - HEAVY RAIN

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

TP-DEP-12 IS ALMOST A CONTINUATION OF TREND OF TP-DEP-11, but is NOT CONTINUOUS FROM one-to-the-other. They ARE SEPARATE & DISTINCT. CTDEP CALLS THESE "LINEAR ANOMALIES"

# TEST PIT RECORD

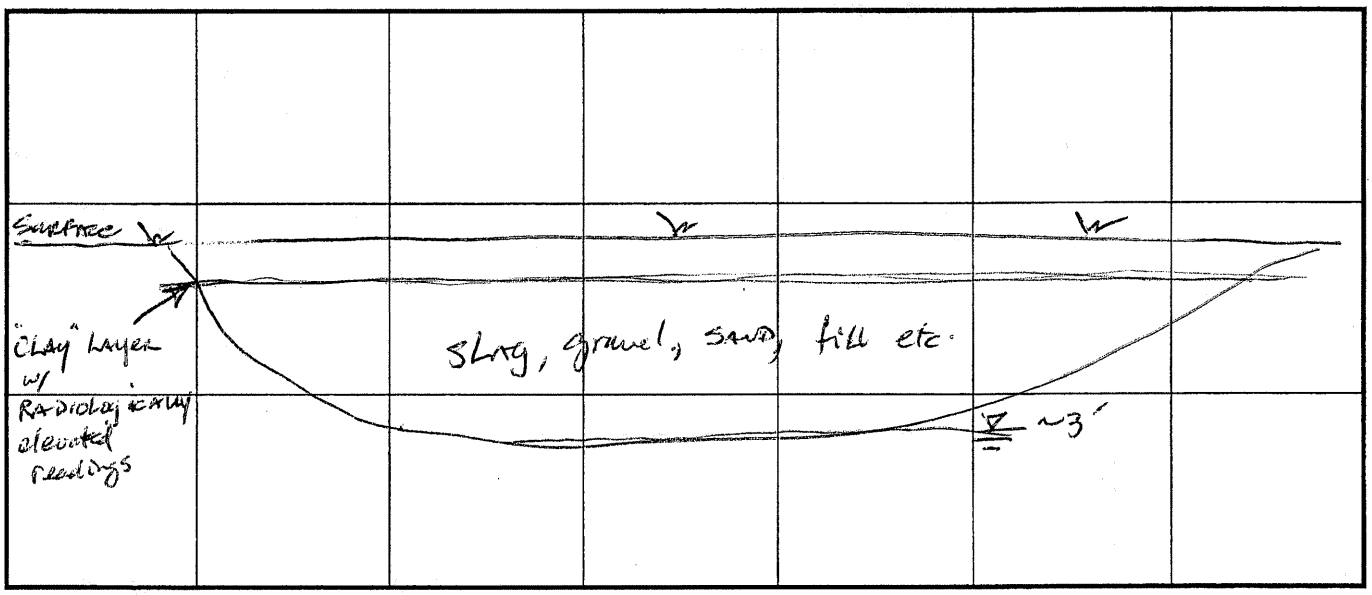


Site: Stratford Army Engine Plant - Causeway

Test Pit ID: TP-DEP-12

9-21-99

**Sketch Map of Test Pit Profile**




Scale: 1"= As shown ft.
Depth: _____ ft.

**Notes:**

Again, clay layer is visible @ shallow DEPTH w/in this test pit. Readings = 1,000 CPM with Rest of soil = 200 CPM (Ave.) using Geiger Mueller ~~test~~ instrument.
Very distinct diesel odor. This test pit is in-line w/ TP-DEP-11 & ~15' to the North. This whole area is a slag dump or sorts. Radiological readings, as in TP-DEP-11, decrease w/ depth below the clay lens.
Sample is collected from just above the ▽ @ 3' bgs.
TP DEP12003XX - full suite

Reference: Field Book #: _____ Pg.: # 28

Attachments: —

Signature: Thomas D. Lyle

# TEST PIT RECORD

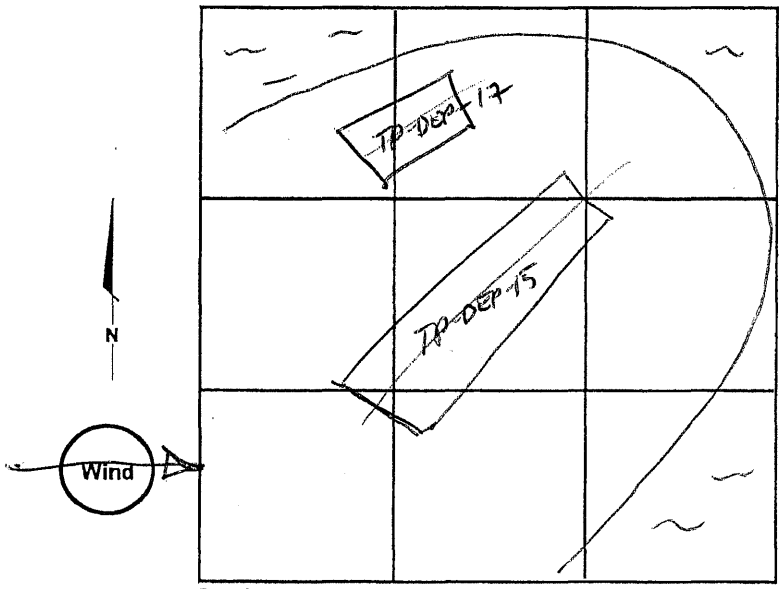


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-21-99

Test Pit ID: TP-DEP-15

**Sketch Map of Test Pit Site:**




Scale: 1"= AS SHOWN ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE backhoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinmans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: See below | | |

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

NO PID - HEAVY RAIN

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

AT THIS TEST PIT, hit pavement (old paved roadway that apparently covered this outer portion of the Causeway) @ ~6" bgs. The fill material on top of bituminous way is sandy material w/ the whitish "clay" radiological material w/in this upper filled soil. Had 500/600 CPM w/ Geiger-Mueller probe on "clay" material & 100 CPM on rest of fill lying over top of this. Soil is yellow brown, gravelly SAND. NO ANALYTICALS collected here due to thin 6" fill over pavement.

ELEV. = 8.1'

John D. Longley

# TEST PIT RECORD

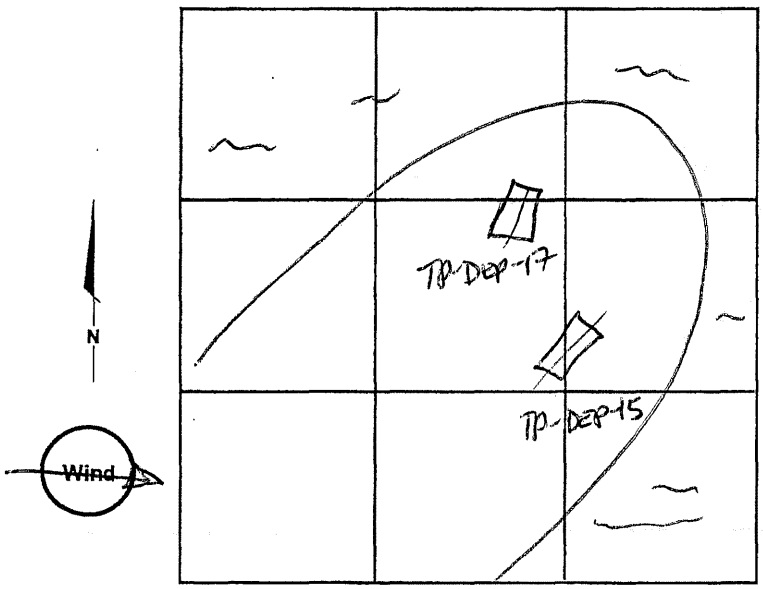


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-29-99

Test Pit ID: TP-DEP-17

**Sketch Map of Test Pit Site:**




Scale: 1"= As Shown ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE backhoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinmans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: See below | | |

No PID - Heavy Rain

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

Again, hit pavement in this location (as in TP-DEP-15) but @ deeper depth of 2½' bgs. Same material in this location again; the whitish "clay" material has readings up to 1,000 CPM w/ PANCAKE probe (Geiger-Mueller). This material is ~2" thick & extends to 10" to 12" bgs, over yellowish brown, gravelly SAND.

# TEST PIT RECORD

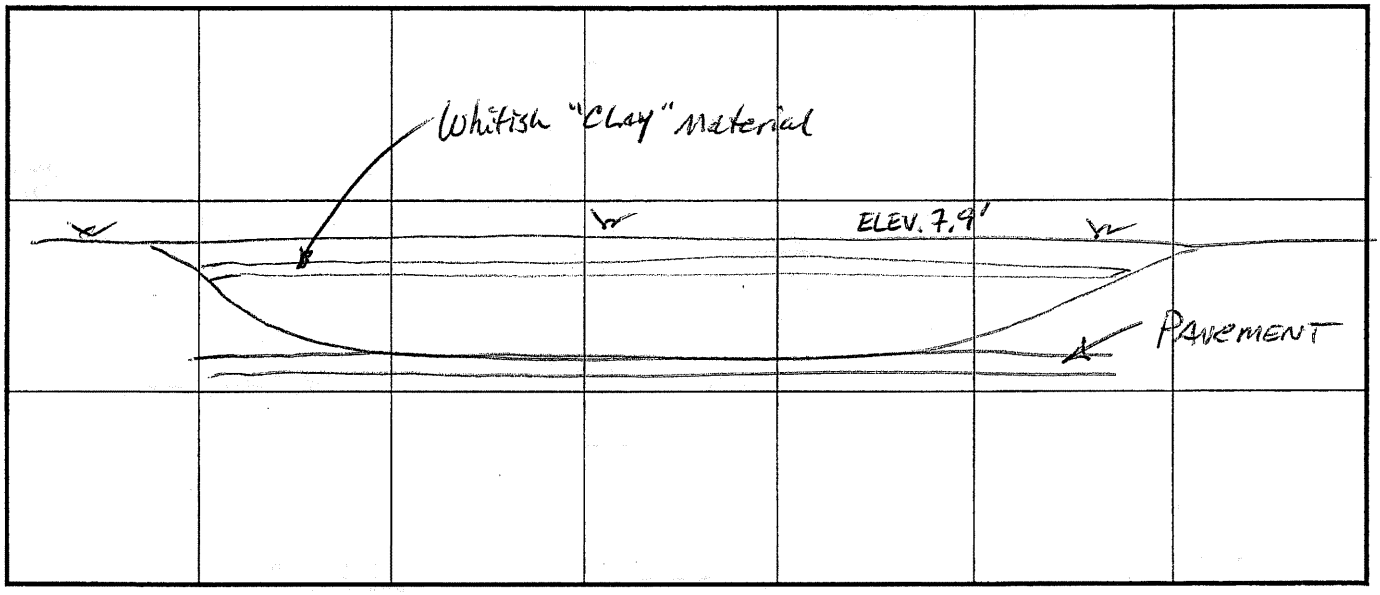


Site: **Stratford Army Engine Plant - Causeway**

Test Pit ID: TP-DEP-17

9-21-99

**Sketch Map of Test Pit Profile**




**Scale: 1"=_____ ft.**
**Depth: _____ ft.**

**Notes:**

Collect Full Suite Sample here @ TP DEP 17003XX w/ Duplicate collected for Metals, VOC, & SVOC only

for all test pits on the Causeway

All samples, once placed into S.S. mixing bowl [except for VOCs which are discreetly collected by syringe] ARE screened by Kyle Kleinhans of F.W. w/ PANCAKE probe — he gives "O.K." for sample collections. Then soil is homogenized & placed into appropriate containers for different parameters.

Reference: Field Book #: ____ Pg.: 29

Attachments: ____

Signature: Thomas D. Zyla

# TEST PIT RECORD

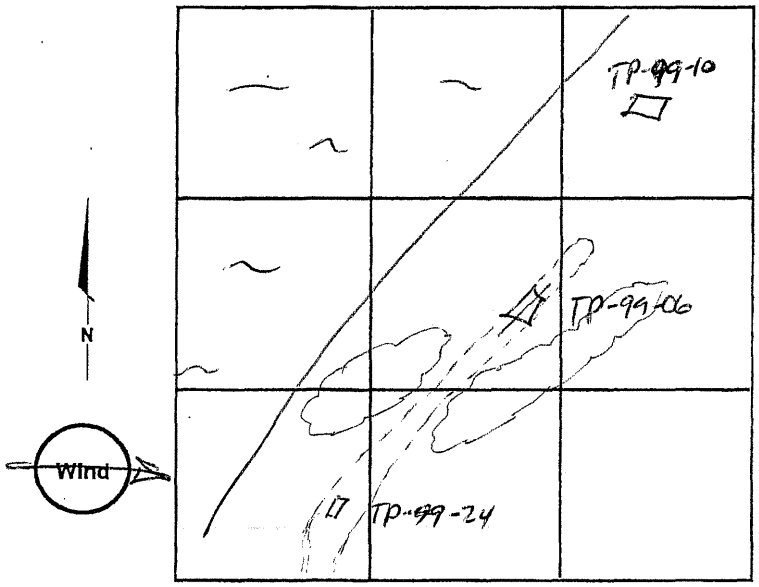


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-30-99

Test Pit ID: TP-99-06

**Sketch Map of Test Pit Site:**




Scale: 1"=_____ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE backhoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinmans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | Y | N |
| Other: See below | (Y) | |

No PID - Heavy Rain

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

This location is on top of Causeway along a "ROADWAY" cleared for access for this work.

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

# TEST PIT RECORD

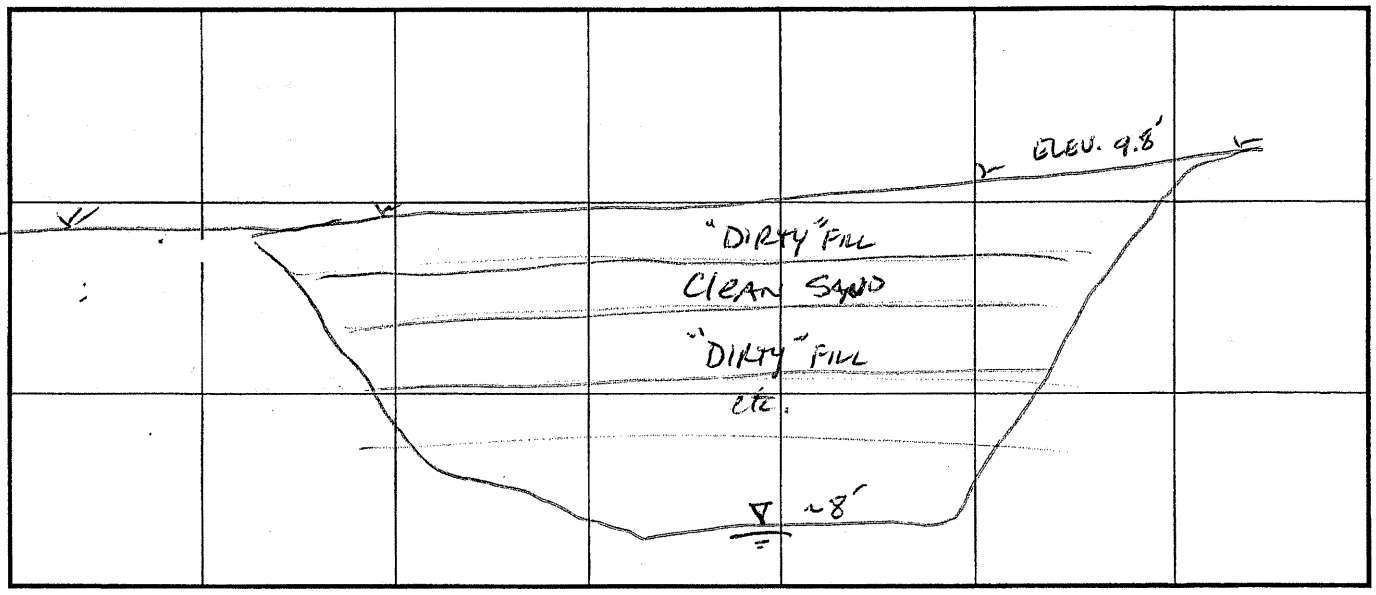


Site: Stratford Army Engine Plant - Causeway

Test Pit ID: TP-99-06

9-21-99

**Sketch Map of Test Pit Profile**




Scale: 1"= \ ft.
Depth: \ ft. AS SHOWN

**Notes:**

Hit water w/in this test pit @ ~ 8' bgs
Collect sample for FULL-suite analysis plus Aste for TICs for VOC & SVOCs.
TEST PIT HAS DARK soil Lenses MIXED w/ Lighter & CLEANER Yellowish SAND LAYERS. There are all kinds of FILL MATERIAL present. SAMPLE IS DARK GRAVELLY SAND (DIRTY FILL) (NO PID-RAINING) W/ FAINT fuel ODOR- fuel is Likely ON TOP OF WATER AT NEARLY ALL LOCATIONS on CAUSEWAY. CAUSEWAY WAS built w/ "DIRTY" MATERIAL alternating w/ APPARENTLY CLEAN, GRAVELLY, yellowish SAND.
TP990608XX

Reference: Field Book #: \ Pg.: 30 & 31

Attachments: \

Signature: Thomas D. Tingley

# TEST PIT RECORD

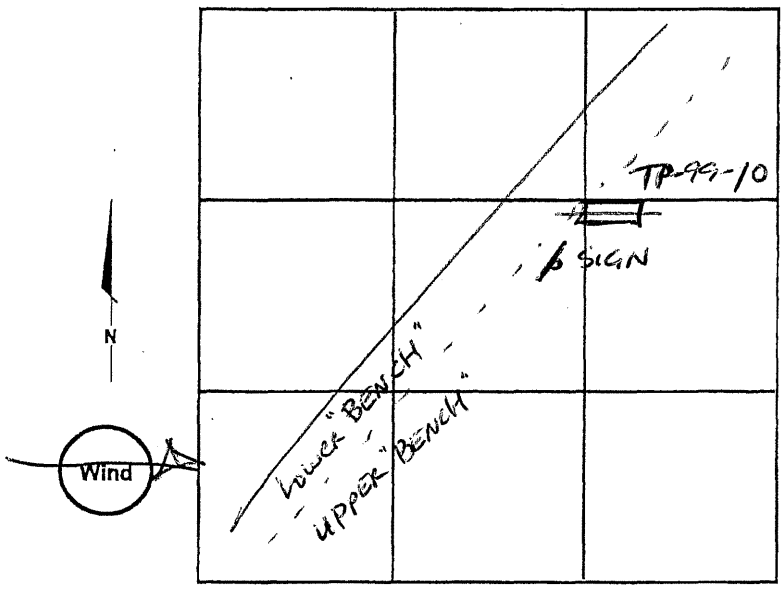


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-28-99

Test Pit ID: TP-99-10

**Sketch Map of Test Pit Site:**




Scale: 1"= _____ ft.

**Notes:** AS SHOWN

SEE TP-DEP-11 for GENERAL NOTES
This Test pit Location is on CAUSEWAY JUST North of U.S. GOV'T property SIGN. There is a Lower "BENCH" of CAUSEWAY that Receives "FLOTSAM" from the RIVER during higher Tides & storm events. The Test pit WAS positioned in the "Upper bench" or higher portion of the CAUSEWAY

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE back hoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. KLEINMANS - F.W.
6. J. FLEMING - ALLIED SIGNAL

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | Y | N |
| Other: See below | (Y) | N |

NO PID - HEAVY RAIN

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

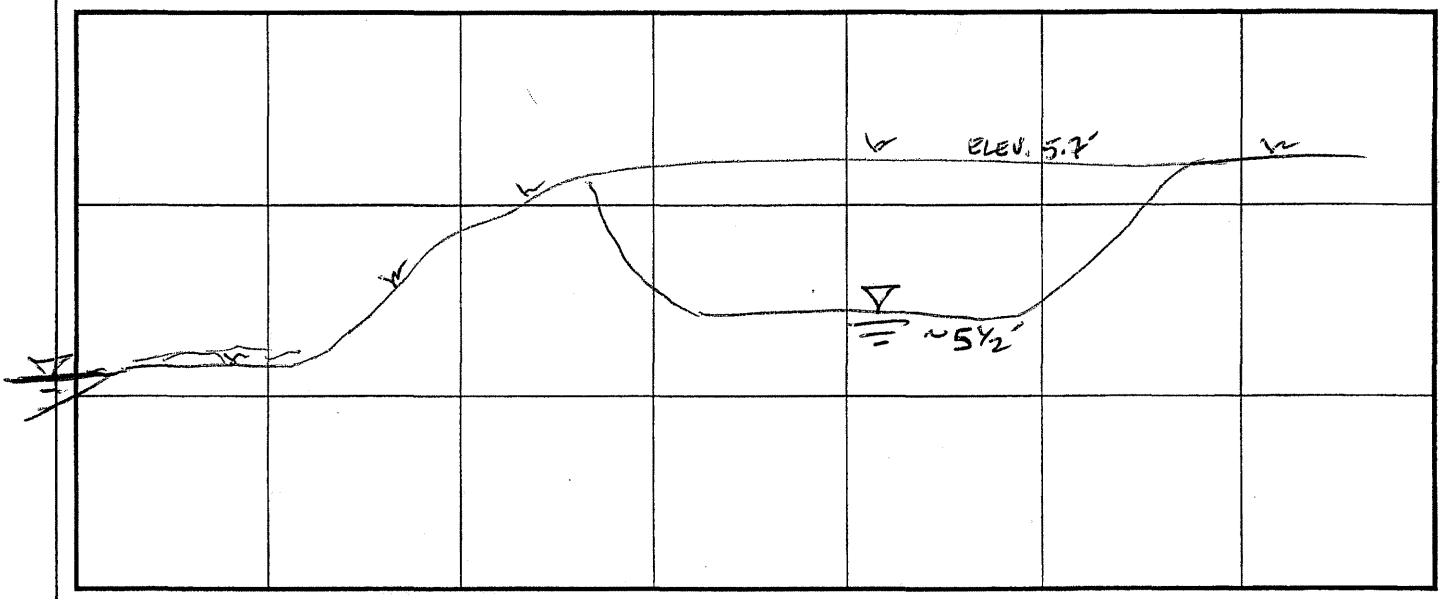
# TEST PIT RECORD



Site: Stratford Army Engine Plant - Causeway

Test Pit ID: TP-99-10 9-21-99

**Sketch Map of Test Pit Profile**




Scale: 1"=~~_____~~ ft.
Depth: _____ ft. AS SHOWN

**Notes:**

Collect sample @ TP991005XX from just above water table
Soils are filled w/ steel pieces, plywood, large stones, etc.

Reference: Field Book #: ____ Pg.: #31

Attachments: —

Signature: Thomas D. Lufty

# TEST PIT RECORD

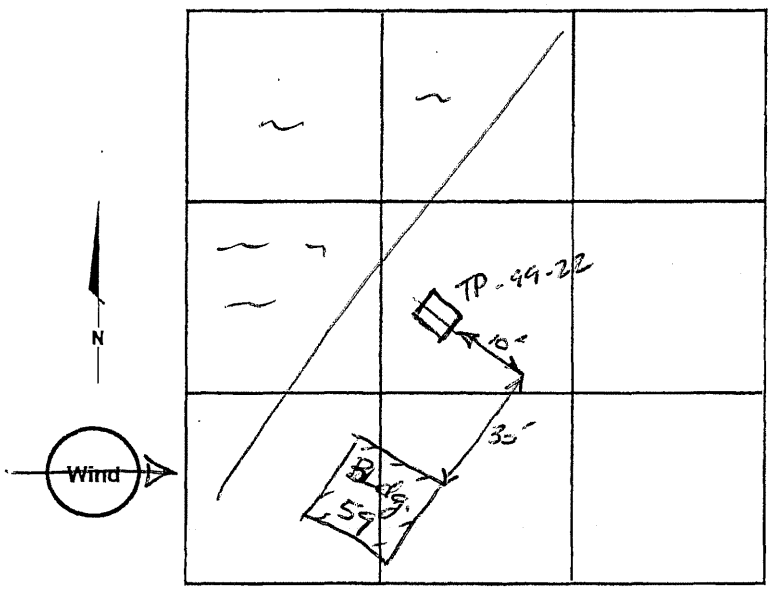


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-29-99

Test Pit ID: TP-99-22

**Sketch Map of Test Pit Site:**




Scale: 1"= As Shown ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE backhoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinmans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | Y | N |
| Other: See below | | |

No PID - Heavy Rain

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

TODAY, will test pit locations on CAUSEWAY NOT yet visited by Drill Rig or Back-hoe. CTDEP expresses SATISFACTION w/ the coverage we have drilled & test pitted on the CAUSEWAY - WE have visited the areas they are MOST INTERESTED IN SO FAR.

# TEST PIT RECORD

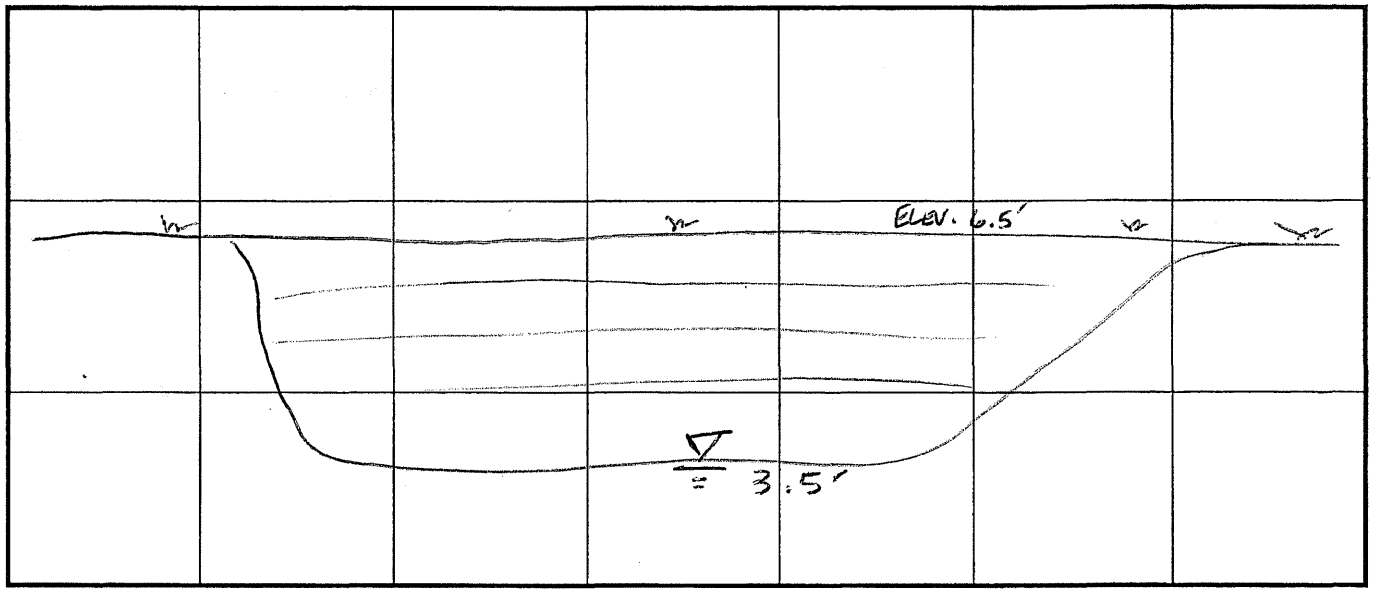


Site: **Stratford Army Engine Plant - Causeway**

Test Pit ID: TP-99-22

9-22-99

**Sketch Map of Test Pit Profile**




**Scale: 1"=** ~~_____~~ **ft.**
**Depth:** ~~_____~~ **ft.** AS SHOWN

**Notes:**

TEST PIT shows a "LAYERING" of sorts of dark fill alternating w/ highly odorous, fuel stained LAYERS beginning @ ~ 3.0' bgs. Pit has piping, gravel, cobbles, stones, etc. Collected SAMPLE @ just above ▽ of 3.5'. SAMPLE is of the black fuel-stained material & SANDY mix.

Collected SAMPLE TP9922003XX for FULL-Suite & MS/MSD for Metals, SPLP, PCB, SVOC, & VOC

Reference: Field Book #: ____ Pg.: #33, 34

Attachments: —

Signature: Thomas D. Tonfy

# TEST PIT RECORD

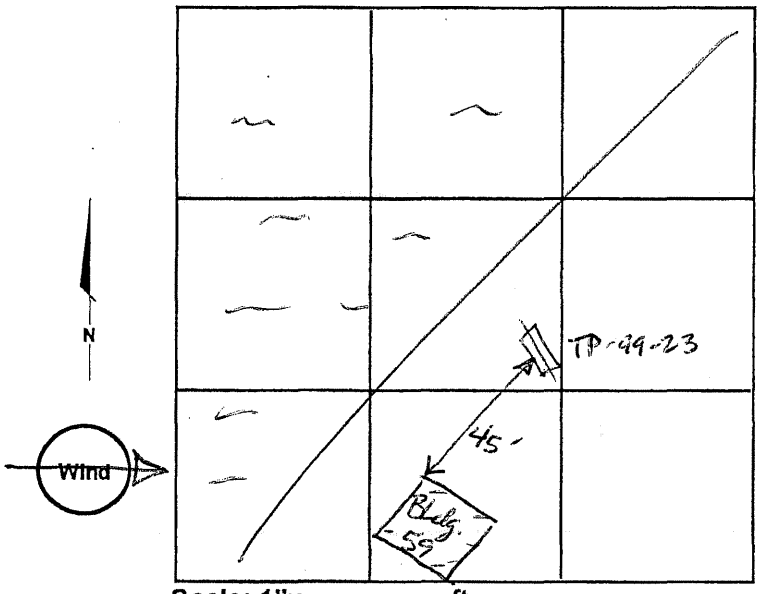


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-~~20~~22-99

Test Pit ID: TP-99-23

**Sketch Map of Test Pit Site:**




Scale: 1"= As Shown ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE back hoe
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinmans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | Y | N |
| Other: See below | | |

No PID - Heavy Rain

**Notes:**

SEE TP-DEP-11 for GENERAL NOTES

This test pit is located as shown above.

ELEV. ~6.5'

- Foster Wheeler PANCAKE PROBE (GEIGER-MUELLER)
- CTDEP SODIUM IODIDE PROBE (GAMMA SCINTILLATOR)

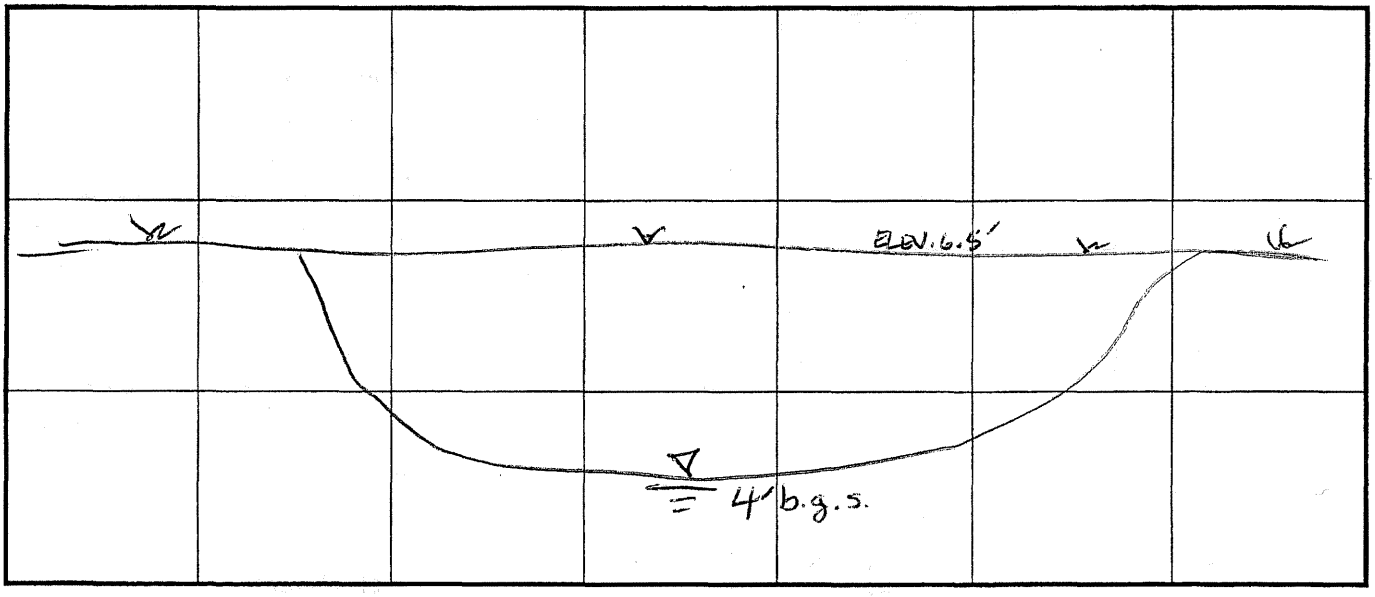
# TEST PIT RECORD



Site: Stratford Army Engine Plant - Causeway

Test Pit ID: TP-99-23 9-22-99

**Sketch Map of Test Pit Profile**




Scale: 1"= ~~_____~~ ft.
Depth: ~~_____~~ ft. As shown

**Notes:**

Test pit has gravelly, cobbly & stony yellowish brown SAND to ~ 3.5/4' bgs then has a black oil-stained layer ~~at~~ @ 3.5' TP-99-22. Highly odorous in the black layer & ~ 4' bgs. Collect sample @ 3' bgs above the black oil-stained zone. Collect a sample - full suite - plus a duplicate of VOC, SVOC & metals.

TP9923003XX

Reference: Field Book #: _____ Pg.: # 34

Attachments: _____

Signature: Thomas D. Zayly

# TEST PIT RECORD

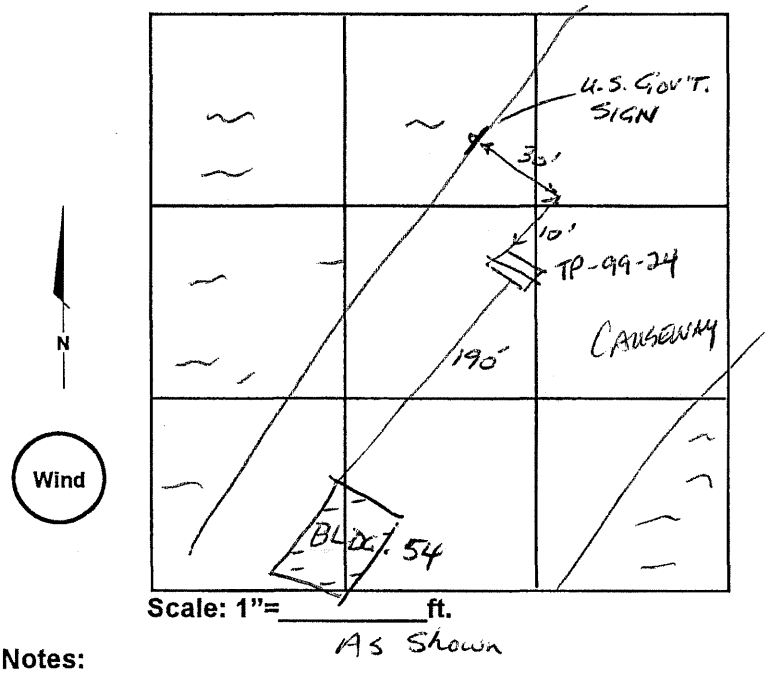


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-22-99

Test Pit ID: TP-99-24

**Sketch Map of Test Pit Site:**




Scale: 1"= As Shown ft.

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinhans - F.W.
6. J. Fleming - ALLIED SIGNAL

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | | |
| Other: See below | (Y) | N |

NO PID - RAIN

- Foster Wheeler PANCAKE Probe (Geiger-Mueller)
- CTDEP SODIUM IODIDE PROBE (GAMMA Scintillator)

**Notes:**

LOCATION is shown AS ABOVE - ALONG Access WAY placed to allow passage to TP-99-06 & TP-99-10. This is "elevated" relative to Causeway on West & EAST sides of this test pit.

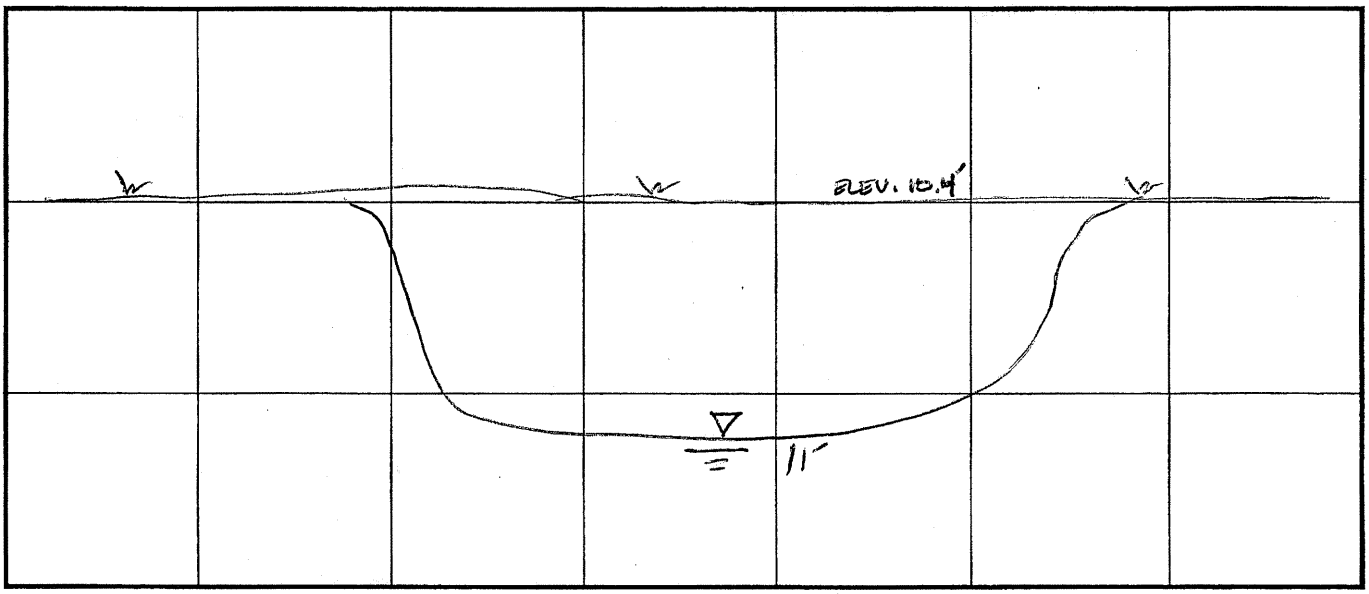
# TEST PIT RECORD



Site: Stratford Army Engine Plant - Causeway

Test Pit ID: TP-99-24 9-22-99

**Sketch Map of Test Pit Profile**




Scale: 1"=_____ ft.
Depth: _____ ft. AS Shown

**Notes:**

Collect GRAIN SIZE HERE plus full-suite plus QA Sample
TP99 24010 XX
Pit shows yellowish brown SAND w/ gravel, cobbles, concrete blocks, Asphalt, etc.
Water @ ~11' bgs - Collect sample just above water -
no fuel odor here in this pit

Reference: Field Book #: _____ Pg.: # 35

Attachments: _____

Signature: Thomas D. Tenfy

# TEST PIT RECORD

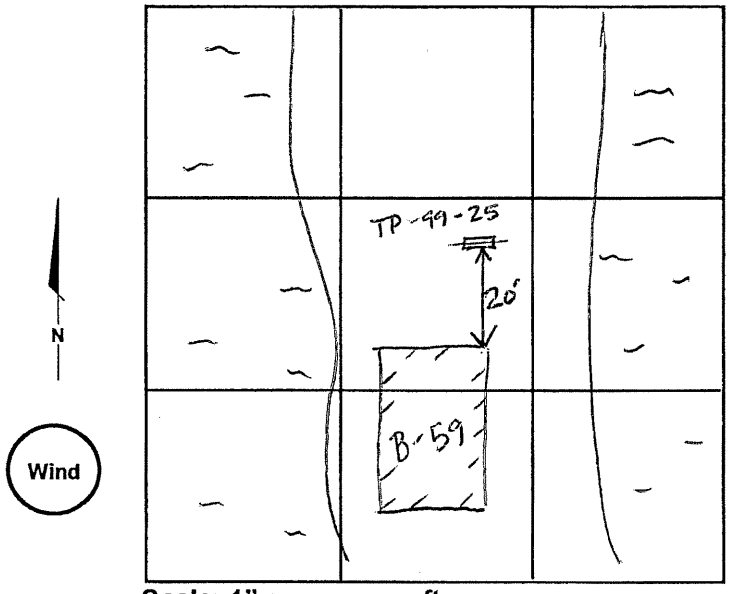


Site: Stratford Army Engine Plant - Causeway

Project No.: 47254 Date: 9-22-99

Test Pit ID: TP-99-25

**Sketch Map of Test Pit Site:**




Scale: 1"= _____ ft.
AS SHOWN

**Crew Members:**

1. T. Longley - HLA
2. S. Smith - NFE
3. F. Scheritzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinhans - F.W.
6. J. FLEMING - ALLIED SIGNAL

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: | | |

- Foster Wheeler Pancake Probe (Geiger-Mueller)
- CTDEP - Sodium Iodide Probe (GAMMA SCINTILLATOR)

**Notes:**

THIS TEST PIT WAS EXCAVATED BASED UPON A RELATIVELY LARGE MAGNETIC ANOMALY AT THIS LOCATION. THIS IS RELATIVELY CLOSE to already EXCAVATED TP-99-22. DURING EXCAVATION, DISCOVERED a potential Thoriated magnesium Casting - This should not be magnetic - very Light weight Relative to its size. This Reads 2 to 3 background radiation as per Fred Scheritzel of CTDEP. Found this @ ~4' bgs. Lot of rubble in hole, ▽ @ 4' bgs - No real reason for observance of magnetic anomaly. Did see one large asphalt-like block ~ 5'x3'x2' which may be cause of the mag. anomaly. High fuel odor in this test pit as in TP-99-23

NO SAMPLES Collected

# TEST PIT RECORD

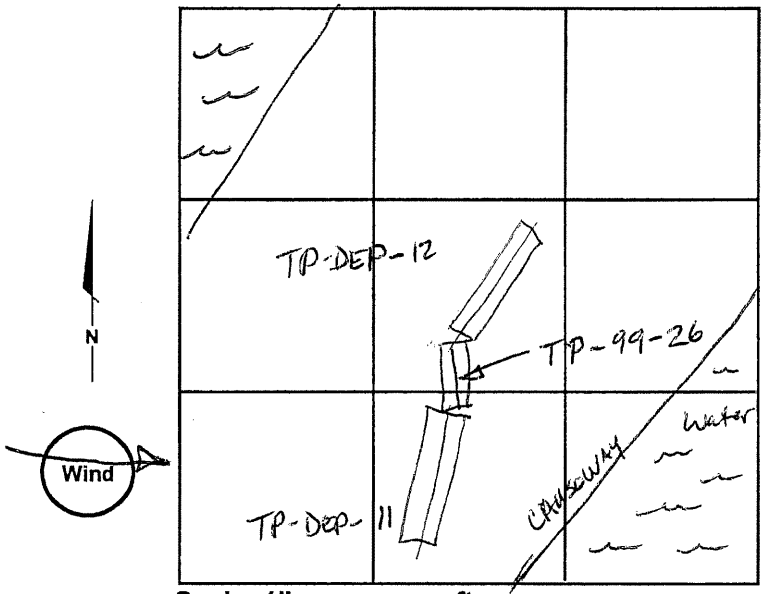


Site: Stratford Army Engine Plant - Causeway

Project No.: (TP-99-26) 47254 Date: 9-22-99

Test Pit ID: TP-99-26

**Sketch Map of Test Pit Site:**




Scale: 1"= As Shown ft.

**Crew Members:**

1. J. Longley - HLA
2. S. Smith - NFE
3. F. Scharitzel - CTDEP
4. K. Scott - CTDEP
5. K. Kleinhans - F.W.
6. J. Fleming - Allied Signal

**Monitor Equipment:**

| | | |
|---|---|---|
| PI Meter | Y | N |
| Explosive Gas | Y | N |
| Avail. Oxygen | Y | N |
| OVA | (Y) | N |
| Other: | | |

NO PID - RAIN

- Foster Wheeler Pancake Probe (Geiger-Mueller)
- CTDEP Sodium Iodide Probe (Gamma Scintillator)

**Notes:**

This test pit was excavated based upon a magnetic anomaly - placed mid-way between ~~TP~~ TP-DEP-11 and TP-DEP-12. Found more slag material which likely could be cause of magnetic anomaly. Slag is present as conglomerate-type rusty slag material. This is the 2nd of 2 anomalies (other one being TP-99-25) that produced magnetic signatures worthy, or large enough, to be explored.

No samples collected

# HAND AUGER LOGS

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Project Number: 47254
Sample Location ID: HA-99-01
Time: Start: 09:30 End: 10:00

Site: Dike
Date: 9-23-99
Signature of Sampler: Thomas D. Tingley

ELEV. = 12.3

**SOIL SAMPLE**

DEPTH OF SAMPLE ~6" BGS

EQUIPMENT USED FOR COLLECTION:
- [✓] HAND AUGER
- [ ] S.S. SPLIT SPOON
- [ ] SHOVEL
- [ ] HAND SPOON
- [ ] ALUMINUM PANS
- [✓] SS BUCKET
- [✓] SYRINGE FOR VOCs (SINGLE USE)

TYPE OF SAMPLE COLLECTED:
- [✓] DISCRETE - VOCs
- [✓] COMPOSITE - all others

SAMPLE OBSERVATIONS:
- [ ] ODOR
- [ ] COLOR
- [ ]

DECONTAMINATION FLUIDS USED:
- ✓ ALL USED
- [ ] ETHYL ALCOHOL
- [ ] 25% METHANOL/ 75% ASTM TYPE II WATER
- [✓] DEIONIZED WATER
- [✓] LIQUINOX SOLUTION
- [ ] HEXANE
- [ ] $HNO_3$ SOLUTION
- [ ] POTABLE WATER
- [ ] NONE

SOIL TYPE:
- [ ] CLAY
- [✓] SAND
- [✓] ORGANIC
- [ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID

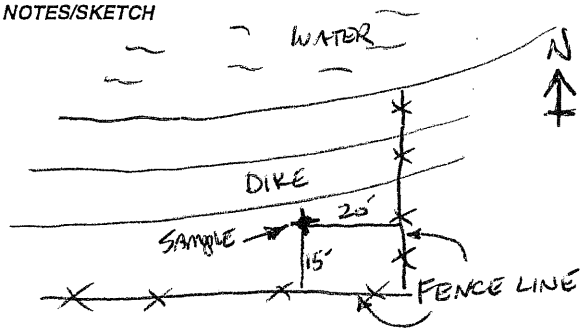
SAMPLE LOCATION SKETCH:
- [✓] YES
- [ ] NO

***SAMPLES COLLECTED***

COLLECTED SAMPLE for VOC, SVOC, PCB, Metals, Asbestos, SPLP HA9901000XX
COLLECTED MS for VOC, SVOC, PCB, Metals
COLLECTED MSD for VOC, SVOC, PCB, Metals

HA9901001XX WAS DISCRETE VOC SAMPLE W/ SINGLE-USE SYRINGE & COMPOSITED FOR ALL OTHER COMPOUNDS

***NOTES/SKETCH***




ON GRASSY SLOPE LEADING UP TO TOP OF CAUSEWAY.

SAMPLE WAS OF DARK BROWN LOAM (FINE SAND & SILT W/ ORGANICS) VERY WELL SORTED, DRY, LOOSE-IN-HAND, FIRM-IN-PLACE.

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Project Number: 47254
Sample Location ID: HA-99-02
Time: Start: 11:00 End: 11:15

Site: Dike
Date: 9-23-99
Signature of Sampler: Thomas D. Lafly

ELEV. = 7.6'

**SOIL SAMPLE**

DEPTH OF SAMPLE ~ 10" TO 12" bgs

EQUIPMENT USED FOR COLLECTION:
- [✓] HAND AUGER
- [ ] S.S. SPLIT SPOON
- [ ] SHOVEL
- [ ] HAND SPOON
- [ ] ALUMINUM PANS
- [✓] SS BUCKET
- [✓] SINGLE USE SYRINGE for VOCs

TYPE OF SAMPLE COLLECTED:
- [✓] DISCRETE VOC
- [✓] COMPOSITE All other param.

SAMPLE OBSERVATIONS:
- [ ] ODOR
- [ ] COLOR
- [ ]

DECONTAMINATION FLUIDS USED:
- ✓ ALL USED
- [ ] ETHYL ALCOHOL
- [ ] 25% METHANOL/ 75% ASTM TYPE II WATER
- [✓] DEIONIZED WATER
- [✓] LIQUINOX SOLUTION
- [ ] HEXANE
- [ ] $HNO_3$ SOLUTION
- [ ] POTABLE WATER
- [ ] NONE

SOIL TYPE:
- [ ] CLAY
- [✓] SAND
- [ ] ORGANIC
- [ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID

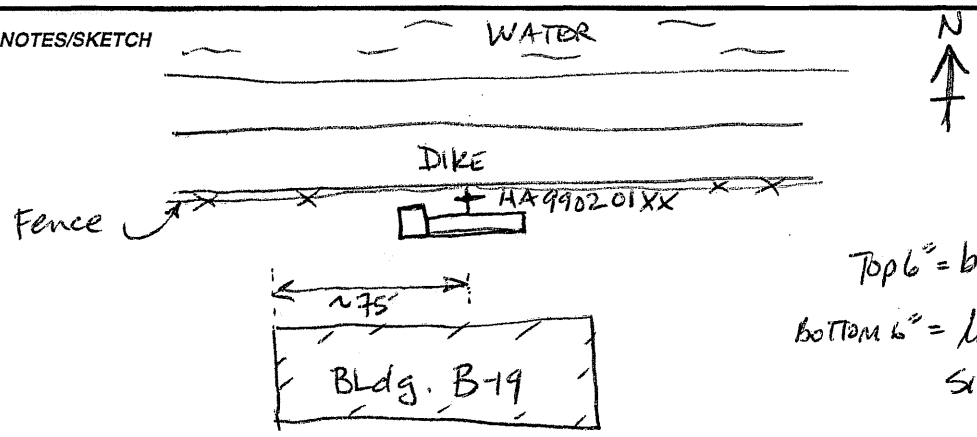
SAMPLE LOCATION SKETCH:
- [✓] YES
- [ ] NO

***SAMPLES COLLECTED***

COLLECTED SAMPLE FOR Asbestos, Metals, PCB, SPLP, SVOC, VOC

HA990201XX

***NOTES/SKETCH***




Top 6" = brown, MOIST, SANDY-SILT

Bottom 6" = light brown MED. SAND w/ SILT, RUSTY & MOTTLED IN PLACES

Harding Lawson Associates

9912003(a) L19

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Site: Dike
Project Number: 47254
Date: 9-23-99
Sample Location ID: HA-99-03
Time: Start: 11:20 End: 11:30
Signature of Sampler: Thomas D. Zayko

ELEV. = 7.5

**SOIL SAMPLE**

DEPTH OF SAMPLE ~8" bgs

EQUIPMENT USED FOR COLLECTION:
[✓] HAND AUGER
[ ] S.S. SPLIT SPOON
[ ] SHOVEL
[ ] HAND SPOON
[ ] ALUMINUM PANS
[✓] SS BUCKET
[✓] SINGLE-USE SYRINGE for VOC

TYPE OF SAMPLE COLLECTED:
[✓] DISCRETE VOC
[✓] COMPOSITE All other param.

SAMPLE OBSERVATIONS:
[ ] ODOR
[ ] COLOR
[ ]

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[✓] DEIONIZED WATER
[✓] LIQUINOX SOLUTION
[ ] HEXANE
[ ] $HNO_3$ SOLUTION
[ ] POTABLE WATER
[ ] NONE

SOIL TYPE:
[ ] CLAY
[✓] SAND
[ ] ORGANIC
[ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID

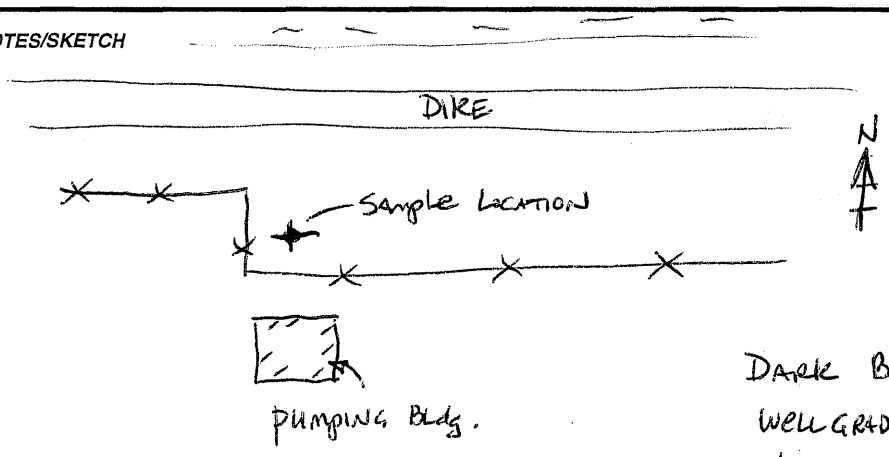
SAMPLE LOCATION SKETCH:
[✓] YES
[ ] NO

***SAMPLES COLLECTED***

HA99030O1XX

COLLECTED Sample for Asbestos, Metals, PCB, SPLP, SVOC, VOC

***NOTES/SKETCH***




DARK BROWN GRAVELLY, SILTY SAND WELL GRADED W/ SOME ORGANICS (LOAM) -bottom is wet - DRY otherwise

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Project Number: 47254
Sample Location ID: _____
Time: Start: _____ End: _____

Site: Dike
Date: 9-23-99
Signature of Sampler: Thomas D. Lafly

***SOIL SAMPLE***

DEPTH OF SAMPLE _____

EQUIPMENT USED FOR COLLECTION:
[ ] HAND AUGER
[ ] S.S. SPLIT SPOON
[ ] SHOVEL
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] _____

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SAMPLE OBSERVATIONS:
[ ] ODOR _____
[ ] COLOR _____
[ ] _____

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] $HNO_3$ SOLUTION
[ ] POTABLE WATER
[ ] NONE

SOIL TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID _____

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

***SAMPLES COLLECTED***

***NOTES/SKETCH***

NOT ABLE TO COLLECT SAMPLES AT LOCATIONS AT:

HA-99-04

HA-99-05

HA-99-06

HA-99-09

DUE TO either physical RESTRAINTS (CONCRETE, TAR, COBBLES) AND/OR PRESENCE OF GEOMEMBRANE FABRIC OVER TOP OF SOIL - NOT Feasible to poke holes IN FABRIC SINCE WOULD HAVE TO REPAIR IT AFTERWARDS.

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Site: Dike
Project Number: 47254
Date: 9-23-99
Sample Location ID: HA-99-07
Time: Start: 11:45 End: 12:00
Signature of Sampler: Thomas D. Lyngby

ELEV. = 6'

***SOIL SAMPLE***

DEPTH OF SAMPLE ~6" bgs

EQUIPMENT USED FOR COLLECTION:
- [X] HAND AUGER
- [ ] S.S. SPLIT SPOON
- [ ] SHOVEL
- [ ] HAND SPOON
- [ ] ALUMINUM PANS
- [X] SS BUCKET
- [X] DISCRETE SYRINGE FOR VOC

TYPE OF SAMPLE COLLECTED:
- [✓] DISCRETE FOR VOC
- [✓] COMPOSITE FOR other param.

SAMPLE OBSERVATIONS:
- [✓] ODOR FUEL
- [✓] COLOR OIL STAINED - black
- [ ] _____

DECONTAMINATION FLUIDS USED:
- ✓ ALL USED
- [ ] ETHYL ALCOHOL
- [ ] 25% METHANOL/ 75% ASTM TYPE II WATER
- [✓] DEIONIZED WATER
- [✓] LIQUINOX SOLUTION
- [ ] HEXANE
- [ ] $HNO_3$ SOLUTION
- [ ] POTABLE WATER
- [ ] NONE

SOIL TYPE:
- [✓] CLAY
- [ ] SAND
- [✓] ORGANIC
- [✓] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID _____

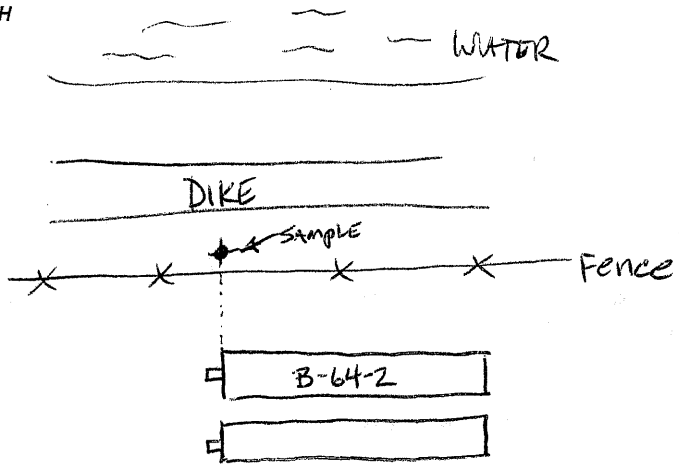
SAMPLE LOCATION SKETCH:
- [✓] YES
- [ ] NO

***SAMPLES COLLECTED***

HA990700 1XX

COLLECTED SAMPLE FOR Asbestos, Metals, PCB, SPLP, SVOC, VOC - Asked for TICs (Tentatively Identified Compounds) From the LABORATORY for the VOC & SVOC ANALYSES

***NOTES/SKETCH***




Black gravelly SILT, CLAY with heavy OIL contamination, FUEL ODOR - has some whitish-yellow fibers - moist to wet. RIGHT AT FENCE LINE.

# HAND AUGER SOIL SAMPLE FIELD DATA RECORD

Project: Stratford Army Engine Plant
Site: Dike
Project Number: 47254
Date: 9-23-99
Sample Location ID: HA-99-08
Time: Start: 12:30 End: 12:45
Signature of Sampler: Thomas D. Lyle

ELEV. = 5.4

**SOIL SAMPLE**

DEPTH OF SAMPLE ~6" bgs

EQUIPMENT USED FOR COLLECTION:
[✓] HAND AUGER
[ ] S.S. SPLIT SPOON
[ ] SHOVEL
[ ] HAND SPOON
[ ] ALUMINUM PANS
[✓] SS BUCKET
[✓] SYRINGE

TYPE OF SAMPLE COLLECTED:
[✓] DISCRETE for VOC
[✓] COMPOSITE ALL others

SAMPLE OBSERVATIONS:
[ ] ODOR
[ ] COLOR
[ ]

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] $HNO_3$ SOLUTION
[ ] POTABLE WATER
[ ] NONE

SOIL TYPE:
[ ] CLAY
[✓] SAND
[ ] ORGANIC
[✓] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID

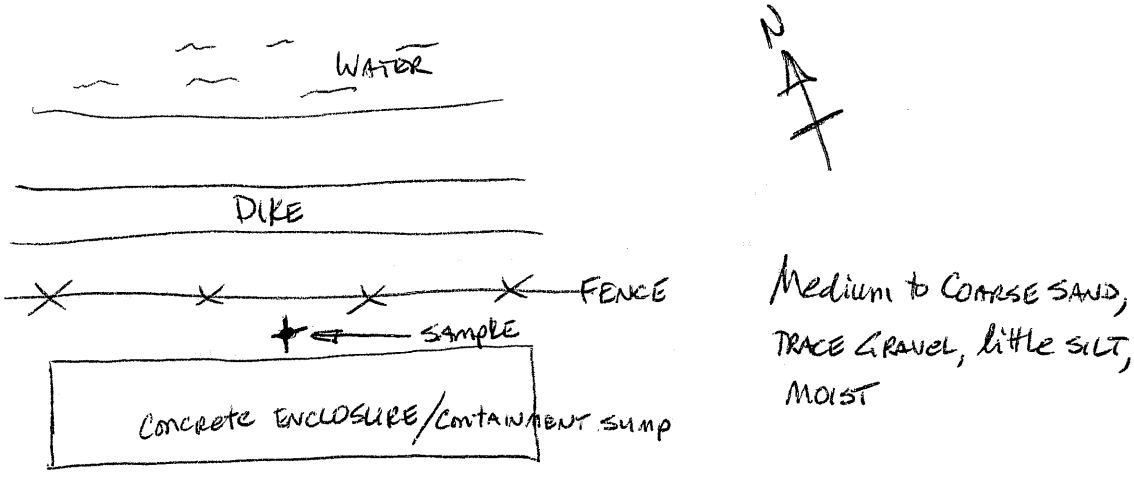
SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

***SAMPLES COLLECTED***

HA9908001XX

Collected sample for Asbestos, Metals, PCB, SPLP, SVOC, VOC

***NOTES/SKETCH***




Medium to Coarse SAND, TRACE GRAVEL, little SILT, MOIST

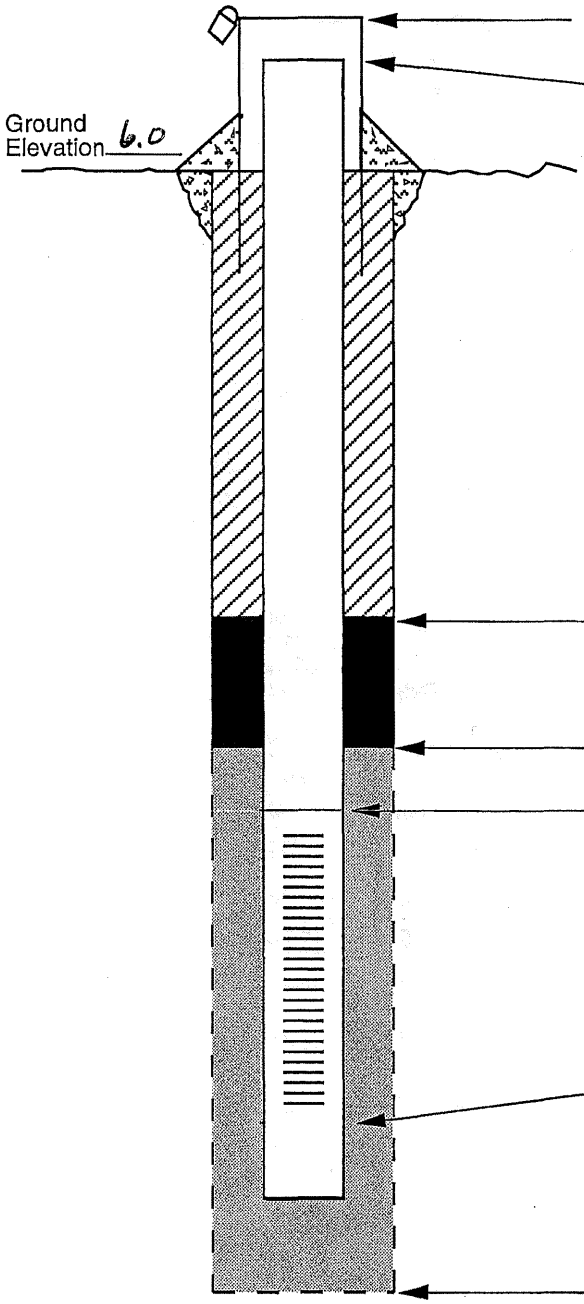
Harding Lawson Associates

# MONITORING WELL CONSTRUCTION DIAGRAMS

# MONITORING WELL CONSTRUCTION DIAGRAM

Project: SAEP | Study Area: Causeway | Driller: NFE
Project No.: 47254 | Boring No.: MWCD-99-01A | Drilling Method: HSA
Date Installed: 9-27-99 | Development Method: Pump & Surge
Field Geologist: BRIAN NOONAN OF F.W.

SHALLOW




Elevation of Top of Surface Casing: 8.37
Stick-up of Casing Above Ground Surface: ~2'
Elevation of Top of Riser Pipe: 7.95'
Type of Surface Seal: Concrete
Type of Surface Casing: Steel

ID of Surface Casing: 4"
Diameter of Borehole: ~6" (4¼" HSA)

Riser Pipe ID: 2"
Type of Riser Pipe: Sch 40 PVC

Type of Backfill: Bent./Cement

Elevation of Top of Seal: 3
Depth of Top of Seal: 3'
Type of Seal: Bentonite Pellets

Elevation of Top of Sand: 2
Depth of Top of Sand: 4'
Elevation of Top of Screen: 1
Depth of Top of Screen: 5'

Type of Screen: Sch 40 PVC
Slot Size x Length: 0.020" x 5'
ID of Screen: ~~0.020"~~ 2"

Type of Sandpack: Silica Well Sand #2

Elevation of Bottom of Screen: -4
Depth of Bottom of Screen: 10'
Depth of Sediment Sump with Plug:

Elevation of Bottom of Borehole: -4
Depth of Bottom of Borehole: 10'

# MONITORING WELL CONSTRUCTION DIAGRAM

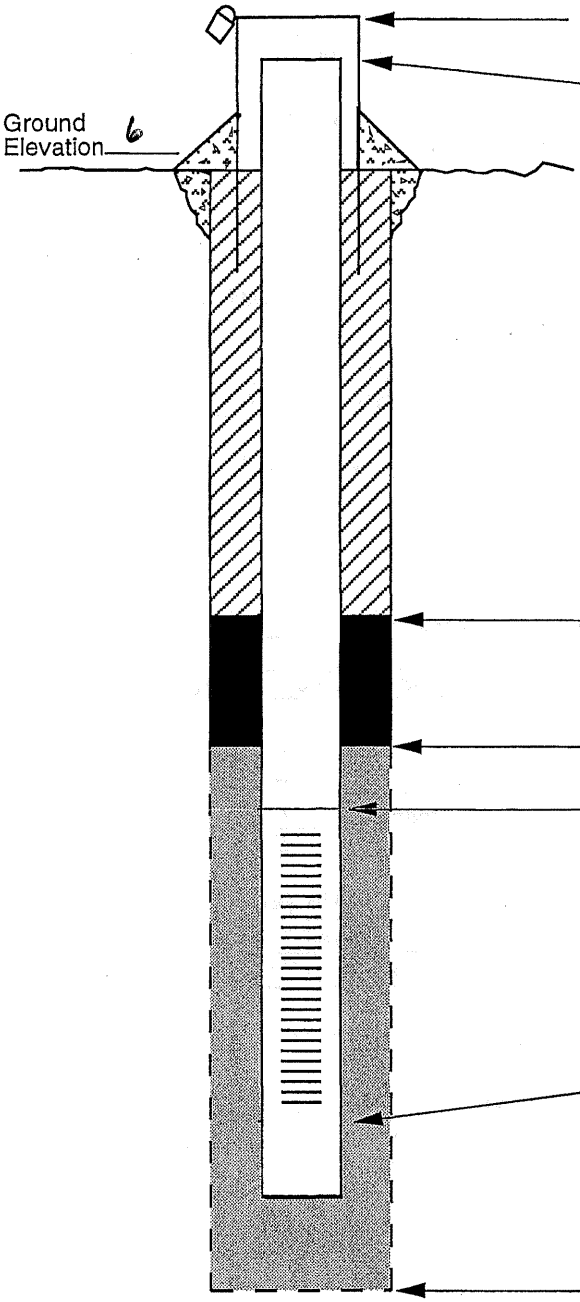
Project SAEP | Study Area Causeway | Driller NFE

Project No. 47254 | Boring No. MWCD-99-01B | Drilling Method HSA

Date Installed 9-27-99 | Development Method Pump & Surge

Field Geologist BRIAN NOONAN OF F.W.

Deep




Elevation of Top of Surface Casing: 8.54

Stick-up of Casing Above Ground Surface: ~2'

Elevation of Top of Riser Pipe: 8.14

Type of Surface Seal: Concrete

Type of Surface Casing: STEEL

ID of Surface Casing: 4"

Diameter of Borehole: ~6"

Riser Pipe ID: 2"

Type of Riser Pipe: SCH 40 PVC

Type of Backfill: Cement/Bentonite Grout Tremie Grouted

Elevation of Top of Seal: -36

Depth of Top of Seal: 42'

Type of Seal: Bent. Pellets

Elevation of Top of Sand: -39

Depth of Top of Sand: 45'

Elevation of Top of Screen: -44

Depth of Top of Screen: 50'

Type of Screen: SCH 40 PVC

Slot Size x Length: 0.020" X 10'

ID of Screen: 2"

Type of Sandpack: SILICA SAND #2

Elevation of Bottom of Screen: -54

Depth of Bottom of Screen: 60'

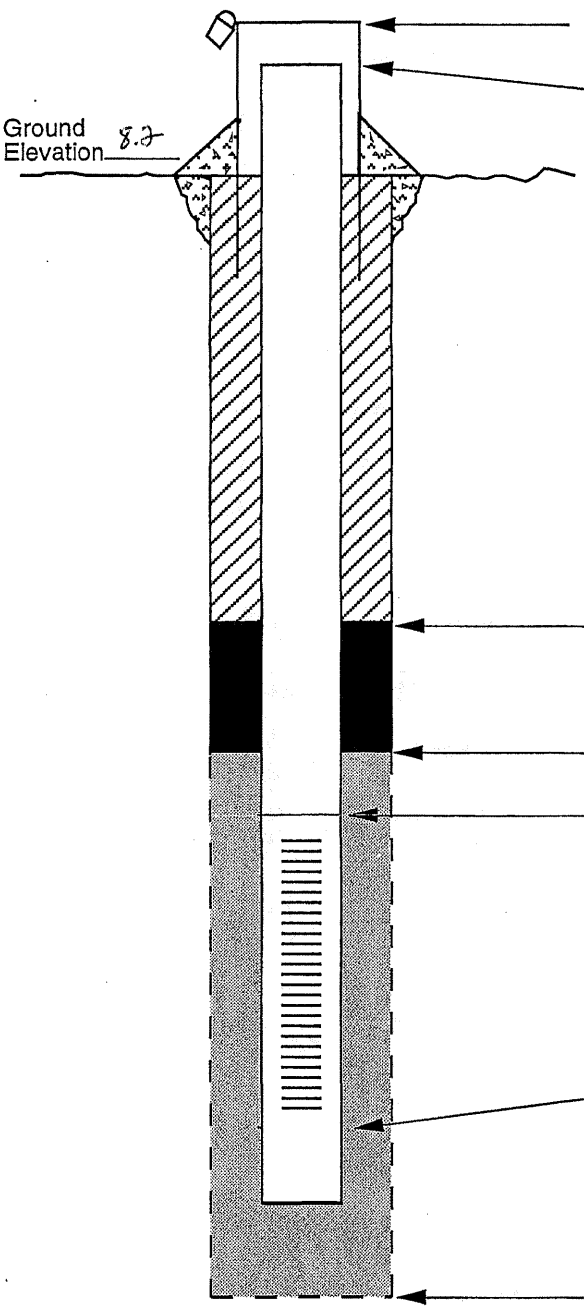
Depth of Sediment Sump with Plug:

Elevation of Bottom of Borehole: -54'

Depth of Bottom of Borehole: 60'

# MONITORING WELL CONSTRUCTION DIAGRAM

Project: SAEP | Study Area: Causeway | Driller: NFE
Project No.: 47254 | Boring No.: MWCD-99-02A | Drilling Method: HSA
Date Installed: 9-28-99 | Development Method: Pump & Surge
Field Geologist: BRIAN NOONAN OF F.W. | SHALLOW




Elevation of Top of Surface Casing: 10.84
Stick-up of Casing Above Ground Surface: ~2'
Elevation of Top of Riser Pipe: 10.47
Type of Surface Seal: Concrete
Type of Surface Casing: Steel

ID of Surface Casing: 4"
Diameter of Borehole: ~6"

Riser Pipe ID: 2"
Type of Riser Pipe: Sch 40 PVC

Type of Backfill: Grout

Elevation of Top of Seal: 5.2
Depth of Top of Seal: 3'
Type of Seal: Bent. Pellets

Elevation of Top of Sand: 4.2
Depth of Top of Sand: 4'
Elevation of Top of Screen: 3.2
Depth of Top of Screen: 5'

Type of Screen: Sch 40 PVC
Slot Size x Length: 0.020" x 5'
ID of Screen: 2"

Type of Sandpack: Silica Sand #2

Elevation of Bottom of Screen: -1.8
Depth of Bottom of Screen: 10'
Depth of Sediment Sump with Plug:

Elevation of Bottom of Borehole: -1.8
Depth of Bottom of Borehole: 10'

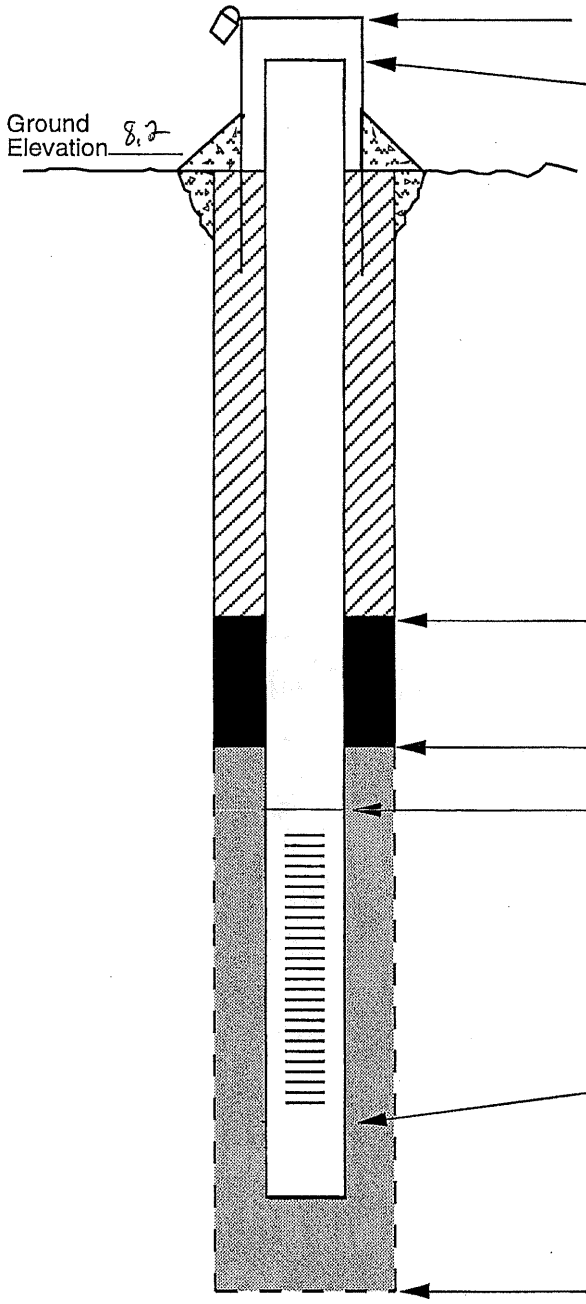
# MONITORING WELL CONSTRUCTION DIAGRAM

Project SAEP | Study Area Causeway | Driller NFE

Project No. 47254 | Boring No. MWCD-99-02B | Drilling Method HSA

Date Installed 9-28-99 | Development Method Pump & Surge

Field Geologist BRIAN NOONAN OF F.W. | Deep




Elevation of Top of Surface Casing: 10.73

Stick-up of Casing Above Ground Surface: ~2'

Elevation of Top of Riser Pipe: 10.33

Type of Surface Seal: Concrete

Type of Surface Casing: Steel

ID of Surface Casing: 2"

Diameter of Borehole: ~6"

Riser Pipe ID: 2"

Type of Riser Pipe: Sch 40 PVC

Type of Backfill: Cement/Bentonite GROUT - TREMIE GROUTED

Elevation of Top of Seal: -31.8

Depth of Top of Seal: 40'

Type of Seal: Bent. Pellets

Elevation of Top of Sand: -36.8

Depth of Top of Sand: 45'

Elevation of Top of Screen: 41.8

Depth of Top of Screen: 50'

Type of Screen: Sch 40 PVC

Slot Size x Length: 0.025" X 10'

ID of Screen: 2"

Type of Sandpack: SILICA SAND #2

Elevation of Bottom of Screen: -51.8

Depth of Bottom of Screen: 60'

Depth of Sediment Sump with Plug: _____

Elevation of Bottom of Borehole: -51.8

Depth of Bottom of Borehole: 60'

# MONITORING WELL DEVELOPMENT LOGS

HARDING LAWSON ASSOCIATES

PAGE ___ OF ___

# FIELD DATA RECORD - WELL DEVELOPMENT

PROJECT: STRATFORD A.E.P. JOB NUMBER: 47254 DATE: 10-12-99

WELL ID: ~~MW-99-09A (shallow)~~ ACTIVITY TIME: START 10:27 END 11:30

107 10/29/99 MWCD-99-01A

DATE OF WELL INSTALLATION: 9-26-99

| WELL DEPTH (TOR) | SCREEN LENGTH | PROTECTIVE CASING STICKUP (FROM GROUND) | PROTECTIVE CASING / RISER DIFFERENCE |
|---|---|---|---|
| 11.59 FT | 5 FT | FT | FT |

| PRE-DEVELOPMENT DEPTH TO WATER (TOR) | PRE-DEVELOPMENT DEPTH TO SEDIMENT | POST-DEVELOPMENT DEPTH TO WATER (TOR) | POST-DEVELOPMENT DEPTH TO SEDIMENT |
|---|---|---|---|
| 6.22 FT | 11.59 FT | FT | FT |

HEIGHT OF WATER COLUMN: 5.37 FT X (0.16 GAL/FT (2 IN.) = / 0.65 GAL/FT (4 IN.) / 1.5 GAL/FT (6 IN.)) = ~0.9 GALLONS / VOLUME

~75 TOTAL GALLONS PURGED

PURGE DATA

| PURGE VOLUME, gallons | ~65 | ~68 | ~71 | ~75 | | |
|---|---|---|---|---|---|---|
| TEMP, degrees celcius | 19.7 | 19.5 | 19.4 | 19.4 | | |
| pH, units | 7.5 | 7.48 | 7.49 | 7.49 | | |
| SPECIFIC CONDUCTIVITY, ~~umhos~~ mS/cm | 24.5 | 24.7 | 24.6 | 24.7 | | |
| TURBIDITY, ntu | 153 | 57 | 35 | 15 | | |
| | | | | | | |

SAMPLE OBSERVATIONS

- [ ] CLEAR
- [ ] COLORED
- [x] CLOUDY very slightly
- [x] TURBID very slightly - collected sample for record
- [ ] ODOR

EQUIPMENT DOCUMENTATION

TYPE OF PUMP: DRILLER-SUPPLIED GRUNDFOS

SURGE TECHNIQUE: w/ Pump

SIZE / CAPACITY OF PUMP: 2" SUBMERSIBLE

PUMPING RATE: GAL/MIN

ESTIMATED RECHARGE RATE: FT/MIN

NOTES: Very dirty well at first but cleared up nicely - Had old fuel odor to it, w/ sheen on development water

SIGNATURE: John D. Lyly

HARDING LAWSON ASSOCIATES



# FIELD DATA RECORD - WELL DEVELOPMENT

PROJECT: STRATFORD AEP | JOB NUMBER: 47254 | DATE: 10-12-99

WELL ID: ~~MW-99-09B (Deep)~~ MWCD-99-01B (JDZ, 10/27/99) | ACTIVITY TIME: START 08:50 END 10:20

DATE OF WELL INSTALLATION: 9-26-99

| WELL DEPTH (TOR) | SCREEN LENGTH | PROTECTIVE CASING STICKUP (FROM GROUND) | PROTECTIVE CASING / RISER DIFFERENCE |
|---|---|---|---|
| 56.74 FT | 10 FT | FT | FT |

| PRE-DEVELOPMENT DEPTH TO WATER (TOR) | PRE-DEVELOPMENT DEPTH TO SEDIMENT | POST-DEVELOPMENT DEPTH TO WATER (TOR) | POST-DEVELOPMENT DEPTH TO SEDIMENT |
|---|---|---|---|
| 7.07 FT | 56.74 FT | FT | FT |

HEIGHT OF WATER COLUMN: 49.67 FT X (0.16 GAL/FT (2 IN.) / 0.65 GAL/FT (4 IN.) / 1.5 GAL/FT (6 IN.)) = 7.9 GALLONS / VOLUME

~138 TOTAL GALLONS PURGED

PURGE DATA

| PURGE VOLUME, gallons | ~60 | ~80 | ~100 | ~123 | ~138 | |
|---|---|---|---|---|---|---|
| TEMP, degrees celcius | 13.6 | 13.5 | 13.4 | 13.8 | 13.9 | |
| pH, units | 6.05 | 6.74 | 6.43 | 6.50 | 6.38 | |
| SPECIFIC CONDUCTIVITY, ~~umhos~~ mS/cm | 12.2 | 12.3 | 12.3 | 12.4 | 12.3 | |
| TURBIDITY, ntu | 358 | 169 | 35 | 14 | 24 | |
| Salinity % | 0.69 | 0.69 | 0.69 | 0.68 | 0.69 | |

SAMPLE OBSERVATIONS

- [ ] CLEAR
- [ ] COLORED
- [ ] CLOUDY
- [x] TURBID — Very slightly turbid - collected sample for record
- [ ] ODOR

EQUIPMENT DOCUMENTATION

TYPE OF PUMP: DRILLER-SUPPLIED GRUNDFOS

SURGE TECHNIQUE: w/ Pump

SIZE / CAPACITY OF PUMP: 2" SUBMERSIBLE

PUMPING RATE: ~1.5 GAL/MIN

ESTIMATED RECHARGE RATE: FT/MIN

NOTES:

SIGNATURE: Thomas D. Zyzy

HARDING LAWSON ASSOCIATES



# FIELD DATA RECORD - WELL DEVELOPMENT

PROJECT: STRATFORD AEP | JOB NUMBER: 47254 | DATE: 10-11-99

WELL ID: ~~MW-99-14A (Stratford)~~ MWCD-99-02A (JDF 10-27-99) | ACTIVITY TIME: START 13:33 END 14:20

DATE OF WELL INSTALLATION: 9-28-99

| WELL DEPTH (TOR) | SCREEN LENGTH | PROTECTIVE CASING STICKUP (FROM GROUND) | PROTECTIVE CASING / RISER DIFFERENCE |
|---|---|---|---|
| 11.88 FT | 5 FT | FT | FT |

| PRE-DEVELOPMENT DEPTH TO WATER (TOR) | PRE-DEVELOPMENT DEPTH TO SEDIMENT | POST-DEVELOPMENT DEPTH TO WATER (TOR) | POST-DEVELOPMENT DEPTH TO SEDIMENT |
|---|---|---|---|
| 6.92 FT | 11.88 FT | FT | FT |

HEIGHT OF WATER COLUMN: 4.96 FT X (0.16 GAL/FT (2 IN.) = / 0.65 GAL/FT (4 IN.) / 1.5 GAL/FT (6 IN.))

0.79 GALLONS / VOLUME

~35 TOTAL GALLONS PURGED

PURGE DATA

| PURGE VOLUME, gallons | ~25 | ~30 | ~32 | ~35 | | |
|---|---|---|---|---|---|---|
| TEMP, degrees celcius | 20.8°c | 21.3 | 21.2 | 21.1 | | |
| pH, units | 8.02 | 8.07 | 8.08 | 8.08 | | |
| SPECIFIC CONDUCTIVITY, ~~umhos~~ mS/cm | 35.0 | 34.9 | 34.8 | 34.5 | | |
| TURBIDITY, ntu | 300 | 30 | 11 | 7 | | |
| Salinity (%) | 2.23 | 2.20 | 2.20 | 2.18 | | |

SAMPLE OBSERVATIONS

- ☐ CLEAR
- ☐ COLORED
- ☐ CLOUDY
- ☒ TURBID — SLIGHTLY TURBID AT END - collected Sample for RECORD
- ☐ ODOR

EQUIPMENT DOCUMENTATION

TYPE OF PUMP: DRILLER-SUPPLIED GRUNDFOS

SIZE / CAPACITY OF PUMP: 2" SUBMERSIBLE

PUMPING RATE: ~1.3 Liters/min ~~GAL/MIN~~

SURGE TECHNIQUE: W/ Pump & SURGE-Block

ESTIMATED RECHARGE RATE: FT/MIN

NOTES: CLEARED up NICELY

NO ODORS

SIGNATURE: Thomas D. Tighe

HARDING LAWSON ASSOCIATES



# FIELD DATA RECORD - WELL DEVELOPMENT

PROJECT: STRATFORD AEP | JOB NUMBER: 47254 | DATE: 10-11-99

WELL ID: ~~MW-99-14B (deep)~~ MWCD-99-02B (JDF 10/12/99)

ACTIVITY TIME: START 14:51 END 16:00

DATE OF WELL INSTALLATION: 9-28-99

| WELL DEPTH (TOR) | SCREEN LENGTH | PROTECTIVE CASING STICKUP (FROM GROUND) | PROTECTIVE CASING / RISER DIFFERENCE |
|---|---|---|---|
| 59.2 FT | 10 FT | FT | FT |

| PRE-DEVELOPMENT DEPTH TO WATER (TOR) | PRE-DEVELOPMENT DEPTH TO SEDIMENT | POST-DEVELOPMENT DEPTH TO WATER (TOR) | POST-DEVELOPMENT DEPTH TO SEDIMENT |
|---|---|---|---|
| 5.0 FT | 59.2 FT | FT | FT |

HEIGHT OF WATER COLUMN: 54.2 FT X (0.16 GAL/FT (2 IN.) = / 0.65 GAL/FT (4 IN.) / 1.5 GAL/FT (6 IN.)) ~8.7 GALLONS / VOLUME

~260 TOTAL GALLONS PURGED

PURGE DATA

| PURGE VOLUME, gallons | ~250 | ~255 | ~260 | | | |
|---|---|---|---|---|---|---|
| TEMP, degrees celcius | 14 | 14 | 14 | | | |
| pH, units | 6.73 | 6.72 | 6.71 | | | |
| SPECIFIC CONDUCTIVITY, ~~umhos~~ mS/cm | 9.6 | 8.1 | 8.1 | | | |
| TURBIDITY, ntu | 29 | 23 | 26 | | | |
| SALINITY (%) | 0.53 | 0.43 | 0.43 | | | |

SAMPLE OBSERVATIONS

- ☐ CLEAR
- ☐ COLORED
- ☐ CLOUDY
- ☒ TURBID — Very slightly turbid at end - Collected sample for record
- ☐ ODOR

EQUIPMENT DOCUMENTATION

TYPE OF PUMP: DRILLER-SUPPLIED GRUNDFOS

SURGE TECHNIQUE: W/ Pump

SIZE / CAPACITY OF PUMP: 2" SUBMERSIBLE

PUMPING RATE: ~0.5 GAL/MIN

ESTIMATED RECHARGE RATE: FT/MIN

NOTES:

SIGNATURE: Thomas D. Tighe

# SURVEY DATA

| Locate_ID | Northing | Easting | Elev_Casing | Elev_Riser | Gnd_Elev |
|---|---|---|---|---|---|
| CB-99-01 | 623592.83 | 897824.71 | 0 | 0 | 10.4 |
| CB-99-02 | 623780.59 | 897902.37 | 0 | 0 | 6.2 |
| CB-99-03 | 623802.34 | 897895.22 | 0 | 0 | 6.9 |
| CB-99-04 | 623805.81 | 897938.39 | 0 | 0 | 7.9 |
| CB-99-05 | 623832.44 | 898000.87 | 0 | 0 | 6.22 |
| CB-99-07 | 623946.46 | 898070.01 | 0 | 0 | 6 |
| CB-99-08 | 624014.72 | 898131.34 | 0 | 0 | 6.2 |
| CB-99-09 | 624013.63 | 898073.28 | 0 | 0 | 8.6 |
| CB-99-11 | 624104.14 | 898195.86 | 0 | 0 | 7 |
| CB-99-12 | 624098.12 | 898142.49 | 0 | 0 | 8.8 |
| CB-99-13 | 624142.35 | 898149.09 | 0 | 0 | 8.6 |
| CB-99-14 | 624162.35 | 898187.5 | 0 | 0 | 8.4 |
| CB-99-15 | 624174.14 | 898153.55 | 0 | 0 | 8.5 |
| CB-99-16 | 624141.28 | 898264.77 | 0 | 0 | 4 |
| CB-99-17 | 624186.41 | 898249.65 | 0 | 0 | 5.6 |
| DB-99-01 | 623332.65 | 898447.97 | 0 | 0 | 13 |
| DB-99-02 | 623387.52 | 898351.68 | 0 | 0 | 12.8 |
| DB-99-03 | 623393.28 | 898209.09 | 0 | 0 | 12.8 |
| DB-99-04 | 623386.49 | 898104.98 | 0 | 0 | 12.8 |
| DB-99-05 | 623418.53 | 898009.65 | 0 | 0 | 12.6 |
| DB-99-06 | 623502.18 | 897845.07 | 0 | 0 | 11.6 |
| DB-99-07 | 623575.07 | 897822.63 | 0 | 0 | 11.6 |
| DB-99-08 | 623544.26 | 897728.89 | 0 | 0 | 11.5 |
| DB-99-09 | 623580.51 | 897518.36 | 0 | 0 | 11.4 |
| DB-99-10 | 623632.48 | 897349.88 | 0 | 0 | 11.6 |
| DB-99-11 | 623688.36 | 897177.94 | 0 | 0 | 11.8 |
| DB-99-12 | 623781.34 | 897038.67 | 0 | 0 | 11.1 |
| DB-99-13 | 623910.67 | 896933.78 | 0 | 0 | 10.8 |
| DB-99-14 | 623987.32 | 896868.21 | 0 | 0 | 10.8 |
| DB-99-15 | 624044.31 | 896776 | 0 | 0 | 10.7 |
| DB-99-16 | 624048.37 | 896666.39 | 0 | 0 | 11.4 |
| DB-99-17 | 624019.02 | 896528.01 | 0 | 0 | 12.3 |
| DB-99-18 | 624005.82 | 896456.49 | 0 | 0 | 11.8 |
| HA-99-01 | 623340.11 | 898527.39 | 0 | 0 | 12.3 |
| HA-99-02 | 623378.16 | 898265.59 | 0 | 0 | 7.6 |
| HA-99-03 | 623370.2 | 898084.66 | 0 | 0 | 7.5 |
| HA-99-07 | 623683.34 | 897134.52 | 0 | 0 | 6 |
| HA-99-08 | 623858.87 | 896947.62 | 0 | 0 | 5.4 |
| MWCD-99-01A | 623755.52 | 897891.74 | 8.37 | 7.95 | 6 |
| MWCD-99-01B | 623750.98 | 897893.68 | 8.54 | 8.14 | 6 |
| MWCD-99-02A | 624162.44 | 898187.48 | 10.84 | 10.47 | 8.2 |
| MWCD-99-02B | 624167.56 | 898188.42 | 10.73 | 10.33 | 8.2 |
| TP-DEP-15 | 624133.47 | 898202.72 | 0 | 0 | 8.1 |
| TP-DEP-17 | 624183.28 | 898183.49 | 0 | 0 | 7.9 |
| TP-99-06-6W | 623953.48 | 898026.26 | 0 | 0 | 9.8 |
| TP-99-06-6W | 623947.24 | 898035.41 | 0 | 0 | 9.8 |
| TP-99-10-5W | 624057.56 | 898067.88 | 0 | 0 | 5.6 |
| TP-99-10-5W | 624062.51 | 898073.18 | 0 | 0 | 5.8 |
| TP-99-22-4W | 623722.13 | 897884.6 | 0 | 0 | 6.4 |
| TP-99-22-4W | 623716.2 | 897888.44 | 0 | 0 | 6.6 |
| TP-99-23-4W | 623741.77 | 897870.04 | 0 | 0 | 6.2 |
| TP-99-23-4'W | 623746.92 | 897862.85 | 0 | 0 | 6.8 |
| TP-99-24-5W | 623871.3 | 897968.39 | 0 | 0 | 10.4 |
| TP-99-24-5W | 623865.83 | 897976.63 | 0 | 0 | 10.4 |

# LABORATORY ANALYTICAL DATA

# I-1 ANALYTICAL DATA

# DATA VALIDATION SUMMARY REPORT
# CAUSEWAY AND DIKE REMEDIAL INVESTIGATION
# STRATFORD ARMY ENGINE PLANT
# December 14, 1999

## 1.0 INTRODUCTION

The purpose of this report is to summarize data validation activities and actions for soil and aqueous samples collected during investigations at the Causeway and Dike at the Stratford Army Engine Plant. Samples were collected by HLA in September and October 1999 and analyzed by Quanterra analytical laboratories in St. Louis, Missouri. Data validation was completed by Environmental Data Quality, Inc., in Exton, Pennsylvania using USEPA Region I Tier II guidelines (USEPA, 1996). Results were reported in six delivery groups identified as 22387, 22193, 22186, 22190, CI9160175, and CI160190.

### 1.1 Analytical Methods

The analytical program included the following methods:

- Volatile Organic Compounds by Method 5035/ 8260B
- Semivolatile organic compounds by Method 3550B/8270C
- Polychlorinated Biphenyls (PCBs) by 3550B/8082
- Inorganics by 6010B/7471A
- SPLP Inorganics by 1312/6010B/7470A
- Asbestos

## 2.0 DATA QUALITY EVALUATION

The majority of the results provided by the laboratory were determined to be adequate for use in contamination and risk evaluations. A subset of results has been qualified as estimated J values based on the validation guidance. For some results potential bias have been identified for the reported results. A subset of results have also been qualified rejected R and are considered to be unusable. Unless noted below quality control measurements associated with these data sets were within method specifications. A summary of validation actions is provided in the following subsections for each analytical method.

### 2.1 VOA

Soil samples collected for volatile analysis were preserved in methanol at the time of sample collection. Sample Quantitation Limits (SQLs) vary between samples depending on the amount of soil collected and the percent solids of the matrix. For some samples dilution reanalyses were necessary to bring target compounds into the instrument calibration range. Sample results from the original and dilution analyses have been combined to obtain final results for all target compounds. The following data validation actions were completed:

- Positive detections of target compounds methylene chloride, acetone, and 2-butanone were qualified non-detect U in a subset of samples due to associated blank contamination. In some samples, methylene chloride and acetone have been reported as a detected values because concentrations are greater than validation action levels.

- Results for chloroethane, acetone, 2-butanone, and bromomethane in subset of samples have been rejected R due to low response in calibration standards

- Results for chloroethane in a subset of samples were qualified estimated UJ due to low recoveries in associated LCS.

- Low surrogate recoveries were reported in many samples. With the exception of sample CB9911002XX, all results were determined to be usable as estimated values. Results were qualified estimated J with a potential low bias in samples HA9901001XX, HA9902001XX, HA9903001XX, a subset of results for HA9907001XX, HA9908001XX, CB9909002XX, CB9909012XX, CB9909022XX, CB9909042XX, CB9909062XX, CB9909082XX, CB9909102XX, CB9901011XX, CB9902007XX, CB9904007XX, CB9903004XX, CB9903004XD, CB9903006XX, CB9904002XX, CB9911002XX, CB9907006XX, CB9908003XX, CB9908003XD, TPDEP12003XX, CB9916009XX, CB9914003XX, CB9914012XX, CB9914032XX, CB9914052XX, CB9914072XX, CB9914092XX, TP9922003XX, TP9923003XX, TP9910005XX, and TP9906008XX. Results for detected compounds were qualified estimated J in sample CB9911002XX and non-detected results rejected R due to very low surrogate recoveries (<10%). Three surrogate compounds were spiked into the methanol used to preserve the VOA samples. Vials with methanol and surrogate were prepared by the laboratory prior to shipment to the field. Samples were analyzed from 7 to 12 days after samples collection, indicating that holding times were met for these samples. Surrogate recovery ranges for the three VOA surrogates used during the sample analyses are listed below:

| SAMPLE ID | SURROGATE RECOVERY RANGE |
|---|---|
| HA9901001XX | 75 - 85 % |
| HA9902001XX | 68 - 93 % |
| HA9903001XX | 72 - 90 % |
| HA9907001XX | 70 - 78 % |
| HA9908001XX | 79 - 87 % |
| CB9909002XX | 71 - 91 % |
| CB9909012XX | 68 - 84 % |
| CB9909022XX | 53 - 72 % |
| CB9909042XX | 63 - 75 % |
| CB9909062XX | 71 - 87 % |
| CB9909082XX | 66 - 86 % |
| CB9909102XX | 71 - 88% |
| CB9901011XX | 18% - 61% |
| CB9902007XX | 71% - 99% |

| SAMPLE ID | SURROGATE RECOVERY RANGE |
|---|---|
| CB9903004XX | 75 - 106 % |
| CB9903004XD | 54 - 79 % |
| CB9903006XX | 69- 87 % |
| CB9904002XX | 82 - 91 % |
| CB9904007XX | 61%- 105 % |
| CB9907006XX | 77 - 92 % |
| CB9908003XX | 15 - 99 % |
| CB9908003XD | 23 -78 % |
| TPDEP12003XX | 61 - 97 % |
| CB9916009XX | 79 - 86 % |
| CB9914003XX | 71 - 91 % |
| CB9914012XX | 62 - 82 % |
| CB9914032XX | 59 – 80 % |
| CB9914052XX | 70 – 75 % |
| CB9914072XX | 76 – 82 % |
| CB9914092XX | 68 – 76 % |
| TP9922003XX | 41 – 76 % |
| TP9923003XX | 85 – 86 % |
| TP9910005XX | 74 – 80 % |
| TP9906008XX | 76 – 85 % |
| CB9911002XX | 0 – 87% |
| | |

For the majority of samples, only one or two of the three surrogates were outside control limits. In accordance with the validation guidelines, all result are qualified if one surrogate is lower than the control limits. For most samples the lower point of the surrogate recovery ranges were only slightly lower than control limits reported by the laboratory. Based on this information, the low bias for the majority of the samples in the VOA data set is interpreted to be relatively small. The concentrations of detected target compounds and quantitation limits for non-detects reported in the samples would be expected to be within 60% to 90% of the reported concentrations. In accordance with the validation guidelines, all result are qualified if one surrogate is lower than the control limits.

- Results for volatile sample CB9908005XX (lab number 22186-015) were rejected due to a suspected spiking error or reporting error at the laboratory. Positive results were reported for every target compound at a similar concentration of approximately 1 to 3 mg/kg. HLA interpreted this to be an impossible situation, and likely the results of an accidental spiking of the sample during preparation. No results are available for this sample location.

## 2.2 SVOA

- Positive detections of target compounds Bis(2-ethylhexyl)phthalate, di-n-butylphthalate were qualified non-detect U in a subset of samples due to associated blank contamination.

- Subset of compounds were estimated J due to low internal standard response in samples HA9901001XX, HA9902001XX, HA9908001XX, CB9909002XX, CB9909012XX, CB9909022XX, CB9909062XX, CB9909082XX, CB9909102XX, CB9902002XX, CB9902007XX, CB9903004XX, CB9903004XD, CB9904002XX, CB9905006XX, CB9905002XX, CB9911002XX, CB9911007XX, CB9908005XX, CB9907006XX, CB9907002XD, CB9908003XX, CB9908003XD, TPDEP11001XX, TPDEP12003XX, TPDEP17003XX, CB9913009XX, CB9913003XX, CB9915009XX, CB9916009XX, CB9916003XX, and CB9917008XX.

## 2.3 PCBs

Results for samples HA9903001XX, CB9909002XX, CB9914003XX were qualified estimated J due to low surrogate recovery, and results should be considered potentially biased low.

Positive results were qualified estimated J and non-detects rejected R in samples TP9922003XX, TP9923003XX due to low surrogate recovery less than 10%. These results are considered to be potentially biased low.

## 2.4 Inorganics

- A subset of positive results for sodium, boron, sodium, and beryllium were qualified non-detect U due to contamination in associated QC blanks.

- Results for antimony, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc were qualified J due to low recoveries in an associated matrix spike (MS) for samples CB9914003XX, CB9914003XD, CB9914012XX, CB9914032XX, CB9914052XX, CB9914072XX, CB9914092XX, TP9922003XX, TP9923003XX, TP9923003XD, TP9924010XX and results are potentially biased low.

- Results for antimony, cadmium, and copper were qualified J due to low recoveries in an associated matrix spike (MS) for samples DB9901004XX, DB9901011XX, DB9902004XX, DB9902011XX, DB9903004XX, DB9903011XX, DB9907010XX, DB9908004XX, DB9908011XX, DB9909004XX, DB9909011XX, DB9910004XX, DB9910004XD, DB9910011XX,DB9904004XX, DB9904011XX, DB9906004XX, DB9906004XD, DB9906011XX, DB9907004XX, DB9911004XX, and DB9911011XX and results are potentially biased low.

- Results for antimony and chromium were qualified J due to low recoveries in an associated matrix spike (MS) for samples HA9901001XX, HA9902001XX, HA9903001XX, HA9907001XX, HA9908001XX and results are potentially biased low.

- Results for antimony were qualified estimated J due to low recoveries in an associated matrix spike for samples DB9912004XX, DB9912011XX, DB9912011XD, DB9913002XX, DB9913011XX, DB9914002XX, DB9914010XX, DB9915002XX, DB9915010XX, DB9916002XX, DB9916010XX, DB9917002XX, DB9917012XX, DB9917012XD, DB9918002XX, DB9918013XX, DB9905002XX, DB9905011XX, and results for these samples are considered to be potentially biased low.

- Results for mercury and vanadium were qualified estimated J due to high recovery in an associated matrix spike in samples HA9901001XX, HA9902001XX, HA9903001XX, HA9907001XX, and HA9908001XX and results are potentially biased high.

- Results for copper and vanadium were qualified estimated J due to high recovery in an associated matrix spike in samples DB9912004XX, DB9912011XX, DB9912011XD, DB9913002XX, DB9913011XX, DB9914002XX, DB9914010XX, DB9915002XX, DB9915010XX, DB9916002XX, DB9916010XX, DB9917002XX, DB9917012XX, DB9917012XD, DB9918002XX, DB9918013XX, DB9905002XX, DB9905011XX, and results are potentially biased high.

- Results for antimony, nickel, and manganese were qualified estimated J due to low MS recovery in samples CB9901002XX, CB9901011XX,CB9902002XX, CB9902007XX, CB9903007XX, CB9903004XX, CB9903004XD, CB9903006XX, CB9904002XX, CB9905006XX, CB9905002XX, CB9911002XX, CB9911007XX, CB9908005XX, CB9907006XX, CB9907002XD, CB9908003XX, CB9907002XX, CB9908003XD, TPDEP11001XX, TPDEP12003XX, TPDEP17003XX, TPDEP17003XD, CB9912002XX, CB9912010XX, CB9913009XX, CB9913003XX, CB9915009XX, CB9916009XX, CB9916003XX, CB9917008XX, CB9917003XX, TP9910005XX, TP9906008XX and results are potentially biased low.

- Results for chromium and lead were qualified estimated J due to high MS recoveries in samples CB9901002XX, CB9901011XX, CB9902002XX, CB9902007XX, CB9903007XX, CB9903004XX, CB9903004XD, CB9903006XX, CB9904002XX, CB9905006XX, CB9905002XX, CB9911002XX, CB9911007XX, CB9908005XX, CB9907006XX, CB9907002XD, CB9908003XX, CB9907002XX, CB9908003XD, TPDEP11001XX, TPDEP12003XX, TPDEP17003XX, TPDEP17003XD, CB9912002XX, CB9912010XX, CB9913009XX, CB9913003XX, CB9915009XX, CB9916009XX, CB9916003XX, CB9917008XX, CB9917003XX, TP9910005XX, TP9906008XX and are potentially biased high.

- Results for zinc were qualified estimated J in the following samples due to serial dilution results in CB9901002XX, CB9901011XX,CB9902002XX, CB9902007XX, CB9903007XX, CB9903004XX, CB9903004XD, CB9903006XX, CB9904002XX, CB9905006XX, CB9905002XX, CB9911002XX, CB9911007XX, CB9908005XX, CB9907006XX, CB9907002XD, CB9908003XX, CB9907002XX, CB9908003XD, TPDEP11001XX, TPDEP12003XX, TPDEP17003XX, TPDEP17003XD, CB9912002XX, CB9912010XX, CB9913009XX, CB9913003XX, CB9915009XX, CB9916009XX, CB9916003XX, CB9917008XX, CB9917003XX, TP9910005XX, TP9906008XX.

## 2.5 SPLP Inorganics

- Low concentrations of barium, cadmium, chromium, beryllium, zinc, nickel, selenium and copper reported in a subset of samples were qualified non-detect U due to associated blank contamination.

- Results for zinc were qualified estimated J due to serial dilution results in samples CB9901002XX and CB9902002XX.

## 2.6 Asbestos

No data qualification was done on the asbestos data set and results are considered usable as reported by the laboratory.

## References:

U.S. Environmental Protection Agency (USEPA), 1996. "Region 1 EPA-NE Data Validation Guidelines For Evaluating Environmental Analyses"; Quality Assurance Unit Staff; Office of Environmental Measurement and Evaluation; December 1996

**TABLE I-1**
**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| DB-99-12 | DB9912011XX | 5 | 8270C | Hexachlorobenzene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Nitrobenzene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 2,6-Dinitrotoluene | 2 U | 1.4 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Hexachlorobutadiene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Hexachloroethane | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Indeno(1,2,3-cd)pyrene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 2-Nitroaniline | 9.7 U | 1.65 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 3-Nitroaniline | 9.7 U | 4.2 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 4-Nitroaniline | 9.7 U | 4.2 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 2,4-Dinitrophenol | 9.7 U | 2.8 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Dibenz(a,h)anthracene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Chrysene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Carbazole | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 2,4,6-Trichlorophenol | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Pentachlorophenol | 9.7 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Benzo(a)pyrene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Benzo(k)fluoranthene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Benzo(b)fluoranthene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | N-Nitrosodiphenylamine | 2 U | 1.4 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | N-Nitrosodi-n-propylamine | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | Benzo(a)anthracene | 2 U | 1 | MG/KG |
| DB-99-12 | DB9912011XX | 5 | 8270C | 3,3'-Dichlorobenzidine | 9.7 U | 0.33 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 3-Nitroaniline | 19 U | 4.2 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Nitrobenzene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Dibenz(a,h)anthracene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | bis(2-Chloroethyl) ether | 4 U | 2.4 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Hexachlorobutadiene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 2,4,6-Trichlorophenol | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Pentachlorophenol | 19 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Benzo(a)pyrene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Benzo(k)fluoranthene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Benzo(b)fluoranthene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | N-Nitrosodiphenylamine | 4 U | 1.4 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 3,3'-Dichlorobenzidine | 19 U | 0.33 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Benzo(a)anthracene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Chrysene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 4-Nitroaniline | 19 U | 4.2 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Indeno(1,2,3-cd)pyrene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 2-Nitroaniline | 19 U | 1.65 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Hexachloroethane | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Hexachlorocyclopentadiene | 19 U | 9.8 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 2,4-Dinitrophenol | 19 U | 2.8 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 2,4-Dinitrotoluene | 4 U | 2.8 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | 2,6-Dinitrotoluene | 4 U | 1.4 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Hexachlorobenzene | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | N-Nitrosodi-n-propylamine | 4 U | 1 | MG/KG |
| DB-99-12 | DB9912011XD | 10 | 8270C | Carbazole | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 2,4,6-Trichlorophenol | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | bis(2-Chloroethyl)Ether | 4 U | 2.4 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 1,2-Dichlorobenzene | 4 U | 3.1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | N-nitroso-di-n-propylamine | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Hexachloroethane | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Nitrobenzene | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Hexachlorocyclopentadiene | 20 U | 9.8 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 2,6-Dinitrotoluene | 4 U | 1.4 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 2-Nitroaniline | 20 U | 1.65 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Dibenz(a,h)Anthracene | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 3,3'-Dichlorobenzidine | 20 U | 0.33 | MG/KG |

**TABLE I-1**
**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| TP-99-10 | TP9910005XX | 10 | 8270C | Pentachlorophenol | 20 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Hexachlorobenzene | 4 U | 1 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | n-Nitrosodiphenylamine | 4 U | 1.4 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 4-Nitroaniline | 20 U | 4.2 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 2,4-Dinitrotoluene | 4 U | 2.8 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 2,4-Dinitrophenol | 20 U | 2.8 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | 3-Nitroaniline | 20 U | 4.2 | MG/KG |
| TP-99-10 | TP9910005XX | 10 | 8270C | Hexachlorobutadiene | 4 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Hexachlorobenzene | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | bis(2-Chloroethyl)Ether | 7.8 U | 2.4 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2-Chlorophenol | 7.8 U | 7.2 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 1,2-Dichlorobenzene | 7.8 U | 3.1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2-Methylphenol | 7.8 U | 7 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | N-nitroso-di-n-propylamine | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 4-Methylphenol | 7.8 U | 7 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Hexachloroethane | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Nitrobenzene | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Isophorone | 7.8 U | 7.4 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 4-Chloroaniline | 7.8 U | 5.6 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Hexachlorobutadiene | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Dibenz(a,h)Anthracene | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 3,3'-Dichlorobenzidine | 39 U | 0.33 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 4-Nitroaniline | 39 U | 4.2 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2,4-Dichlorophenol | 7.8 U | 4 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | n-Nitrosodiphenylamine | 7.8 U | 1.4 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Pentachlorophenol | 39 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2,4-Dinitrotoluene | 7.8 U | 2.8 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2,4-Dinitrophenol | 39 U | 2.8 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 3-Nitroaniline | 39 U | 4.2 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2,6-Dinitrotoluene | 7.8 U | 1.4 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2-Nitroaniline | 39 U | 1.65 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | 2,4,6-Trichlorophenol | 7.8 U | 1 | MG/KG |
| HA-99-03 | HA9903001XX | 20 | 8270C | Hexachlorocyclopentadiene | 39 U | 9.8 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 3-Nitroaniline | 330 U | 4.2 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,4-Dinitrotoluene | 330 U | 2.8 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 1,2,4-Trichlorobenzene | 67 U | 14 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 4-Chloroaniline | 67 U | 5.6 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Hexachlorobutadiene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Dibenzofuran | 67 U | 5.6 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,4-Dinitrophenol | 67 U | 2.8 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,6-Dinitrotoluene | 67 U | 1.4 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2-Nitroaniline | 330 U | 1.65 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,4,6-Trichlorophenol | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | N-nitroso-di-n-propylamine | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Hexachlorocyclopentadiene | 330 U | 9.8 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,4-Dichlorophenol | 67 U | 4 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2,4-Dimethylphenol | 67 U | 28 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2-Nitrophenol | 67 U | 11 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Isophorone | 67 U | 7.4 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Nitrobenzene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 4-Methylphenol | 67 U | 7 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Fluorene | 67 U | 56 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Carbazole | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2-Methylphenol | 67 U | 7 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 1,2-Dichlorobenzene | 67 U | 3.1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 1,4-Dichlorobenzene | 67 U | 15 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 2-Chlorophenol | 67 U | 7.2 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | bis(2-Chloroethyl)Ether | 67 U | 2.4 | MG/KG |

**TABLE I-1**
**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| HA-99-07 | HA9907001XX | 50 | 8270C | Hexachloroethane | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Dibenz(a,h)Anthracene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Indeno(1,2,3-CD)Pyrene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 4-Nitroaniline | 330 U | 4.2 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Benzo(g,h,i)Perylene | 67 U | 42 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Benzo(a)Pyrene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Benzo(k)Fluoranthene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Benzo(b)Fluoranthene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | di-N-OctylPhthalate | 67 U | 20 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Hexachlorobenzene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | 3,3'-Dichlorobenzidine | 330 U | 0.33 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Benzo(a)Anthracene | 67 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Pyrene | 67 U | 40 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Fluoranthene | 67 U | 56 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Pentachlorophenol | 330 U | 1 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | n-Nitrosodiphenylamine | 67 U | 1.4 | MG/KG |
| HA-99-07 | HA9907001XX | 50 | 8270C | Chrysene | 67 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,4,6-Trichlorophenol | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 3-Nitroaniline | 180 U | 4.2 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Hexachlorobenzene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Pentachlorophenol | 180 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Benzo(a)Anthracene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 3,3'-Dichlorobenzidine | 180 U | 0.33 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Chrysene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | bis(2-Ethylhexyl)Phthalate | 36 U | 11 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | di-N-OctylPhthalate | 36 U | 20 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Benzo(b)Fluoranthene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,6-Dinitrotoluene | 36 U | 1.4 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,4-Dichlorophenol | 36 U | 4 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,4-Dimethylphenol | 36 U | 28 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 1,2,4-Trichlorobenzene | 36 U | 14 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 4-Chloroaniline | 36 U | 5.6 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Hexachlorobutadiene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,4-Dinitrophenol | 180 U | 2.8 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Hexachlorocyclopentadiene | 180 U | 9.8 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Dibenzofuran | 36 U | 5.6 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2-Nitroaniline | 180 U | 1.65 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Carbazole | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | N-nitroso-di-n-propylamine | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2-Methylphenol | 36 U | 7 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 1,2-Dichlorobenzene | 36 U | 3.1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 1,4-Dichlorobenzene | 36 U | 15 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 4-Nitroaniline | 180 U | 4.2 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Benzo(k)Fluoranthene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | n-Nitrosodiphenylamine | 36 U | 1.4 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2-Chlorophenol | 36 U | 7.2 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | bis(2-Chloroethyl)Ether | 36 U | 2.4 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Benzo(a)Pyrene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Dibenz(a,h)Anthracene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 4-Methylphenol | 36 U | 7 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2,4-Dinitrotoluene | 36 U | 2.8 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | 2-Nitrophenol | 36 U | 11 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Isophorone | 36 U | 7.4 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Indeno(1,2,3-CD)Pyrene | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Hexachloroethane | 36 U | 1 | MG/KG |
| CB-99-03 | CB9903006XX | 100 | 8270C | Nitrobenzene | 36 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2-Methylphenol | 37 U | 7 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 1,4-Dichlorobenzene | 37 U | 15 | MG/KG |

**TABLE I-1**
**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| CB-99-04 | CB9904007XX | 100 | 8270C | 2-Chlorophenol | 37 U | 7.2 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | bis(2-Chloroethyl)Ether | 37 U | 2.4 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | N-nitroso-di-n-propylamine | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 1,2-Dichlorobenzene | 37 U | 3.1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 3-Nitroaniline | 180 U | 4.2 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Isophorone | 37 U | 7.4 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,4-Dinitrophenol | 180 U | 2.8 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,6-Dinitrotoluene | 37 U | 1.4 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2-Nitroaniline | 180 U | 1.65 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,4,6-Trichlorophenol | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Hexachlorocyclopentadiene | 180 U | 9.8 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2-Methylnaphthalene | 37 U | 9.8 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Hexachlorobutadiene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 1,2,4-Trichlorobenzene | 37 U | 14 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2-Nitrophenol | 37 U | 11 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Nitrobenzene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Hexachloroethane | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 4-Chloroaniline | 37 U | 5.6 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,4-Dimethylphenol | 37 U | 28 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Chrysene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 4-Methylphenol | 37 U | 7 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,4-Dichlorophenol | 37 U | 4 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Carbazole | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Dibenz(a,h)Anthracene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Indeno(1,2,3-CD)Pyrene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Benzo(a)Pyrene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Benzo(k)Fluoranthene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Benzo(b)Fluoranthene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | bis(2-Ethylhexyl)Phthalate | 37 U | 11 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | n-Nitrosodiphenylamine | 37 U | 1.4 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Dibenzofuran | 37 U | 5.6 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | di-N-OctylPhthalate | 37 U | 20 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 4-Nitroaniline | 180 U | 4.2 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 3,3'-Dichlorobenzidine | 180 U | 0.33 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Hexachlorobenzene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Pentachlorophenol | 180 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | Benzo(a)Anthracene | 37 U | 1 | MG/KG |
| CB-99-04 | CB9904007XX | 100 | 8270C | 2,4-Dinitrotoluene | 37 U | 2.8 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 1,2,4-Trichlorobenzene | 43 U | 14 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,4-Dichlorophenol | 43 U | 4 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,4-Dimethylphenol | 43 U | 28 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2-Nitrophenol | 43 U | 11 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Isophorone | 43 U | 7.4 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Nitrobenzene | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Hexachloroethane | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | N-nitroso-di-n-propylamine | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 1,2-Dichlorobenzene | 43 U | 3.1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2-Methylphenol | 43 U | 7 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2-Chlorophenol | 43 U | 7.2 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | bis(2-Chloroethyl)Ether | 43 U | 2.4 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 4-Methylphenol | 43 U | 7 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | di-N-OctylPhthalate | 43 U | 20 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Hexachlorobutadiene | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2-Methylnaphthalene | 43 U | 9.8 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Hexachlorocyclopentadiene | 210 U | 9.8 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,4,6-Trichlorophenol | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2-Nitroaniline | 210 U | 1.65 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,6-Dinitrotoluene | 43 U | 1.4 | MG/KG |

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**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| CB-99-12 | CB9912010XX | 100 | 8270C | 4-Chloroaniline | 43 U | 5.6 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 1,4-Dichlorobenzene | 43 U | 15 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 3-Nitroaniline | 210 U | 4.2 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | bis(2-Ethylhexyl)Phthalate | 43 U | 11 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 3,3'-Dichlorobenzidine | 210 U | 0.33 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Pentachlorophenol | 210 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Hexachlorobenzene | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | n-Nitrosodiphenylamine | 43 U | 1.4 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 4-Nitroaniline | 210 U | 4.2 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,4-Dinitrotoluene | 43 U | 2.8 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | 2,4-Dinitrophenol | 210 U | 2.8 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Benzo(g,h,i)Perylene | 43 U | 42 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Indeno(1,2,3-CD)Pyrene | 43 U | 1 | MG/KG |
| CB-99-12 | CB9912010XX | 100 | 8270C | Carbazole | 43 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2-Nitrophenol | 35 U | 11 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 3-Nitroaniline | 170 U | 4.2 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,6-Dinitrotoluene | 35 U | 1.4 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2-Nitroaniline | 170 U | 1.65 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Hexachlorocyclopentadiene | 170 U | 9.8 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Hexachlorobutadiene | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 4-Chloroaniline | 35 U | 5.6 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 1,2,4-Trichlorobenzene | 35 U | 14 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,4-Dinitrophenol | 170 U | 2.8 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,4-Dimethylphenol | 35 U | 28 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,4,6-Trichlorophenol | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Isophorone | 35 U | 7.4 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Nitrobenzene | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Hexachloroethane | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 4-Methylphenol | 35 U | 7 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | N-nitroso-di-n-propylamine | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2-Methylphenol | 35 U | 7 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 1,2-Dichlorobenzene | 35 U | 3.1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 1,4-Dichlorobenzene | 35 U | 15 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2-Chlorophenol | 35 U | 7.2 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | bis(2-Chloroethyl)Ether | 35 U | 2.4 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,4-Dichlorophenol | 35 U | 4 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2-Methylnaphthalene | 35 U | 9.8 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 2,4-Dinitrotoluene | 35 U | 2.8 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Dibenz(a,h)Anthracene | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Hexachlorobenzene | 35 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | bis(2-Ethylhexyl)Phthalate | 35 U | 11 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 3,3'-Dichlorobenzidine | 170 U | 0.33 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | 4-Nitroaniline | 170 U | 4.2 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | Pentachlorophenol | 170 U | 1 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | n-Nitrosodiphenylamine | 35 U | 1.4 | MG/KG |
| CB-99-15 | CB9915003XX | 100 | 8270C | di-N-OctylPhthalate | 35 U | 20 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4,6-Trichlorophenol | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Hexachlorocyclopentadiene | 3700 U | 9.8 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Methylnaphthalene | 740 U | 9.8 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Hexachloroethane | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Hexachlorobutadiene | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 4-Chloroaniline | 740 U | 5.6 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Nitrobenzene | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4-Dimethylphenol | 740 U | 28 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4-Dichlorophenol | 740 U | 4 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4,5-Trichlorophenol | 740 U | 140 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4-Dinitrophenol | 3700 U | 2.8 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Nitrophenol | 740 U | 11 | MG/KG |

**TABLE I-1**
**SUMMARY OF DILUTION SVOC RESULTS WITH REPORTING LIMITS GREATER THAN POLLUTION MOBILITY STANDARDS**

| LOCATION | SAMPLED | DF | METHOD | PARAMETER | RL | MOB STD | UNITS |
|---|---|---|---|---|---|---|---|
| CB-99-15 | CB9915009XX | 400 | 8270C | Isophorone | 740 U | 7.4 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 1,2,4-Trichlorobenzene | 740 U | 14 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Dibenz(a,h)Anthracene | 740 UJ | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | n-Nitrosodiphenylamine | 740 U | 1.4 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 4-Bromophenyl-Phenyl Ether | 740 U | 82 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Hexachlorobenzene | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Pentachlorophenol | 3700 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Di-N-Butylphthalate | 740 U | 140 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | ButylBenzylPhthalate | 740 UJ | 200 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 3,3'-Dichlorobenzidine | 3700 UJ | 0.33 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,6-Dinitrotoluene | 740 U | 1.4 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | di-N-OctylPhthalate | 740 UJ | 20 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Chloronaphthalene | 740 U | 110 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 1,4-Dichlorobenzene | 740 U | 15 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 4-Methylphenol | 740 U | 7 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 4-Nitroaniline | 3700 U | 4.2 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 4-Chlorophenyl-PhenylEther | 740 U | 82 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2,4-Dinitrotoluene | 740 U | 2.8 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 3-Nitroaniline | 3700 U | 4.2 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | Acenaphthylene | 740 U | 84 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Nitroaniline | 3700 U | 1.65 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | bis(2-Ethylhexyl)Phthalate | 740 UJ | 11 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | N-nitroso-di-n-propylamine | 740 U | 1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Methylphenol | 740 U | 7 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 1,3-Dichlorobenzene | 740 U | 120 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 1,2-Dichlorobenzene | 740 U | 3.1 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Methylphenol | 740 U | 70 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | 2-Chlorophenol | 740 U | 7.2 | MG/KG |
| CB-99-15 | CB9915009XX | 400 | 8270C | bis(2-Chloroethyl)Ether | 740 U | 2.4 | MG/KG |

## LE I-2

## SUMMARY OF ANTIMONY RESULTS WITH REPORTING LIMITS GREATER THAN RESIDENTIAL DIRECT EXPOSURE STANDARDS

| METHOD | LOCATION | SAMPLE ID | DF | PARAMETER | RL | DE STD | UNITS |
|---|---|---|---|---|---|---|---|
| SW-846 6010B | CB-99-05 | CB9905002XX | 10 | Antimony | 67.3 UJ | 27 | MG/KG |
| SW-846 6010B | CB-99-08 | CB9908003XD | 10 | Antimony | 69.5 UJ | 27 | MG/KG |
| SW-846 6010B | CB-99-08 | CB9908003XX | 10 | Antimony | 70 UJ | 27 | MG/KG |
| SW-846 6010B | CB-99-08 | CB9908005XX | 10 | Antimony | 68.4 UJ | 27 | MG/KG |
| SW-846 6010B | CB-99-11 | CB9911002XX | 10 | Antimony | 68 UJ | 27 | MG/KG |
| SW-846 6010B | CB-99-16 | CB9916003XX | 10 | Antimony | 67.2 UJ | 27 | MG/KG |
| SW-846 6010B | TP-DEP-11 | TPDEP11001XX | 10 | Antimony | 76 UJ | 27 | MG/KG |

# I-2 ASBESTOS RESULTS

# RJ Lee *Group*, Inc.

350 Hochberg Road
Monroeville, PA 15146
Tel: (724) 325-1776
Fax: (724) 733-1799

The Materials Characterization Specialists


September 29, 1999

Mr. David Dunlap
Quanterra
450 William Pitt Way
Pittsburgh, PA 15238

RE: PLM Standard Analysis for Samples as Shown on the Test Report
Job Number: AOH909393
Customer Purchase Order Number: 728122

Dear Mr. Dunlap:

Enclosed are the results obtained from the asbestos identification for the above referenced samples. Analysis of the samples was made using the polarizing light microscope (PLM) and dispersion staining objective in accordance with guidelines set forth in the EPA Method for the Determination of Asbestos in Bulk Building Materials, U.S. EPA/600/R-93/116 (7/93 Edition).

RJ Lee Group, Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for selected test methods for airborne asbestos fiber analysis (TEM) and asbestos fiber analysis (PLM). RJ Lee Group's Monroeville laboratory is accredited by the American Industrial Hygiene Association for asbestos, silica and metals. The results contained herein apply only to analyzed samples.

These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions and no responsibility or liability is assumed for the manner in which the results are used or interpreted. Unless notified in writing to return the samples covered by this report, RJ Lee Group will store the samples for a period of ninety (90) days before discarding. A shipping and handling fee will be assessed for the return of any samples.

If you have any questions on this report or if we can be of further assistance, please feel free to call me.

Sincerely yours,

William H. Powers

William H. Powers
Manager, Bulk Materials Analysis

WHP/ku
Enclosure

# Test Report

## PLM Analysis Results

## Project AOH909393

| Sample Number / Sample Appearance | Client Sample Number | Asbestos: Chrysotile | Amosite | Crocidolite | Anthophyllite | Tremolite | Actinolite | Cellulose | Nonasbestos: Mineral Wool | Fibrous Glass | Synthetic Fibers | Other Fibers | NonFibrous Material | Run Date Analyst |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2556331BHPL** | DB9901004XX | - | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | **NFM:** Qtz, Carb, F-Spar, Mica, Misc. Particles | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556332BHPL** | DB9902004XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Tan Sandy Soil | | | | | | **NFM:** Qtz, Carb, Opaq, Mica, F-Spar, Misc. Particles | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556333BHPL** | DB9903004XX | <1 % | - | - | - | - | - | <1 % | - | - | - | <1 % | 100 % | 9/29/99 |
| Brown Sandy Soil | | | | | | **NFM:** Qtz, Carb, Opaq, Mica, F-Spar, Misc. Particles | | | | | | | | RFW |
| *Layer Content:* | Plaster Chips- Negative 1/2" X 1/4" Transite Chip- 20 Chrys 80 NFM | | | | | | | | | | | | | Homogeneous |
| **2556334BHPL** | DB9908004XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Light Brown Soil | | | | | | **NFM:** Qtz, Carb, Opaq, Mica, Cement | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556335BHPL** | DB9909004XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | **NFM:** Qtz, Tar, Carb, Opaq, Mica, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556336BHPL** | DB9910004XX | - | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | **NFM:** Qtz, Tar, Carb, Opaq, Mica, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556337BHPL** | DB9904004XX | <1 % | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | **NFM:** Qtz, Carb, Opaq, Mica, F-Spar, Metal Shavings | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |
| **2556338BHPL** | DB9906004XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | **NFM:** Qtz, Carb, Opaq, Mica, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | | Homogeneous |

Samples received on: Saturday, September 18, 1999

Authorized Signature Robert F. Wellman cm

Robert F. Wellman, Microscopist

Date Wednesday, September 29, 1999

**RJ Lee Group, Inc.**
*Headquarters*

350 Hochberg Road
Monroeville, PA 15146

Phone (724) 325-1776
Fax (724) 733-1799

# Test Report

## PLM Analysis Results

## Project AOH909393

| Sample Number / Sample Appearance | Client Sample Number | Asbestos: Chrysotile | Amosite | Crocidolite | Anthophyllite | Tremolite | Actinolite | Cellulose | Nonasbestos: Mineral Wool | Fibrous Glass | Synthetic Fibers | Other Fibers | NonFibrous Material | Run Date / Analyst |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2556339BHPL** | DB9906004XD | - | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | NFM: Qtz, Carb, Opaq, Mica, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556340BHPL** | DB9907004XX | - | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Tan Soil | | | | | | NFM: Qtz, Carb, Mica, Opaq, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556341BHPL** | DB9911004XX | - | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | | | | | NFM: Qtz, Carb, Opaq, Mica, F-Spar | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |

Samples received on: Saturday, September 18, 1999

Authorized Signature Robert F. Wellman

Robert F. Wellman, Microscopist

Date Wednesday, September 29, 1999

**RJ Lee Group, Inc.**
*Headquarters*

350 Hochberg Road
Monroeville, PA 15146

Phone (724) 325-1776
Fax (724) 733-1799

# Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

AOH90934?

JA-4124

| | | | |
|---|---|---|---|
| Client: Quanterra Pittsburgh | Project Manager: Dave Dunlap | Date: 9/16/99 | Chain Of Custody Number: 53775 |
| Address: 450 William Pitt Way | Telephone Number (Area Code)/Fax Number: 412-820-2088 / 412-820-2080 | Lab Number: C9I160175 | Page 1 of 1 |
| City: Pittsburgh / State: PA / Zip Code: ~~15146~~ 15238 9/16/99 | Site Contact: Barb Smith (KJ Lee) | | |
| Project Name: FW/HLA | Carrier/Waybill Number: | | |
| Contract/Purchase Order/Quote No.: will supply PO. in next few days | | | |

| Sample I.D. No. and Description | Date | Time | Sample Type | Total Volume | Containers Type | Containers No. | Preservative | Condition on Receipt | Analysis: OSbasics by RM |
|---|---|---|---|---|---|---|---|---|---|
| DB9910004XX | 9/13/99 | 1615 | soil | 4 oz | 4ozg | 1 | — | | X |
| DB9902004XX | ↓ | 1645 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9903004XX | ↓ | 1720 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9908004XX | 9/14/99 | 1055 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9909004XX | ↓ | 1135 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9910004XX | ↓ | 1225 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9904004XX | ↓ | 0825 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9906004XX | ↓ | 0915 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9906004XD | ↓ | 0915 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9907004XX | ↓ | 0955 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |
| DB9911004XX | ↓ | 1300 | ↓ | ↓ | ↓ | ↓ | ↓ | | X |

~~DX~~ 9/16/99

Special Instructions: Single report for these samples

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

Turn Around Time Required: ☐ Normal ☐ Rush report by 9/29/99 AM

QC Level: ☐ I. ☐ II. ☐ III.

Project Specific (Specify):

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| Relinquished By: D. Dunlap / Quanterra | 9/16/99 | 1705 | 1. Received By: P.F. Wellman / [illegible] | 9-16-99 | 1705 |
| Relinquished By: | | | 2. Received By: | | |
| Relinquished By: | | | 3. Received By: | | |

Comments:

DISTRIBUTION: WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

# RJ Lee *Group*, Inc.

350 Hochberg Road
Monroeville, PA 15146
Tel: (724) 325-1776
Fax: (724) 733-1799

The Materials Characterization Specialists


September 29, 1999

Mr. David Dunlap
Quanterra
450 William Pitt Way
Pittsburgh, PA 15238

RE: PLM Standard Analysis for Samples as Shown on the Test Report
Job Number: AOH909394
Customer Purchase Order Number: 728122

Dear Mr. Dunlap:

Enclosed are the results obtained from the asbestos identification for the above referenced samples. Analysis of the samples was made using the polarizing light microscope (PLM) and dispersion staining objective in accordance with guidelines set forth in the EPA Method for the Determination of Asbestos in Bulk Building Materials, U.S. EPA/600/R-93/116 (7/93 Edition).

RJ Lee Group, Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for selected test methods for airborne asbestos fiber analysis (TEM) and asbestos fiber analysis (PLM). RJ Lee Group's Monroeville laboratory is accredited by the American Industrial Hygiene Association for asbestos, silica and metals. The results contained herein apply only to analyzed samples.

These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions and no responsibility or liability is assumed for the manner in which the results are used or interpreted. Unless notified in writing to return the samples covered by this report, RJ Lee Group will store the samples for a period of ninety (90) days before discarding. A shipping and handling fee will be assessed for the return of any samples.

If you have any questions on this report or if we can be of further assistance, please feel free to call me.

Sincerely yours,

William H. Powers

William H. Powers
Manager, Bulk Materials Analysis

WHP/ku
Enclosure

# Test Report

## PLM Analysis Results

## Project AOH909394

| Sample Number / Sample Appearance | Client Sample Number | Asbestos: Chrysotile | Amosite | Crocidolite | Anthophyllite | Tremolite | Actinolite | Cellulose | Nonasbestos: Mineral Wool | Fibrous Glass | Synthetic Fibers | Other Fibers | NonFibrous Material | Run Date / Analyst |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2556342BHPL** | DB9912004XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Tar, Carb, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556343BHPL** | DB9913002XX | <1 % | - | - | - | - | - | <1 % | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Tar, Carb, Ver, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556344BHPL** | DB9914002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Tar, Carb, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556345BHPL** | DB9915002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Carb, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556346BHPL** | DB9916002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Carb, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556347BHPL** | DB9917002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Tar, Carb, Opaq, Gyp, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556348BHPL** | DB9918002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Carb, Opaq, Gyp, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |
| **2556349BHPL** | DB9905002XX | - | - | - | - | - | - | - | - | - | - | - | 100 % | 9/29/99 |
| Brown Soil | | NFM: Qtz, Tar, Carb, Opaq, Mica, F-Spar | | | | | | | | | | | | RFW |
| | | | | | | | | | | | | | Homogeneous | |

Samples received on: Saturday, September 18, 1999

Authorized Signature Robert F. Wellman (cm)

Robert F. Wellman, Microscopist

Date Wednesday, September 29, 1999

**RJ Lee Group, Inc.**
*Headquarters*

350 Hochberg Road
Monroeville, PA 15146

Phone (724) 325-1776
Fax (724) 733-1799

# Chain of Custody Record

Quanterra, Inc. - Pittsburgh PA Lab
450 William Pitt Way
Pittsburgh PA 15238

Quanterra

AGH909394

QUA-4124

| Client | Project Manager | Date | Chain Of Custody Number |
|---|---|---|---|
| Quanterra Pittsburgh | Dave Dunlop | 9/16/99 | 63774 |
| **Address** 450 William Pitt Way | **Telephone Number (Area Code)/Fax Number** 412-820-2088 / 412-820-2080 | **Lab Number** C9I160190 | **Page** 1 of 1 |
| **City** Pittsburgh **State** PA **Zip Code** 15238 | **Site Contact** Barb Smith (RJ Lee) | | |
| **Project Name** FW/HLA | **Carrier/Waybill Number** | | |
| **Contract/Purchase Order/Quote No.** will supply PO. in next few days | | | |

| Sample I.D. No. and Description | Date | Time | Sample Type | Total Volume | Containers Type | Containers No. | Preservative | Condition on Receipt | Analysis: Asbestos by PLM |
|---|---|---|---|---|---|---|---|---|---|
| DB9912004XX DK 9/16/99 | 9/14/99 | 1515 | Soil | 4 oz | 4 oz g | 1 | — | | X |
| DB9913004XX 2XX | ↓ | 1535 | | | | | | | X |
| DB9914002XX | ↓ | 1620 | | | | | | | X |
| DB9915002XX | 9/15/99 | 0845 | | | | | | | X |
| DB9916002XX | | 0940 | | | | | | | X |
| DB9917002XX | | 1010 | | | | | | | X |
| DB9918002XX | | 1105 | | | | | | | X |
| DB9905002XX | ↓ | 1200 | ↓ | ↓ | ↓ | ↓ | | | X |

DK 9/16/99

**Special Instructions** Single report for these samples

**Possible Hazard Identification**
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

**Sample Disposal**
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

**Turn Around Time Required**
☐ Normal ☐ Rush report by 9/30/99 AM

**QC Level**
☐ I. ☐ II. ☐ III.

**Project Specific (Specify)**

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| 1. Relinquished By Dave Dunlop-Quanterra | 9/16/99 | 1705 | 1. Received By RF Wellman / Robert D Wellman | 9-16-99 | 1705 |
| 2. Relinquished By | | | 2. Received By | | |
| 3. Relinquished By | | | 3. Received By | | |

**Comments**

**DISTRIBUTION:** WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

# PRELIMINARY SEISMIC DATA

# SEISMIC REFRACTION SURVEY
# AT THE SAEP SITE
# STRATFORD, CONNECTICUT
**For**
**Harding Lawson Associates**
**November, 1999**

Northeast Geophysical Services
Division of NGS, Inc.
4 Union Street, Suite 3
Bangor, Maine 04401

## TABLE OF CONTENTS

# SEISMIC REFRACTION SURVEY
# AT THE SAEP SITE
# STRATFORD, CONNECTICUT

## INTRODUCTION

At the request of Harding Lawson Associates a seismic refraction survey was completed at the Stratford Army Engine Plant (SAEP) site located in Stratford, Connecticut. The objective of this survey was to determine the bedrock depth and configuration beneath the survey area. This information will be used to guide the location of subsequent subsurface investigations. The field survey was undertaken on September 28 to October 1, 1999. Seven seismic lines totaling 5,593 lineal feet were surveyed. Preliminary profiles were faxed to HLA on October 2 and October 21, 1999.

This report describes the equipment and methods used and the results of the survey, and includes tabulated data and profiles for each of the interpreted seismic lines. Each profile is presented at a scale of 1-inch equals 120 feet on the horizontal scale and 1 inch equals 60 feet on the vertical scale.

## LOCATION AND SITE CONDITIONS

The survey area is located on the property of the inactive Stratford Army Engine Plant in Stratford, Connecticut. The locations of the survey lines are shown on the Seismic Line Location Map (Figure 1). The locations shown on Figure 1 are approximate. Surface conditions for Lines 3-7 were mainly asphalt or concrete pavements. Lines 1 and 2 were located in mud along the shoreline.

The site was seismically noisy which made the collection of clear seismic records challenging. Although the SAEP site is inactive there is still some maintenance machinery and equipment in operation that often created a high background of noise. In addition to these on-site noise sources there was additional noise contributed by the nearby airport and off-site vehicular traffic.

## SUMMARY OF RESULTS

The seismic refraction results are presented in the appendix as profiles of each line showing the seismically interpreted bedrock depths and configurations. Tabulated results for each line are also appended. The seismically calculated bedrock depths range from about 49 feet to184 feet deep over the survey area. Bedrock is deepest to the northwest along Line 7 and the west end of Line 2 and shallowest to the southeast, along Lines 3 and 5 and the east end of Line 2.

## SEISMIC METHODS AND INSTRUMENTATION

The seismic refraction method relies on travel times of sound waves, measured in milliseconds, traveling through and refracting from subsurface layers with contrasting densities. The seismic refraction lines were surveyed using a Geometrics ES-2401, 24-channel seismograph.

Each line consisted of 1 to 3 segments with each segment containing 24 geophones. Geophones were nominally spaced at 20 feet apart. Each segment was tested with 5 to 6 shots. The general shot configuration consisted of one shot at either end of the segment, one off each end about 200 to 300 feet, and one or two shots within the segment. The energy source consisted of a small explosive charge buried about 3 feet.

Individual shot point and geophone elevations were surveyed using a Trimble GPS instrument operated by Foster Wheeler Environmental Corporation personnel. Surface elevations shown are approximate.

The seismic data were processed and interpreted using the RIMRock Geophysics SIPT-2 (formerly U.S.G.S. SIPT-2) seismic interpretation program. This program calculates seismic velocities by regression and by the Hobson-Overton method, and solves for layer thicknesses using the delay-time method and iterative ray tracing modeling.

## SEISMIC SURVEY RESULTS

The seismic refraction results are presented in the appendix as profiles of each line showing the seismically interpreted bedrock depths and configurations. Tabulated results for each line are also appended.

The survey identified three velocity layers in the subsurface at the site. The average Layer 1 velocity for Lines 3-7 was approximately 1,500 feet per second (fps) and is interpreted to represent unsaturated overburden. On Lines 1 and 2 the Layer 1 velocity was higher at about 2,100 fps. This layer is interpreted to represent saturated organic muds. The average Layer 2 velocity for the survey was 5,455 fps and is interpreted to represent saturated overburden. The average Layer 3 velocity for the survey was about 18,000 fps and is interpreted to represent bedrock.

A three-velocity layer model was used for interpretation using the measured velocities of each line. The velocities used in the seismic interpretation for each segment are shown on the profiles.

The seismic survey results indicate that the bedrock depths range from approximately 49 feet to184 feet over the survey area. The area of lowest calculated bedrock elevations (-140 to -177 ft msl) are in the northwest part of the survey area along Line 7 and the west end of Line 2. The highest calculated bedrock elevations (-42 to -50 ft. msl) are at the southeast part of the survey area along Lines 3 and 5 and the east end of Line 2.

Profile of Line 1 (708 lineal feet) Line 1 trends from southwest to northeast along a jetty that extends out into the Housatonic River. The seismically calculated depth to layer 2 along this profile averaged 22 feet. The seismically calculated bedrock depths along this profile range from about 70 feet at the south end of the profile to 121 feet deep at 535 feet north.

Profile of Line 2 (1,630 lineal feet) Line 2 trends from northwest to southeast along the shoreline of the Housatonic River, which forms the northerly boundary of the SAEP site. The seismically calculated depth to Layer 2 along this profile averaged *50* feet. The seismically calculated bedrock depths along this profile range from about 50 to 60 feet deep at the southeast end of the profile to a depth of 158 feet at the northeast end of the line at 200 feet northeast.

Profile of Line 3 (630 lineal feet) Line 3 trends from southwest to northeast and is located in a paved area between buildings B-3 and B-10 within the SAEP facility. The seismically calculated depth to layer 2 along this profile averaged 17 feet. The seismically calculated bedrock depths along this profile range from about 100 feet at the southwest end of the survey line to a depth of about 50 feet near the northwest end of the survey line at 490 feet north. The data quality on this line was not good. Thus the interpretation of Line 3 is more uncertain than the other seismic lines.

Profile of Line 4 (690 lineal feet) Line 4 trends from northwest to southeast and is located in a paved area between buildings B-2 and B-12 &10. The line begins near the northeast end of Line 7 and ends near the southwest end of Line 3. Seismic data was too poor to make an interpretation of this line.

Profile of Line 5 (930 lineal feet) Line 5 trends from southwest to northeast and is located in the South Parking Lot and along Sniffens Lane along the southeast side of the site. The seismically calculated depth to layer 2 along this profile averaged 11 feet. The seismically calculated bedrock depths along this profile range from about 69 feet at the southwest end of the profile to about 52 feet at 230 feet north and from about 52 to 60 feet deep at the northeast end of the line.

Profile of Line 6 (502 lineal feet) Line 6 trends from southwest to northeast and is located in the West Parking Lot on the southwest side of the site. The seismically calculated depth to layer 2 along this profile averaged 17 feet. The seismically calculated bedrock depths along this profile range from about 80 feet at the northeast end of the profile to about 125 feet near the southwest end of the line at station 120 feet north.

Profile of Line 7 (503 lineal feet) Line 7 trends from southwest to northeast and is located within the Building number 2. Line 7 had the greatest bedrock depths of the lines surveyed. The seismically calculated depth to layer 2 along this profile averaged 19 feet. The seismically calculated bedrock depths along this profile range from about 130 feet at the northeast end of the line to about 185 feet at the southwest end of the line.

## DISCUSSION OF SEISMIC RESULTS

In order for the seismic refraction method to accurately estimate velocity layer depths, certain natural conditions should exist:

a.) Layers should increase in velocity and in thickness with depth. A typical example would be ten feet of unsaturated soil at 1,500 fps overlying 50 feet of saturated soil at 5,000 fps that overlies bedrock at 16,000 fps.

b.) There should be a sufficient velocity contrast between different layers. Ideally, each velocity layer would be 2 to 3 times faster than the overlying layer.

c.) The velocity within a layer should be relatively constant throughout that layer (lateral homogeneity).

In addition to these conditions, it is also important that there be a low level of background noise at the site. It is also very helpful if there is some ground truth data, such as borehole data, to compare and calibrate the seismic model.

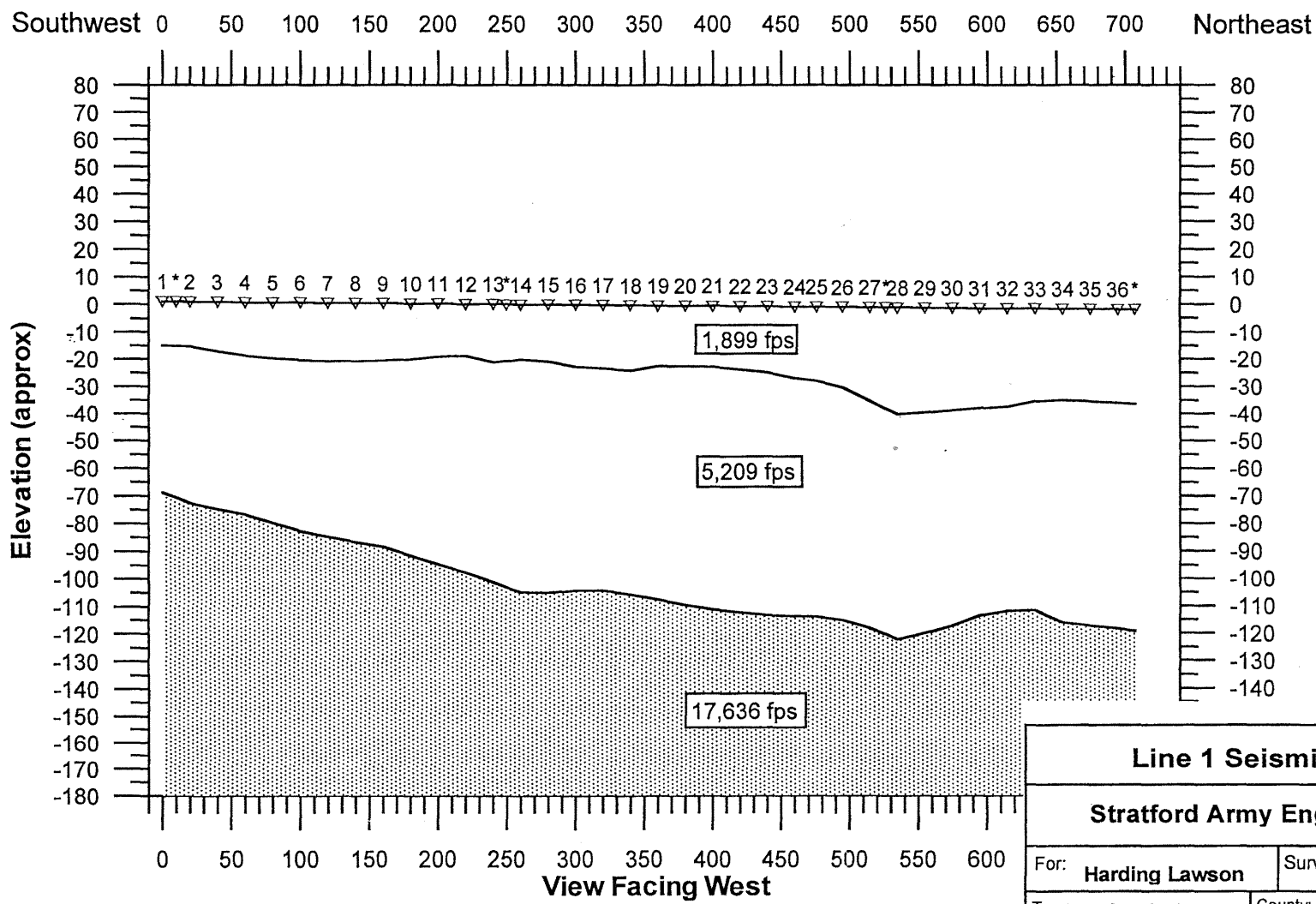
Under favorable conditions seismic refraction results can be fairly precise, within +/- 10 percent. The conditions at the SAEP Site were difficult for seismic refraction. High noise levels affected the quality of the seismic data. The use of explosive charges as a sound source enabled the collection of interpretable data for all of the lines except for Line 4. On Line 4 high noise levels and subsurface utilities located beneath the seismic line resulted in unclear, unreliable data. For this reason an interpretation of Line 4 was not included in this report. Interpretable data was collected on the other survey lines with the best data coming from Line 2, which was along the shoreline and the noisier data from the lines within the facility, Lines 3 and 7.

There are two conditions that may exist over parts of the survey area that could affect the accuracy of the survey. The first is the possibility that hidden velocity layers exist. A velocity layer can be undetectable by seismic refraction if it is too thin or if it has a lower velocity than the layers above it. The effect of a hidden layer can be to under or over-estimate the depth to bedrock. An example of a too thin layer is a 10-foot thick till unit that underlies 40 feet of saturated sand. Although the till has a higher velocity than the sand it cannot be detected because the refracted sound energy from the bedrock arrives at the surface ahead of the refracted energy from the till layer. In areas where the till is relatively thick the seismic interpretation of bedrock depth will be underestimated.

A second factor that may affect the accuracy of the seismic interpretation is that lateral variations in the seismic velocity of the soil and bedrock may exist. For interpretation of the seismic data each layer is assumed to have a constant, homogeneous, velocity. The effect of lateral velocity variations can be to under or over-estimate the depth to bedrock. For example: If a zone of 1,000 fps material existed within a layer whose overall velocity was 1,400 fps, the seismically calculated depths in this slow zone would be deeper than they actually were. There are likely lateral velocity

inhomogenieties in some parts of the survey area. The bedrock depth estimates in these areas would be less precise.

On the other hand, if a slow velocity layer exists beneath a faster layer the effect on the seismic interpretation will be to overestimate the bedrock depth. Such a situation does not generally occur in nature but an example would be a perched water table with saturated (higher velocity) material overlying unsaturated (lower velocity) material. In both of these situations the accuracy of the seismic interpretation can be improved if the depth to bedrock is known (by borings) in a few locations. Based on the available information, it appears that the seismic survey fairly accurately depicts the bedrock configuration.




## Line 1 Seismic Profile

### Stratford Army Engine Plant Site

| | | | |
|---|---|---|---|
| For: **Harding Lawson** | | Survey Date: **9/28/99** | |
| Town: Stratford | County: Fairfield | State: CT | |
| Scale: Horizontal: 1 in = 120 ft<br>Vertical: 1 in = 60 ft | | Instrument: Geometrics 2401 | |

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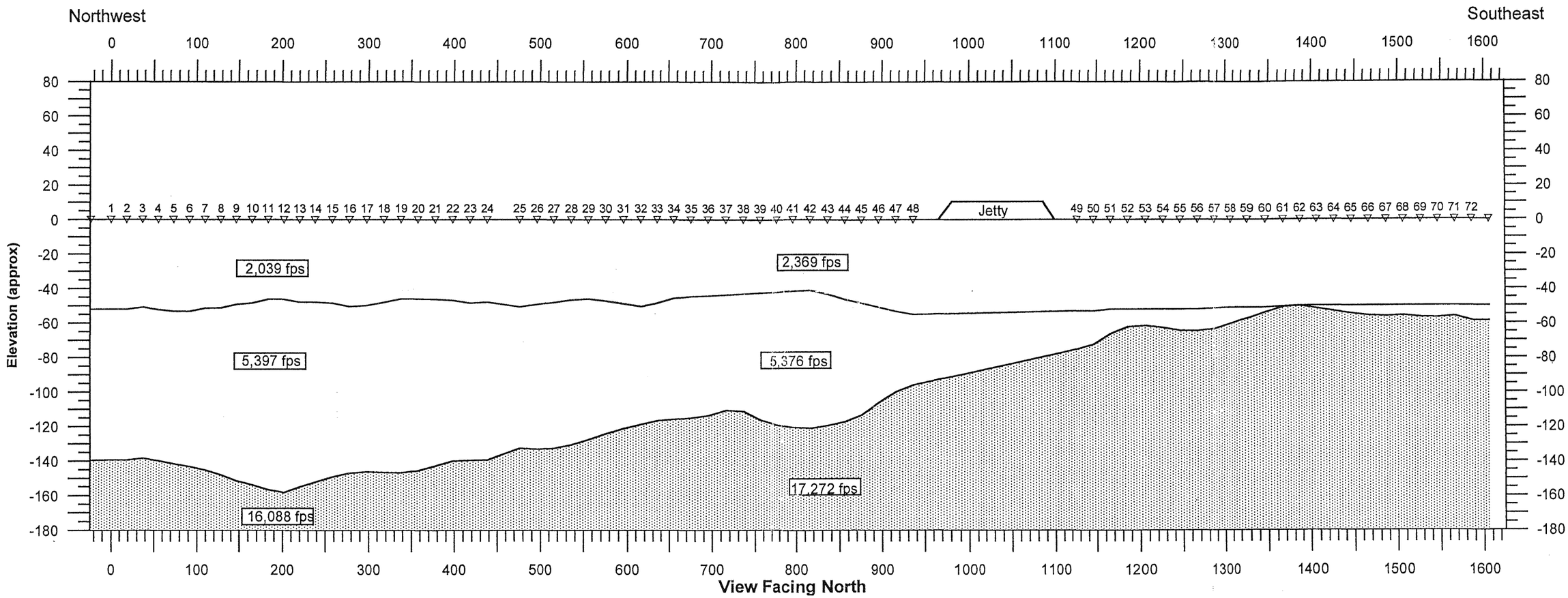
A division of NGS, Inc.
Bangor, Maine




## Line 2 Seismic Profile

### Stratford Army Engine Plant Site

| | | |
|---|---|---|
| For: Harding Lawson | Survey Date: 9/29/99 | |
| Town: Stratford | County: Fairfield | State: CT |
| Scale: Horizontal: 1 in = 120 ft<br>Vertical: 1 in = 60 ft | Instrument: Geometrics 2401 | |

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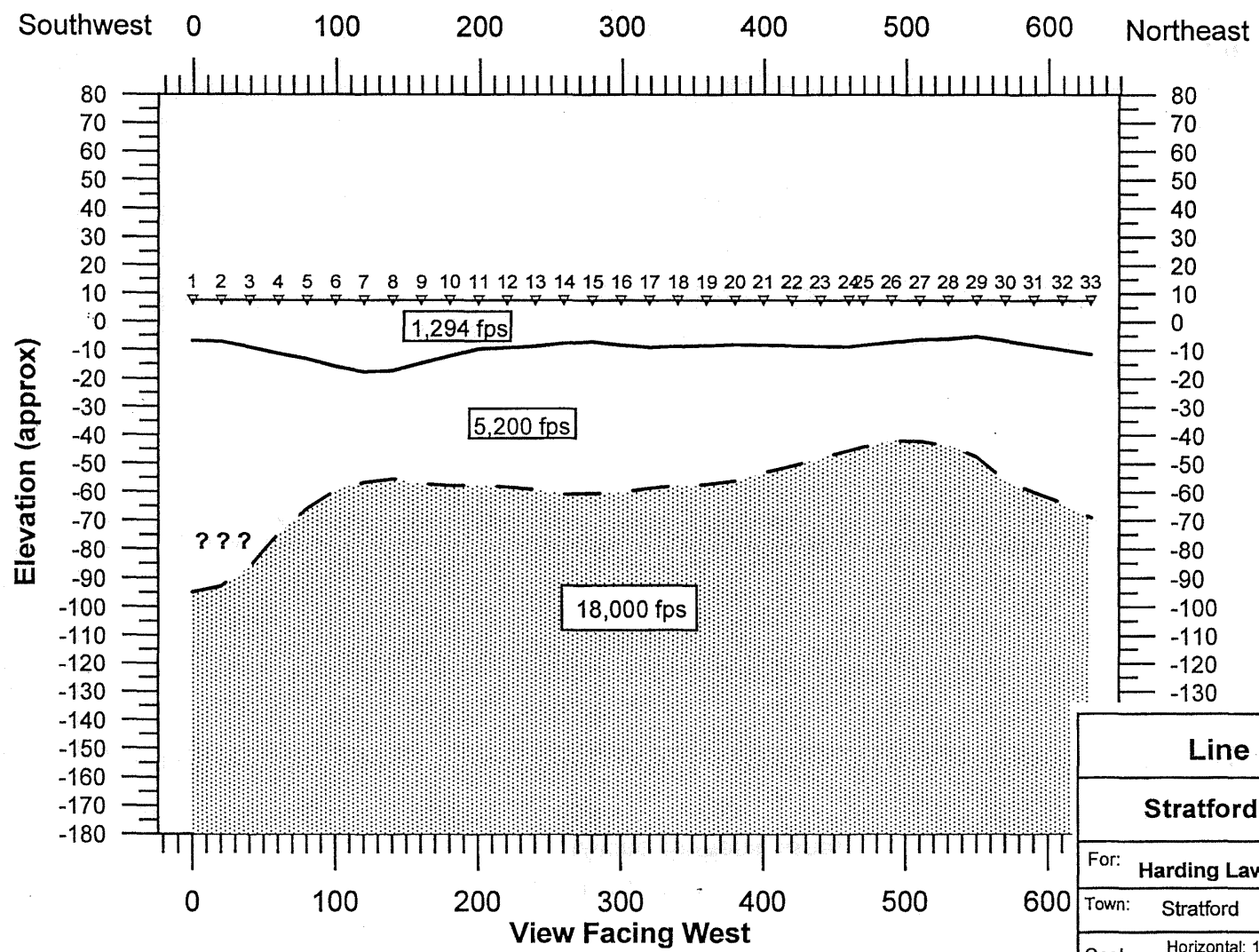


## Line 3 Seismic Profile

### Stratford Army Engine Plant Site

| | | | |
|---|---|---|---|
| For: **Harding Lawson** | | Survey Date: **9/28/99** | |
| Town: Stratford | County: Fairfield | State: CT | |
| Scale: Horizontal: 1 in = 120 ft<br>Vertical: 1 in = 60 ft | | Instrument: Geometrics 2401 | |

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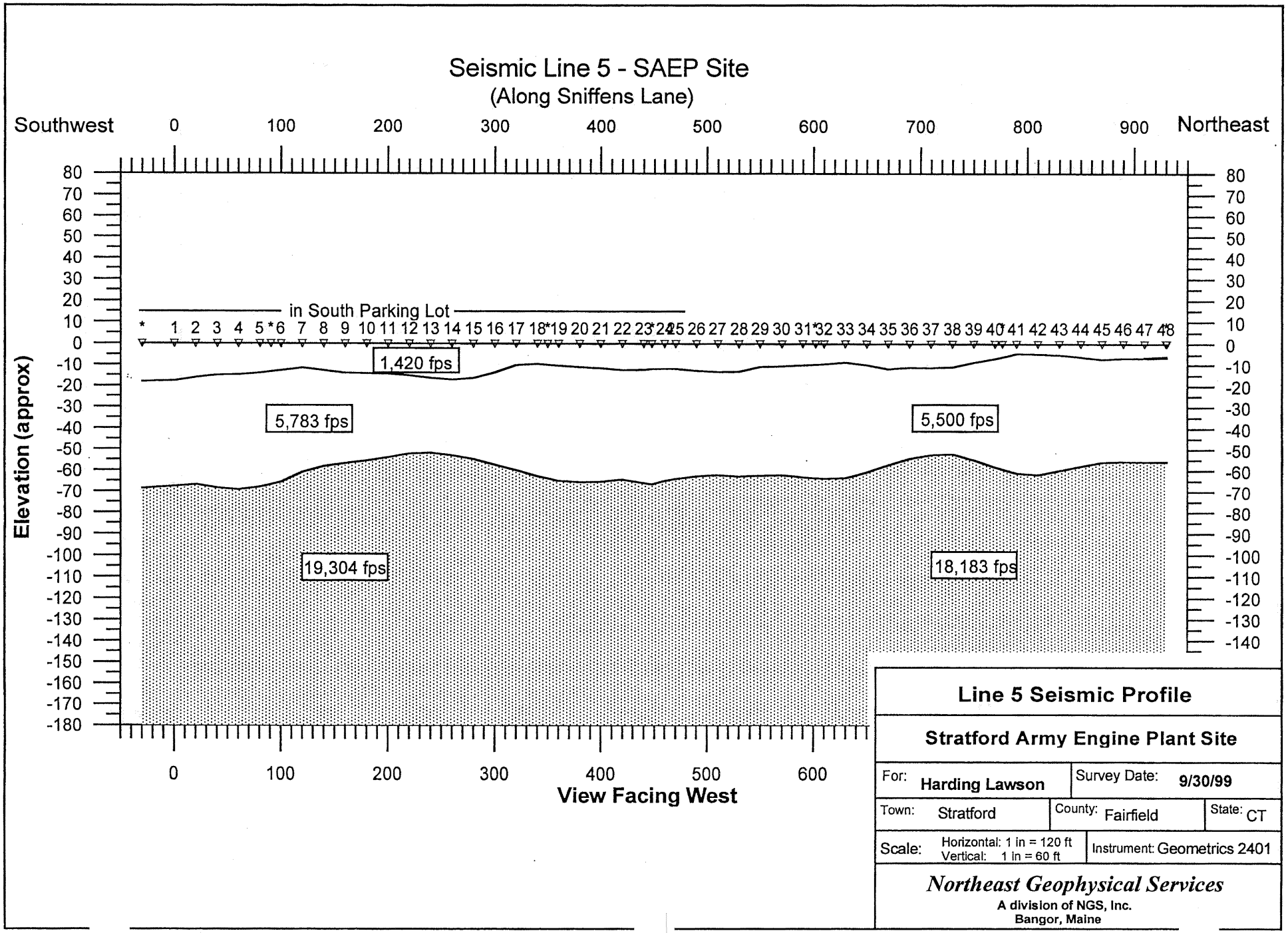
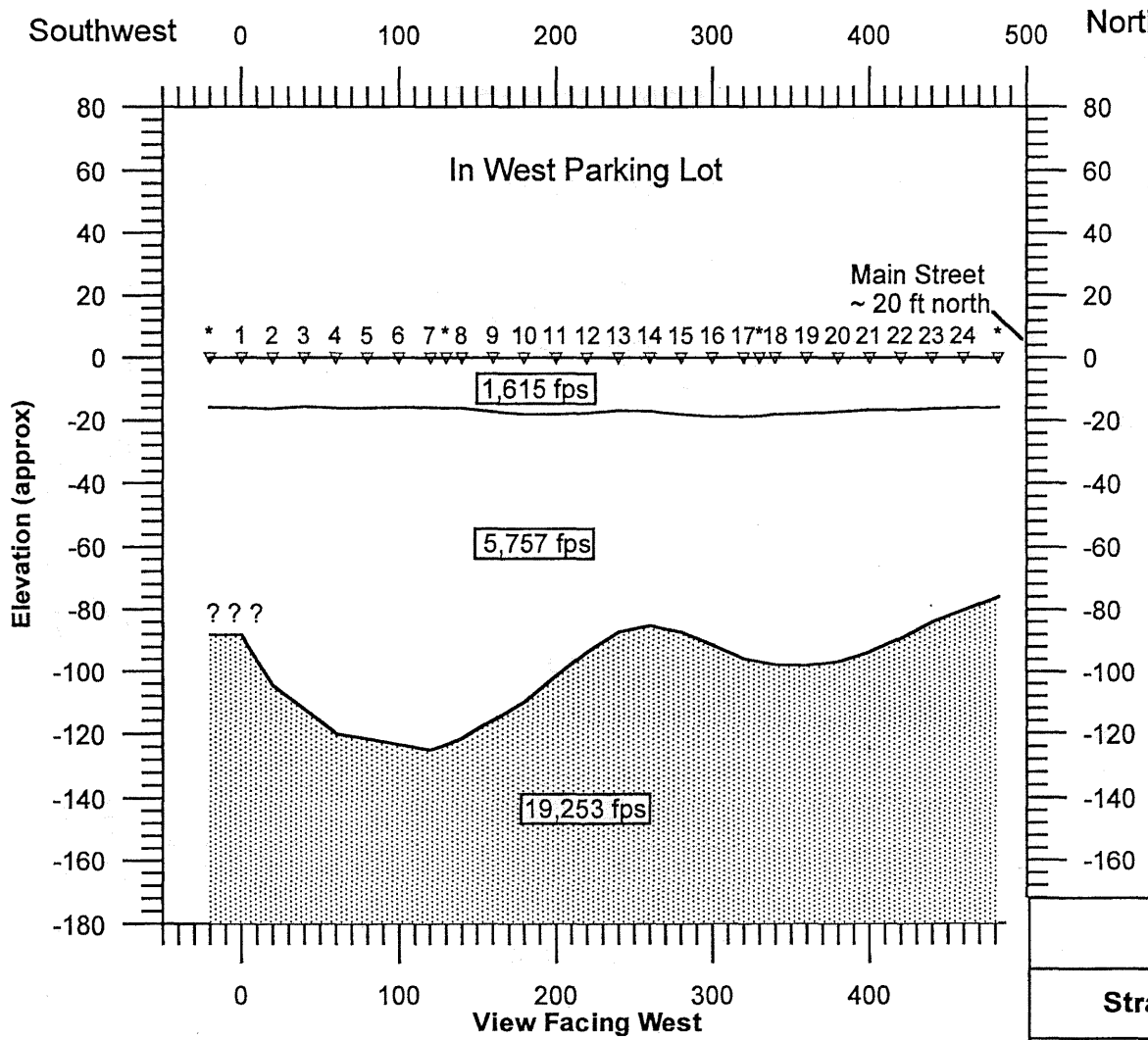

Seismic Line 5 - SAEP Site
(Along Sniffens Lane)
Southwest
Northeast
0 100 200 300 400 500 600 700 800 900
Elevation (approx)
80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180
in South Parking Lot
* 1 2 3 4 5 *6 7 8 9 10 11 12 13 14 15 16 17 18 *19 20 21 22 23 *24 25 26 27 28 29 30 31 *32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
1,420 fps
5,783 fps
5,500 fps
19,304 fps
18,183 fps
0 100 200 300 400 500 600
View Facing West
Line 5 Seismic Profile
Stratford Army Engine Plant Site
For: Harding Lawson
Survey Date: 9/30/99
Town: Stratford
County: Fairfield
State: CT
Scale: Horizontal: 1 in = 120 ft
Vertical: 1 in = 60 ft
Instrument: Geometrics 2401
Northeast Geophysical Services
A division of NGS, Inc.
Bangor, Maine




## Line 6 Seismic Profile

### Stratford Army Engine Plant Site

| | | | |
|---|---|---|---|
| For: **Harding Lawson** | | Survey Date: **9/29/99** | |
| Town: Stratford | County: Fairfield | State: CT | |
| Scale: Horizontal: 1 in = 120 ft<br>Vertical: 1 in = 60 ft | | Instrument: Geometrics 2401 | |

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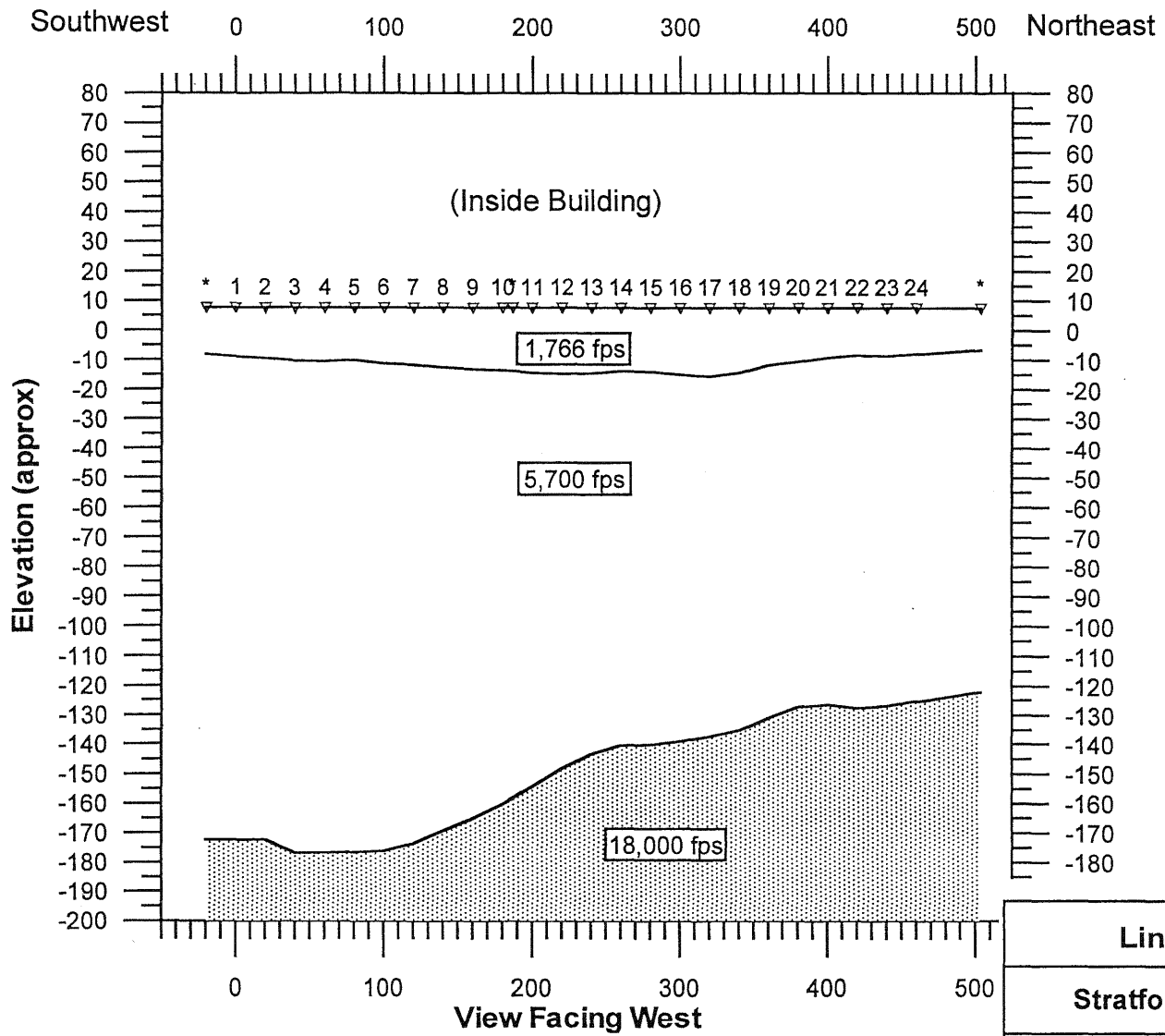


## Line 7 Seismic Profile

### Stratford Army Engine Plant Site

| | | | |
|---|---|---|---|
| For: **Harding Lawson** | | Survey Date: **9/30/99** | |
| Town: Stratford | County: Fairfield | State: CT | |
| Scale: Horizontal: 1 in = 120 ft<br>Vertical: 1 in = 60 ft | | Instrument: Geometrics 2401 | |

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Bangor, Maine

Northeast Geophysical Services

| **Line 1 SAEP Site Stratford, CT** Seismically interpreted depths | | | | | | |
|---|---|---|---|---|---|---|
| Geophone | X dist (feet) | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
| 1 | 0 | 1.0 | 16.1 | -15 | 70 | -69 |
| * | 10 | 0.9 | 16 | -15 | 72 | -71 |
| 2 | 20 | 0.8 | 16 | -15 | 73 | -73 |
| 3 | 40 | 0.8 | 18 | -17 | 76 | -75 |
| 4 | 60 | 0.7 | 20 | -19 | 78 | -77 |
| 5 | 80 | 0.6 | 21 | -20 | 80 | -80 |
| 6 | 100 | 0.5 | 21 | -20 | 83 | -83 |
| 7 | 120 | 0.5 | 21 | -21 | 85 | -85 |
| 8 | 140 | 0.4 | 21 | -21 | 87 | -87 |
| 9 | 160 | 0.3 | 21 | -21 | 89 | -88 |
| 10 | 180 | 0.2 | 21 | -20 | 92 | -92 |
| 11 | 200 | 0.2 | 20 | -19 | 95 | -95 |
| 12 | 220 | 0.1 | 19 | -19 | 98 | -98 |
| 13 | 240 | 0.0 | 21 | -21 | 101 | -101 |
| * | 249.7 | -0.1 | 21 | -21 | 103 | -103 |
| 14 | 260 | -0.2 | 20 | -20 | 105 | -105 |
| 15 | 280 | -0.2 | 21 | -21 | 105 | -105 |
| 16 | 300 | -0.3 | 23 | -23 | 104 | -105 |
| 17 | 320 | -0.4 | 23 | -23 | 104 | -105 |
| 18 | 340 | -0.5 | 24 | -24 | 105 | -106 |
| 19 | 360 | -0.5 | 22 | -23 | 107 | -108 |
| 20 | 380 | -0.6 | 22 | -23 | 109 | -110 |
| 21 | 400 | -0.7 | 22 | -23 | 111 | -111 |
| 22 | 420 | -0.8 | 23 | -24 | 112 | -112 |
| 23 | 440 | -0.8 | 24 | -25 | 112 | -113 |
| 24 | 460 | -0.9 | 26 | -27 | 113 | -114 |
| 25 | 476 | -1.0 | 27 | -28 | 113 | -114 |
| 26 | 495 | -1.1 | 29 | -30 | 114 | -115 |
| 27 | 515 | -1.2 | 34 | -35 | 117 | -118 |
| * | 526.5 | -1.2 | 37 | -38 | 119 | -120 |
| 28 | 535 | -1.3 | 39 | -40 | 121 | -122 |
| 29 | 555 | -1.4 | 38 | -40 | 119 | -120 |
| 30 | 575 | -1.5 | 37 | -39 | 116 | -117 |
| 31 | 595 | -1.5 | 37 | -38 | 112 | -114 |
| 32 | 615 | -1.6 | 36 | -37 | 110 | -112 |
| 33 | 635 | -1.7 | 34 | -35 | 110 | -112 |
| 34 | 655 | -1.8 | 33 | -35 | 114 | -116 |
| 35 | 675 | -1.8 | 34 | -36 | 115 | -117 |
| 36 | 695 | -1.9 | 34 | -36 | 116 | -118 |
| * | 707.5 | -2.0 | 34 | -36 | 117 | -119 |

**Line 2 SAEP Site Stratford, CT**

Seismically interpreted depths

| Geophone | X dist (feet) | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
|---|---|---|---|---|---|---|
| * | -24 | 0 | 52 | -52 | 140 | -140 |
| 1 | 0 | 0 | 52 | -52 | 140 | -140 |
| 2 | 18.3 | 0 | 52 | -52 | 139 | -139 |
| 3 | 36.6 | 0 | 51 | -51 | 139 | -139 |
| 4 | 54.9 | 0 | 52 | -52 | 140 | -140 |
| 5 | 73.2 | 0 | 53 | -53 | 142 | -142 |
| 6 | 91.5 | 0 | 53 | -53 | 143 | -143 |
| 7 | 109.8 | 0 | 51 | -51 | 145 | -145 |
| 8 | 128.2 | 0 | 51 | -51 | 148 | -148 |
| 9 | 146.5 | 0 | 49 | -49 | 151 | -151 |
| 10 | 164.8 | 0 | 48 | -48 | 154 | -154 |
| 11 | 183.1 | 0 | 46 | -46 | 157 | -157 |
| 12 | 201.4 | 0 | 46 | -46 | 158 | -158 |
| 13 | 219.7 | 0 | 48 | -48 | 155 | -155 |
| 14 | 238 | 0 | 48 | -48 | 152 | -152 |
| 15 | 258 | 0 | 48 | -48 | 149 | -149 |
| 16 | 278 | 0 | 51 | -51 | 147 | -147 |
| 17 | 298 | 0 | 50 | -50 | 146 | -146 |
| 18 | 318 | 0 | 48 | -48 | 147 | -147 |
| 19 | 338 | 0 | 46 | -46 | 147 | -147 |
| 20 | 358 | 0 | 46 | -46 | 146 | -146 |
| 21 | 378 | 0 | 46 | -46 | 143 | -143 |
| 22 | 398 | 0 | 47 | -47 | 140 | -140 |
| 23 | 418 | 0 | 48 | -48 | 140 | -140 |
| 24 | 438 | 0 | 48 | -48 | 140 | -140 |
| 25 | 476 | 0 | 51 | -51 | 133 | -133 |
| 26 | 496 | 0 | 49 | -49 | 133 | -133 |
| 27 | 516 | 0 | 48 | -48 | 133 | -133 |
| 28 | 536 | 0 | 47 | -47 | 131 | -131 |
| 29 | 556 | 0 | 46 | -46 | 128 | -128 |
| 30 | 576 | 0 | 47 | -47 | 124 | -124 |
| 31 | 596 | 0 | 49 | -49 | 121 | -121 |
| 32 | 616 | 0 | 51 | -51 | 119 | -119 |
| 33 | 636 | 0 | 48 | -48 | 117 | -117 |
| 34 | 656 | 0 | 46 | -46 | 116 | -116 |
| 35 | 676 | 0 | 45 | -45 | 115 | -115 |
| 36 | 696 | 0 | 44 | -44 | 114 | -114 |
| 37 | 716 | 0 | 44 | -44 | 111 | -111 |
| 38 | 736 | 0 | 43 | -43 | 111 | -111 |
| 39 | 756 | 0 | 43 | -43 | 116 | -116 |
| 40 | 776 | 0 | 42 | -42 | 119 | -119 |
| 41 | 796 | 0 | 42 | -42 | 121 | -121 |
| 42 | 816 | 0 | 41 | -41 | 121 | -121 |
| 43 | 836 | 0 | 43 | -43 | 120 | -120 |
| 44 | 856 | 0 | 46 | -46 | 117 | -117 |
| 45 | 876 | 0 | 49 | -49 | 114 | -114 |
| 46 | 896 | 0 | 51 | -51 | 106 | -106 |
| 47 | 916 | 0 | 53 | -53 | 100 | -100 |
| 48 | 936 | 0 | 55 | -55 | 96 | -96 |
| 49 | 1126 | 0 | 53 | -53 | 75 | -75 |
| 50 | 1146 | 0 | 53 | -53 | 72 | -72 |
| 51 | 1166 | 0 | 52 | -52 | 66 | -66 |
| 52 | 1186 | 0 | 52 | -52 | 62 | -62 |
| 53 | 1206 | 0 | 52 | -52 | 62 | -62 |
| 54 | 1226 | 0 | 52 | -52 | 63 | -63 |
| 55 | 1246 | 0 | 52 | -52 | 64 | -64 |
| 56 | 1266 | 0 | 52 | -52 | 65 | -65 |
| 57 | 1286 | 0 | 52 | -52 | 64 | -64 |
| 58 | 1306 | 0 | 51 | -51 | 60 | -60 |
| 59 | 1326 | 0 | 51 | -51 | 58 | -58 |
| 60 | 1346 | 0 | 51 | -51 | 54 | -54 |
| 61 | 1366 | 0 | 51 | -51 | 51 | -51 |
| 62 | 1386 | 0 | 50 | -50 | 50 | -50 |
| 63 | 1406 | 0 | 50 | -50 | 52 | -52 |
| 64 | 1426 | 0 | 50 | -50 | 53 | -53 |
| 65 | 1446 | 0 | 50 | -50 | 55 | -55 |
| 66 | 1466 | 0 | 50 | -50 | 56 | -56 |
| 67 | 1486 | 0 | 50 | -50 | 56 | -56 |
| 68 | 1506 | 0 | 50 | -50 | 56 | -56 |
| 69 | 1526 | 0 | 50 | -50 | 57 | -57 |
| 70 | 1546 | 0 | 50 | -50 | 57 | -57 |
| 71 | 1566 | 0 | 50 | -50 | 56 | -56 |
| 72 | 1586 | 0 | 50 | -50 | 59 | -59 |
| * | 1606 | 0 | 50 | -50 | 59 | -59 |

| Line 3 SAEP Site Stratford, CT<br>Seismically interpreted depths | | | | | | |
|---|---|---|---|---|---|---|
| Geophone | X Dist feet | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
| 1 | 0 | 7.5 | 15 | -7 | 103 | -95 |
| 2 | 20 | 7.5 | 15 | -7 | 100 | -93 |
| 3 | 40 | 7.5 | 17 | -9 | 94 | -87 |
| 4 | 60 | 7.5 | 19 | -11 | 82 | -75 |
| 5 | 80 | 7.5 | 21 | -13 | 74 | -66 |
| 6 | 100 | 7.5 | 24 | -16 | 67 | -60 |
| 7 | 120 | 7.5 | 25 | -18 | 64 | -57 |
| 8 | 140 | 7.5 | 25 | -17 | 63 | -56 |
| 9 | 160 | 7.5 | 22 | -15 | 65 | -57 |
| 10 | 180 | 7.5 | 20 | -12 | 66 | -58 |
| 11 | 200 | 7.5 | 17 | -10 | 66 | -58 |
| 12 | 220 | 7.5 | 17 | -9 | 66 | -58 |
| 13 | 240 | 7.5 | 16 | -9 | 67 | -59 |
| 14 | 260 | 7.5 | 15 | -8 | 68 | -61 |
| 15 | 280 | 7.5 | 15 | -7 | 68 | -61 |
| 16 | 300 | 7.5 | 16 | -8 | 68 | -60 |
| 17 | 320 | 7.5 | 17 | -9 | 66 | -59 |
| 18 | 340 | 7.5 | 16 | -9 | 65 | -58 |
| 19 | 360 | 7.5 | 16 | -9 | 65 | -57 |
| 20 | 380 | 7.5 | 16 | -8 | 64 | -56 |
| 21 | 400 | 7.5 | 16 | -8 | 61 | -54 |
| 22 | 420 | 7.5 | 16 | -9 | 58 | -51 |
| 23 | 440 | 7.5 | 16 | -9 | 56 | -48 |
| 24 | 460 | 7.5 | 16 | -9 | 53 | -46 |
| 25 | 470 | 7.5 | 16 | -8 | 52 | -44 |
| 26 | 490 | 7.5 | 15 | -7 | 49 | -42 |
| 27 | 510 | 7.5 | 14 | -6 | 50 | -42 |
| 28 | 530 | 7.5 | 14 | -6 | 51 | -44 |
| 29 | 550 | 7.5 | 13 | -5 | 55 | -48 |
| 30 | 570 | 7.5 | 14 | -7 | 63 | -56 |
| 31 | 590 | 7.5 | 16 | -8 | 68 | -60 |
| 32 | 610 | 7.5 | 18 | -10 | 71 | -64 |
| 33 | 630 | 7.5 | 19 | -12 | 77 | -69 |

| **Line 5 SAEP Site Stratford, CT** Seismically interpreted depths | | | | | | |
|---|---|---|---|---|---|---|
| Geophone | X dist (feet) | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
| * | -30 | 7.5 | 18 | -11 | 69 | -61 |
| 1 | 0 | 7.5 | 18 | -10 | 68 | -60 |
| 2 | 20 | 7.5 | 16 | -9 | 67 | -59 |
| 3 | 40 | 7.5 | 15 | -8 | 68 | -61 |
| 4 | 60 | 7.5 | 15 | -7 | 69 | -62 |
| 5 | 80 | 7.5 | 14 | -7 | 68 | -61 |
| * | 90.5 | 7.5 | 13 | -6 | 67 | -59 |
| 6 | 100 | 7.5 | 13 | -5 | 66 | -58 |
| 7 | 120 | 7.5 | 12 | -4 | 61 | -53 |
| 8 | 140 | 7.5 | 13 | -5 | 58 | -51 |
| 9 | 160 | 7.5 | 14 | -7 | 57 | -49 |
| 10 | 180 | 7.5 | 14 | -7 | 56 | -48 |
| 11 | 200 | 7.5 | 14 | -7 | 54 | -46 |
| 12 | 220 | 7.5 | 15 | -8 | 52 | -45 |
| 13 | 240 | 7.5 | 16 | -9 | 52 | -44 |
| 14 | 260 | 7.5 | 17 | -10 | 53 | -46 |
| 15 | 280 | 7.5 | 16 | -9 | 55 | -47 |
| 16 | 300 | 7.5 | 14 | -6 | 57 | -50 |
| 17 | 320 | 7.5 | 10 | -3 | 60 | -52 |
| 18 | 340 | 7.5 | 10 | -2 | 63 | -55 |
| * | 349.8 | 7.5 | 10 | -3 | 64 | -56 |
| 19 | 360 | 7.5 | 10 | -3 | 65 | -58 |
| 20 | 380 | 7.5 | 11 | -4 | 66 | -58 |
| 21 | 400 | 7.5 | 12 | -4 | 65 | -58 |
| 22 | 420 | 7.5 | 13 | -5 | 64 | -57 |
| 23 | 440 | 7.5 | 12 | -5 | 66 | -58 |
| * | 448 | 7.5 | 12 | -5 | 67 | -59 |
| 24 | 460 | 7.5 | 12 | -5 | 65 | -58 |
| 25 | 470 | 7.5 | 12 | -5 | 64 | -57 |
| 26 | 490 | 7.5 | 13 | -5 | 63 | -55 |
| 27 | 510 | 7.5 | 13 | -6 | 62 | -55 |
| 28 | 530 | 7.5 | 13 | -6 | 63 | -55 |
| 29 | 550 | 7.5 | 11 | -4 | 62 | -55 |
| 30 | 570 | 7.5 | 11 | -3 | 62 | -55 |
| 31 | 590 | 7.5 | 10 | -3 | 63 | -56 |
| * | 601.7 | 7.5 | 10 | -2 | 64 | -56 |
| 32 | 610 | 7.5 | 10 | -2 | 64 | -56 |
| 33 | 630 | 7.5 | 9 | -1 | 64 | -56 |
| 34 | 650 | 7.5 | 10 | -2 | 61 | -53 |
| 35 | 670 | 7.5 | 12 | -4 | 57 | -50 |
| 36 | 690 | 7.5 | 11 | -4 | 54 | -47 |
| 37 | 710 | 7.5 | 11 | -4 | 53 | -45 |
| 38 | 730 | 7.5 | 11 | -4 | 52 | -45 |
| 39 | 750 | 7.5 | 9 | -1 | 55 | -48 |
| 40 | 770 | 7.5 | 7 | 1 | 58 | -51 |
| * | 776.8 | 7.5 | 6 | 1 | 59 | -52 |
| 41 | 790 | 7.5 | 5 | 3 | 61 | -54 |
| 42 | 810 | 7.5 | 5 | 3 | 62 | -55 |
| 43 | 830 | 7.5 | 5 | 2 | 60 | -53 |
| 44 | 850 | 7.5 | 6 | 1 | 58 | -50 |
| 45 | 870 | 7.5 | 7 | 0 | 56 | -49 |
| 46 | 890 | 7.5 | 7 | 1 | 56 | -48 |
| * | 930.7 | 7.5 | 7 | 1 | 56 | -48 |
| 47 | 910 | 7.5 | 6 | 1 | 56 | -48 |
| 48 | 930 | 7.5 | 6 | 2 | 56 | -49 |

Northeast Geophysical Services

| **Line 6 SAEP Site Stratford, CT** Seismically interpreted depths | | | | | | |
|---|---|---|---|---|---|---|
| Geophone | X dist (feet) | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
| * | -20 | 8 | 16 | -8 | 88 | -80 |
| 1 | 0 | 8 | 16 | -8 | 88 | -80 |
| 2 | 20 | 8 | 16 | -8 | 105 | -97 |
| 3 | 40 | 8 | 16 | -8 | 112 | -104 |
| 4 | 60 | 8 | 16 | -8 | 120 | -112 |
| 5 | 80 | 8 | 16 | -8 | 122 | -114 |
| 6 | 100 | 8 | 16 | -8 | 123 | -115 |
| 7 | 120 | 8 | 16 | -8 | 125 | -117 |
| * | 130 | 8 | 16 | -8 | 123 | -115 |
| 8 | 140 | 8 | 16 | -8 | 122 | -114 |
| 9 | 160 | 8 | 17 | -9 | 116 | -108 |
| 10 | 180 | 8 | 18 | -10 | 110 | -102 |
| 11 | 200 | 8 | 18 | -10 | 102 | -94 |
| 12 | 220 | 8 | 18 | -10 | 94 | -86 |
| 13 | 240 | 8 | 17 | -9 | 87 | -79 |
| 14 | 260 | 8 | 17 | -9 | 85 | -77 |
| 15 | 280 | 8 | 18 | -10 | 87 | -79 |
| 16 | 300 | 8 | 19 | -11 | 91 | -83 |
| 17 | 320 | 8 | 19 | -11 | 96 | -88 |
| * | 330 | 8 | 19 | -11 | 97 | -89 |
| 18 | 340 | 8 | 18 | -10 | 98 | -90 |
| 19 | 360 | 8 | 18 | -10 | 98 | -90 |
| 20 | 380 | 8 | 17 | -9 | 97 | -89 |
| 21 | 400 | 8 | 17 | -9 | 94 | -86 |
| 22 | 420 | 8 | 17 | -9 | 89 | -81 |
| 23 | 440 | 8 | 16 | -8 | 84 | -76 |
| 24 | 460 | 8 | 16 | -8 | 80 | -72 |
| * | 482 | 8 | 16 | -8 | 76 | -68 |

Northeast Geophysical Services

| **Line 7 SAEP Site Stratford, CT** Seismically interpreted depths | | | | | | |
|---|---|---|---|---|---|---|
| Geophone | X dist (feet) | Surface Elev | Layer 2 Depth | Layer 2 Elev | Bedrock Depth | Bedrock Elev |
| * | -20 | 7.5 | 16 | -8 | 180 | -173 |
| 1 | 0 | 7.5 | 16 | -9 | 180 | -173 |
| 2 | 20 | 7.5 | 17 | -10 | 180 | -173 |
| 3 | 40 | 7.5 | 18 | -10 | 185 | -177 |
| 4 | 60 | 7.5 | 18 | -11 | 184 | -177 |
| 5 | 80 | 7.5 | 18 | -10 | 184 | -177 |
| 6 | 100 | 7.5 | 19 | -11 | 184 | -176 |
| 7 | 120 | 7.5 | 19 | -12 | 181 | -174 |
| 8 | 140 | 7.5 | 20 | -13 | 177 | -170 |
| 9 | 160 | 7.5 | 21 | -13 | 173 | -165 |
| 10 | 180 | 7.5 | 21 | -14 | 168 | -160 |
| * | 186.7 | 7.5 | 21 | -14 | 166 | -158 |
| 11 | 200 | 7.5 | 22 | -14 | 162 | -154 |
| 12 | 220 | 7.5 | 22 | -15 | 156 | -148 |
| 13 | 240 | 7.5 | 22 | -15 | 151 | -144 |
| 14 | 260 | 7.5 | 21 | -14 | 148 | -141 |
| 15 | 280 | 7.5 | 22 | -14 | 148 | -140 |
| 16 | 300 | 7.5 | 22 | -15 | 147 | -139 |
| 17 | 320 | 7.5 | 23 | -16 | 145 | -138 |
| 18 | 340 | 7.5 | 22 | -14 | 143 | -135 |
| 19 | 360 | 7.5 | 19 | -12 | 139 | -131 |
| 20 | 380 | 7.5 | 18 | -11 | 135 | -127 |
| 21 | 400 | 7.5 | 17 | -9 | 134 | -127 |
| 22 | 420 | 7.5 | 16 | -8 | 135 | -128 |
| 23 | 440 | 7.5 | 16 | -9 | 134 | -127 |
| 24 | 460 | 7.5 | 16 | -8 | 133 | -125 |
| * | 503.4 | 7.5 | 14 | -7 | 130 | -122 |

# APPENDIX - SEISMIC REFRACTION PROFILES AND TABULATED RESULTS


**Figure 1.**
**Seismic Line Location Map**
**Seismic Refraction Survey**
**Stratford Army Engine Plant**
**Stratford, Connecticut**

Surveyed 9/28 - 10/1/99 by:
*Northeast Geophysical Services*

# RADIOLOGICAL DATA

## K-1 CTDEP RADIOLOGICAL DATA
## K-2 ALLIED SIGNAL RADIOLOGICAL DATA

# K-1 CTDEP RADIOLOGICAL DATA

TELEDYNE BROWN ENGINEERING Environmental Services

REPORT OF ANALYSIS

Nov 17 1999, 03:20 pm

LOGIN # L8306

RECEIVED
NOV 22 1999
NOV 24 1999
DEPT. OF ENVIRONMENTAL PROTECTION
DIVISION OF RADIATION

| Address | Work Order #: | Cust. P.O. #: | Date Received | Delivery Date |
|---|---|---|---|---|
| MIKE FIRSICK | L8306 | 1611980747 S#1 | 10/21/99 | 11/20/99 |
| STATE OF CONNECTICUT | | Release #: | | |
| DEP RADIATION CONTROL SECTION | | | | |
| 79 ELM STREET | | | | |
| HARTFORD CT 06106-5127 | | | | |

Project Manager: A.CARMICHAEL

| Teledyne Sample # | Customer's Identification | Sta. # | Collection-Dates Start Date/Time | Stop Date/Time | Matrix/ Nuclide | Activity | Units | Count Date | Volume Procedure # | Units Lab Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| Matrix: Soil | | | | | | | | | | |
| L8306-1 | SARP-A1 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19223 | | | | | K-40 | 9.46+-0.95E 00 | pCi/g Dry | 11/05/99 | | 42 |
| | | | | | CO-60 | L.T. 2. E-02 | | 11/05/99 | | 42 |
| | | | | | CS-137 | L.T. 3. E-02 | | 11/05/99 | | 42 |
| | | | | | TL-208 | 2.21+-0.25E-01 | | 11/05/99 | | 42 |
| | | | | | PB-212 | 8.39+-0.84E-01 | | 11/05/99 | | 42 |
| | | | | | BI-214 | 8.18+-0.82E-01 | | 11/05/99 | | 42 |
| | | | | | PB-214 | 9.65+-0.97E-01 | | 11/05/99 | | 42 |
| | | | | | RA-226 | 1.47+-0.34E 00 | | 11/05/99 | | 42 |
| | | | | | AC-228 | 7.04+-0.80E-01 | | 11/05/99 | | 42 |
| | | | | | TH-234 | 1.30+-0.33E 00 | | 11/05/99 | | 42 |
| | | | | | U-235 | L.T. 2. E-01 | | 11/05/99 | | 42 |
| L8306-2 | SARP-A1 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19224 | | | | | K-40 | 1.17+-0.12E 01 | | 11/05/99 | | 42 |
| | | | | | CO-60 | L.T. 3. E-02 | | 11/05/99 | | 42 |
| | | | | | CS-137 | L.T. 2. E-02 | | 11/05/99 | | 42 |
| | | | | | TL-208 | 1.60+-0.24E-01 | | 11/05/99 | | 42 |
| | | | | | PB-212 | 4.69+-0.47E-01 | | 11/05/99 | | 42 |
| | | | | | BI-214 | 4.57+-0.51E-01 | | 11/05/99 | | 42 |
| | | | | | PB-214 | 4.57+-0.47E-01 | | 11/05/99 | | 42 |
| | | | | | RA-226 | 6.10+-3.10E-01 | | 11/05/99 | | 42 |
| | | | | | AC-228 | 4.91+-0.85E-01 | | 11/05/99 | | 42 |
| | | | | | TH-234 | 6.50+-3.00E-01 | | 11/05/99 | | 42 |
| | | | | | U-235 | L.T. 2. E-01 | | 11/05/99 | | 42 |
| L8306-3 | SARP-A2 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19225 | | | | | K-40 | 1.13+-0.11E 01 | | 11/08/99 | | 42 |
| | | | | | CO-60 | L.T. 2. E-02 | | 11/08/99 | | 42 |
| | | | | | CS-137 | L.T. 2. E-02 | | 11/08/99 | | 42 |
| | | | | | TL-208 | 2.12+-0.27E-01 | | 11/08/99 | | 42 |
| | | | | | PB-212 | 7.00+-0.70E-01 | | 11/08/99 | | 42 |
| | | | | | BI-214 | 4.95+-0.55E-01 | | 11/08/99 | | 42 |

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GS(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 12 - Environmental TLD; 72 - Consulting;

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TELEDYNE BROWN ENGINEERING Environmental Services

REPORT OF ANALYSIS

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|---|---|---|---|---|---|
| MIKE FIRSICK | L8306 | 10119B0747 S#1 | 10/21/99 | 11/20/99 | |
| STATE OF CONNECTICUT | | Release #: | | | Project Manager: A.CARMICHAEL |
| DEP RADIATION CONTROL SECTION | | | | | |
| 79 ELM STREET | | | | | |
| HARTFORD CT 06106-5127 | | | | | |

| Teledyne Sample # | Customer's Identification | Sta # | Collection Dates Start Date/Time | Stop Date/Time | Matrix/ Nuclide | Activity | Units | Count Date | Volume Procedure # | Units Lab Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| Continued | | | | | | | | | | |
| | | | | | PB-214 | 4.44+-0.55E-01 | pCi/g Dry | 11/08/99 | | 42 |
| | | | | | RA-226 | 1.05+-0.40E 00 | | 11/08/99 | | 42 |
| | | | | | AC-228 | 4.68+-0.92E-01 | | 11/08/99 | | 42 |
| | | | | | TH-234 | 6.89+-3.46E-01 | | 11/08/99 | | 42 |
| | | | | | U-235 | L.T. 2. E-01 | | 11/08/99 | | 42 |
| L8306-4 | SAEP-A3 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19226 | | | | | K-40 | 1.05+-0.10E 01 | | 11/08/99 | | 42 |
| | | | | | CO-60 | L.T. 3. E-02 | | 11/08/99 | | 42 |
| | | | | | CS-137 | L.T. 3. E-02 | | 11/08/99 | | 42 |
| | | | | | TL-208 | 4.78+-0.48E-01 | | 11/08/99 | | 42 |
| | | | | | PB-212 | 1.25+-0.13E 00 | | 11/08/99 | | 42 |
| | | | | | BI-214 | 2.54+-0.25E 00 | | 11/08/99 | | 42 |
| | | | | | PB-214 | 2.60+-0.26E 00 | | 11/08/99 | | 42 |
| | | | | | RA-226 | 5.17+-0.68E 00 | | 11/08/99 | | 42 |
| | | | | | AC-228 | 1.33+-0.13E 00 | | 11/08/99 | | 42 |
| | | | | | TH-234 | 1.88+-0.59E 00 | | 11/08/99 | | 42 |
| | | | | | U-235 | L.T. 3. E-01 | | 11/08/99 | | 42 |
| L8306-5 | SAEP-A4 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19227 | | | | | K-40 | 9.38+-0.94E 00 | | 11/08/99 | | 42 |
| | | | | | CO-60 | L.T. 4. E-02 | | 11/08/99 | | 42 |
| | | | | | CS-137 | 7.72+-2.60E-02 | | 11/08/99 | | 42 |
| | | | | | TL-208 | 8.80+-0.88E-01 | | 11/08/99 | | 42 |
| | | | | | PB-212 | 2.48+-0.25E 00 | | 11/08/99 | | 42 |
| | | | | | BI-214 | 6.63+-0.66E 00 | | 11/08/99 | | 42 |
| | | | | | PB-214 | 7.11+-0.71E 00 | | 11/08/99 | | 42 |
| | | | | | RA-226 | 1.08+-0.11E 01 | | 11/08/99 | | 42 |
| | | | | | AC-228 | 2.46+-0.25E 00 | | 11/08/99 | | 42 |
| | | | | | TH-234 | 3.02+-1.82E 00 | | 11/08/99 | | 42 |
| | | | | | U-235 | 4.97+-2.39E-01 | | 11/08/99 | | 42 |
| L8306-6 | SAEP-A5 | | 10/01/99 00:00 | | Soil | | | | | |

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GR(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 12 - Environmental TLD; 72 - Consulting;

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| STATE OF CONNECTICUT | | Release #: | | | Project Manager: A.CARMICHAEL |
| DEP RADIATION CONTROL SECTION | | | | | |
| 79 ELM STREET | | | | | |
| HARTFORD CT 06106-5127 | | | | | |

| Teledyne Sample # | Customer's Identification | Sta. # | Collection Dates Start Date/Time | Stop Date/Time | Matrix/ Nuclide | Activity | Units | Count Date | Volume Procedure # | Units Lab Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| Continued | | | | | | | | | | |
| TI#-19228 | | | | | K-40 | 1.30+-0.13E 01 | pCi/g Dry | 11/08/99 | | 42 |
| | | | | | CO-60 | L.T. 2. E-02 | | 11/08/99 | | 42 |
| | | | | | CS-137 | L.T. 2. E-02 | | 11/08/99 | | 42 |
| | | | | | TL-208 | 1.98+-0.20E-01 | | 11/08/99 | | 42 |
| | | | | | PB-212 | 5.30+-0.53E-01 | | 11/08/99 | | 42 |
| | | | | | BI-214 | 4.64+-0.46E-01 | | 11/08/99 | | 42 |
| | | | | | PB-214 | 4.46+-0.45E-01 | | 11/08/99 | | 42 |
| | | | | | RA-226 | 9.08+-2.71E-01 | | 11/08/99 | | 42 |
| | | | | | AC-228 | 5.70+-0.69E-01 | | 11/08/99 | | 42 |
| | | | | | TH-234 | 8.00+-2.72E-01 | | 11/08/99 | | 42 |
| | | | | | U-235 | L.T. 1. E-01 | | 11/08/99 | | 42 |
| L8306-7 | SAEP-A6 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19229 | | | | | K-40 | 4.09+-0.81E 00 | | 11/08/99 | | 42 |
| | | | | | CO-60 | L.T. 1. E-01 | | 11/08/99 | | 42 |
| | | | | | CS-137 | L.T. 1. E-01 | | 11/08/99 | | 42 |
| | | | | | TL-208 | 6.48+-0.61E 00 | | 11/08/99 | | 42 |
| | | | | | PB-212 | 1.58+-0.16E 01 | | 11/08/99 | | 42 |
| | | | | | BI-214 | 6.18+-0.62E 01 | | 11/08/99 | | 42 |
| | | | | | PB-214 | 6.34+-0.63E 01 | | 11/08/99 | | 42 |
| | | | | | RA-226 | 8.07+-0.81E 01 | | 11/08/99 | | 42 |
| | | | | | AC-228 | 1.85+-0.18E 01 | | 11/08/99 | | 42 |
| | | | | | TH-234 | 2.83+-0.28E 01 | | 11/08/99 | | 42 |
| | | | | | U-235 | 3.26+-0.67E 00 | | 11/08/99 | | 42 |
| L8306-8 | SAEP-A7 | | 10/01/99 00:00 | | Soil | | | | | |
| TI#-19230 | | | | | K-40 | L.T. 1. E 00 | | 11/10/99 | | 42 |
| | | | | | CO-60 | L.T. 1. E-01 | | 11/10/99 | | 42 |
| | | | | | CS-137 | L.T. 1. E-01 | | 11/10/99 | | 42 |
| | | | | | TL-208 | 3.14+-0.31E 00 | | 11/10/99 | | 42 |
| | | | | | PB-212 | 8.27+-0.83E 00 | | 11/10/99 | | 42 |
| | | | | | BI-214 | 5.07+-0.51E 01 | | 11/10/99 | | 42 |
| | | | | | PB-214 | 5.25+-0.53E 01 | | 11/10/99 | | 42 |
| | | | | | RA-226 | 6.85+-0.68E 01 | | 11/10/99 | | 42 |

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GE(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 12 - Environmental TLD; 72 - Consulting;

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| MIKE FIRSICK<br>STATE OF CONNECTICUT<br>DEP RADIATION CONTROL SECTION<br>79 ELM STREET<br>HARTFORD CT 06106-5127 | L8306 | 1011980747 S#1<br>Release #: | 10/21/99 | 11/20/99 | Project Manager: A.CARMICHAEL |

| Teledyne Sample # | Customer's Identification | Sta. # | Collection-Dates Start Date/Time | Stop Date/Time | Matrix/ Nuclide | Activity | Units | Count Date | Volume Procedure # | Units Lab | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Continued | | | | | | | | | | | |
| | | | | | AC-228 | 9.51+-0.95E 00 | pCi/g Dry | 11/10/99 | | 42 | |
| | | | | | TH-234 | 1.12+-0.33E 01 | | 11/10/99 | | 42 | |
| | | | | | U-235 | 2.85+-0.68E 00 | | 11/10/99 | | 42 | |

Jeffrey Guenther
Operations Manager

Last Page of Report

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GE(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 17 - Environmental TLD; 72 - Consulting;

# K-2 ALLIED SIGNAL RADIOLOGICAL DATA

# ATL International, Inc.
# Radioanalytical Laboratory

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## REPORT OF ANALYTICAL RESULTS

| | |
|---|---|
| Report Date: | 10/27/99 |
| Customer ID: | CW-00001 |
| Customer Sample ID: | AS-97 |
| ATL Sample ID: | SAEPS01 |
| Matrix: | Soil |
| Sample Amount: | 2043.96 g (dry) |
| Analyzed Amount: | 517.36 g |
| Sample Date/Time: | 10/01/99 1200 |
| Requested Analyses: | Gamma Spectroscopy |
| Report Level: | QA-II |
| Report Due: | 10/28/99 |
| Comments: | |

**RESULTS**

| Analysis | Result | Unit | Error | MDA | Unit | Flag |
|---|---|---|---|---|---|---|
| Gamma Spectroscopy | | | | | | |
| Identified Radionuclides | | | | | | |
| K-40 | 11.63 | pCi/g | 2.482 | 1.427 | pCi/g | |
| Tl-208 | 1.973 | pCi/g | 0.3192 | 0.1434 | pCi/g | |
| Pb-210 | 11.62 | pCi/g | 3.546 | 1.965 | pCi/g | |
| Bi-212 | 4.288 | pCi/g | 1.997 | 1.768 | pCi/g | |
| Pb-212 | 6.505 | pCi/g | 0.7422 | 0.2109 | pCi/g | |
| Bi-214 | 26.47 | pCi/g | 3.070 | 0.2355 | pCi/g | |
| Pb-214 | 27.93 | pCi/g | 2.719 | 0.2736 | pCi/g | |
| Ra-226 | 53.18 | pCi/g | 6.837 | 2.823 | pCi/g | |
| Ac-228 | 5.358 | pCi/g | 1.485 | 0.5090 | pCi/g | |
| Th-228 | 30.49 | pCi/g | 8.950 | 6.078 | pCi/g | |
| Th-231 | 5.518 | pCi/g | 7.678 | 1.100 | pCi/g | |
| Th-232 | 5.536 | pCi/g | 0.8085 | 0.2035 | pCi/g | |
| Th-234 | 17.53 | pCi/g | 71.14 | 1.228 | pCi/g | |
| U-235 | 2.324 | pCi/g | 0.9714 | 0.1744 | pCi/g | |

(Actual measurements and MDAs for all radionuclides are identified on the Detailed Gamma Spectroscopy Report attached)

ATL warrants that these analytical results were obtained in accordance with ATL Radioanalytical Laboratory Procedures and Quality Assurance Program. ATL makes no other warranty, expressed or implied, including fitness for any particular purpose.

10/27/99
Zhibo (David) Lin – Radiochemist

10/27/99
William D. Ulicny – Laboratory Manager

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## REPORT OF ANALYTICAL RESULTS

| | |
|---|---|
| Report Date: | 10/27/99 |
| Customer ID: | CW-00001 |
| Customer Sample ID: | AS-109 |
| ATL Sample ID: | SAEPS02 |
| Matrix: | Soil |
| Sample Amount: | 1468.15 g (dry) |
| Analyzed Amount: | 532.38 g |
| Sample Date/Time: | 10/01/99 1200 |
| Requested Analyses: | Gamma Spectroscopy |
| Report Level: | QA-II |
| Report Due: | 10/28/99 |
| Comments: | |

**RESULTS**

| Analysis | Result | Unit | Error | MDA | Unit | Flag |
|---|---|---|---|---|---|---|
| Gamma Spectroscopy | | | | | | |
| Identified Radionuclides | | | | | | |
| Tl-208 | 4.614 | pCi/g | 0.6545 | 0.1994 | pCi/g | |
| Pb-210 | 12.91 | pCi/g | 3.966 | 2.761 | pCi/g | |
| Bi-212 | 16.00 | pCi/g | 3.590 | 2.570 | pCi/g | |
| Pb-212 | 14.39 | pCi/g | 1.541 | 0.2981 | pCi/g | |
| Bi-214 | 53.24 | pCi/g | 6.088 | 0.3342 | pCi/g | |
| Pb-214 | 56.08 | pCi/g | 5.366 | 0.3769 | pCi/g | |
| At-218 | 4.022 | pCi/g | 2.114 | 1.524 | pCi/g | |
| Ra-226 | 108.2 | pCi/g | 12.44 | 3.972 | pCi/g | |
| Ac-228 | 15.34 | pCi/g | 3.779 | 0.6434 | pCi/g | |
| Th-228 | 55.83 | pCi/g | 13.05 | 7.959 | pCi/g | |
| Th-231 | 10.10 | pCi/g | 13.94 | 1.440 | pCi/g | |
| Th-232 | 12.95 | pCi/g | 1.600 | 0.2877 | pCi/g | |
| Th-234 | 23.97 | pCi/g | 97.22 | 1.917 | pCi/g | |
| U-235 | 3.861 | pCi/g | 1.566 | 0.2454 | pCi/g | |

(Actual measurements and MDAs for all radionuclides are identified on the Detailed Gamma Spectroscopy Report attached)

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## REPORT OF ANALYTICAL RESULTS

| | |
|---|---|
| Report Date: | 10/27/99 |
| Customer ID: | CW-00001 |
| Customer Sample ID: | AS-114 |
| ATL Sample ID: | SAEPS03 |
| Matrix: | Soil |
| Sample Amount: | 2353.79 g (dry) |
| Analyzed Amount: | 494.94 g |
| Sample Date/Time: | 10/01/99 1200 |
| Requested Analyses: | Gamma Spectroscopy |
| Report Level: | QA-II |
| Report Due: | 10/28/99 |
| Comments: | |

**RESULTS**

| Analysis | Result | Unit | Error | MDA | Unit | Flag |
|---|---|---|---|---|---|---|
| Gamma Spectroscopy | | | | | | |
| Identified Radionuclides | | | | | | |
| K-40 | 9.041 | pCi/g | 2.366 | 1.385 | pCi/g | |
| Tl-208 | 1.995 | pCi/g | 0.3197 | 0.1257 | pCi/g | |
| Pb-210 | 7.018 | pCi/g | 2.973 | 1.883 | pCi/g | |
| Pb-212 | 6.568 | pCi/g | 0.7365 | 0.1818 | pCi/g | |
| Bi-214 | 18.97 | pCi/g | 2.229 | 0.2046 | pCi/g | |
| Pb-214 | 20.44 | pCi/g | 2.025 | 0.2312 | pCi/g | |
| Ra-226 | 43.24 | pCi/g | 5.863 | 2.507 | pCi/g | |
| Ac-228 | 5.353 | pCi/g | 1.439 | 0.4561 | pCi/g | |
| Th-228 | 34.92 | pCi/g | 9.077 | 5.788 | pCi/g | |
| Th-231 | 6.318 | pCi/g | 8.749 | 1.047 | pCi/g | |
| Th-232 | 5.599 | pCi/g | 0.8080 | 0.1754 | pCi/g | |
| Th-234 | 15.30 | pCi/g | 62.08 | 1.164 | pCi/g | |

(Actual measurements and MDAs for all radionuclides are identified on the Detailed Gamma Spectroscopy Report attached)

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## REPORT OF ANALYTICAL RESULTS

| | |
|---|---|
| Report Date: | 10/27/99 |
| Customer ID: | CW-00001 |
| Customer Sample ID: | AS-121-4 |
| ATL Sample ID: | SAEPS04 |
| Matrix: | Soil |
| Sample Amount: | 1255.76 g (dry) |
| Analyzed Amount: | 487.39 g |
| Sample Date/Time: | 10/01/99 1200 |
| Requested Analyses: | Gamma Spectroscopy |
| Report Level: | QA-II |
| Report Due: | 10/28/99 |
| Comments: | |

**RESULTS**

| Analysis | Result | Unit | Error | MDA | Unit | Flag |
|---|---|---|---|---|---|---|
| Gamma Spectroscopy | | | | | | |
| Identified Radionuclides | | | | | | |
| K-40 | 4.790 | pCi/g | 2.530 | 1.587 | pCi/g | |
| Tl-208 | 16.17 | pCi/g | 2.091 | 0.2039 | pCi/g | |
| Pb-210 | 3.911 | pCi/g | 3.340 | 2.889 | pCi/g | |
| Pb-212 | 51.83 | pCi/g | 5.348 | 0.2996 | pCi/g | |
| Bi-214 | 7.301 | pCi/g | 1.056 | 0.3638 | pCi/g | |
| Pb-214 | 7.357 | pCi/g | 0.8684 | 0.3446 | pCi/g | |
| Ra-224 | 59.14 | pCi/g | 34.14 | 3.378 | pCi/g | |
| Ra-226 | 14.56 | pCi/g | 5.502 | 3.638 | pCi/g | |
| Ac-228 | 49.26 | pCi/g | 11.70 | 0.5020 | pCi/g | |
| Th-228 | 68.05 | pCi/g | 15.48 | 9.162 | pCi/g | |
| Th-231 | 12.31 | pCi/g | 16.98 | 1.658 | pCi/g | |
| Th-232 | 45.37 | pCi/g | 4.943 | 0.2891 | pCi/g | |

(Actual measurements and MDAs for all radionuclides are identified on the Detailed Gamma Spectroscopy Report attached)

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