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Work Plan for Additional Investigation Activities for the Southern Boundary of the Eastern Plume and Site 11, Naval Air Station Brunswick, Brunswick Maine

Contract N62472-92-D-1296
Contract Task Order No. 0047

Prepared for

Department of the Navy
Engineering Field Activity Northeast
10 Industrial Highway, Mail Stop 82
Lester, Pennsylvania 19113-2090

Prepared by

EA Engineering, Science, and Technology
Southborough Technology Park
333 Turnpike Road (Route 9)
Southborough, Massachusetts 01772

November 2002
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Alexander C. Easterday, P.G. — Date
CTO Manager

7 November 2002

Kenneth W. Kilmer — Date
Program Manager

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QUALITY REVIEW STATEMENT

Contract No. N62472-92-D-1296 EA Project No.: 29600.47
Contract Task Order No. 0047
Activity: Naval Air Station, Brunswick, Maine

Description of Report/Deliverable:

Final Work Plan for Additional Investigation Activities for the Southern Boundary of the Eastern Plume and Site 11, Naval Air Station, Brunswick, Maine

EA CTO Manager: Alexander C. Easterday, P.G.

In compliance with EA's Quality Procedures for review of deliverables outlined in the Quality Management Plan, this final deliverable has been reviewed for quality by the undersigned Senior Technical Reviewer(s). The information presented in this report/deliverable has been prepared in accordance with the approved Implementation Plan for the Contract Task Order (CTO) and reflects a proper presentation of the data and/or the conclusions drawn and/or the analyses or design completed during the conduct of the work. This statement is based upon the standards identified in the CTO and/or the standard of care existing at the time of preparation.

Senior Technical Reviewer

Peter Nimmer (signature)

7 November 2002
(Date)

Peter L. Nimmer, P.G.
Geologist

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1. INTRODUCTION

Under Contract No. N62472-92-D-1296, Engineering Field Activity Northeast, Naval Facilities Engineering Command issued Contract Task Order No. 0047 to EA Engineering, Science, and Technology to conduct additional investigations at the Southern Boundary of the Eastern Plume and Site 11, Naval Air Station (NAS), Brunswick, Maine. This Work Plan details the overall approach of the field activities that will be conducted as part of these additional investigations.

NAS Brunswick is located south of the Androscoggen River between Brunswick and Bath, Maine, as shown on Figure 1. NAS Brunswick is an active base owned and operated by the Federal government through the Department of the Navy. In 1987, NAS Brunswick was placed on the National Priorities List by the U.S. Environmental Protection Agency (EPA) and is currently participating in the Navy's Installation Restoration Program.

The Navy has responded to EPA and Maine Department of Environmental Protection (MEDEP) comments on the Draft Work Plan. The Navy's responses are provided in Appendix A. EPA's and MEDEP's agreements with Navy responses are also provided in Appendix A. EPA has agreed with the Navy's responses for tasks being completed in the Southern Boundary of the Eastern Plume as presented in Section 2 (Southern Boundary Field Activities); however, EPA will defer concurrence to Section 3 (Field Activities and Procedures – Site 11) and responses to comments regarding work at Site 11 until a later date, as discussed on 6 November 2002 during a project conference call for the NAS Brunswick Installation Restoration Program.

1.1 WORK PLAN OBJECTIVES

The additional investigations at the Southern Boundary of the Eastern Plume and Site 11 outlined in this Work Plan are being completed in response to regulator's comments and concerns which were discussed at the 12 February 2002 Technical Meeting with EPA and MEDEP. The objectives of these investigations are to satisfy regulatory concerns that existed at the 12 February 2002 Technical Meeting related to potential data gaps in the Southern Boundary area and the potential for bedrock impact at Site 11.

The investigation activities outlined in this Work Plan include the following tasks:

- Southern Boundary of the Eastern Plume
  - Collecting ground-water samples at 7 locations, and advancement of soil borings to collect data on the southern extent of the Eastern Plume.
  - Installation of 4 deep monitoring wells and 3 shallow monitoring wells at the southern end of the Eastern Plume. These wells will be included in the Long-Term Monitoring Program for the site.

- Site 11
  - Installation of 1 bedrock monitoring well and collection of ground-water samples from bedrock intervals to assess the potential for contaminant migration into bedrock.

1.2 WORK PLAN ORGANIZATION

This Work Plan details the field activities that will be conducted as part of the additional investigations for the Southern Boundary of the Eastern Plume and Site 11. The field activities at the two sites may be completed at separate times and, therefore, two separate sections are provided to document field work at the two sites. Field activities and procedures specific to the Southern Boundary of the Eastern Plume are detailed in Section 2. Field activities and procedures specific to Site 11 are detailed in Section 3. Responses to regulator's comments on the Draft Work Plan are provided in Appendix A. Field forms are provided in the Appendix B. Standard operating procedures for ground-water sampling by the low-flow purge method are provided in Appendix C.

2. SOUTHERN BOUNDARY FIELD ACTIVITIES

This section provides a summary of the field activities that will be conducted as part of the additional investigation at the Southern Boundary of the Eastern Plume. A total of 7 soil borings will be installed. The specific location of each boring was identified and marked in the field with MEDEP and EPA personnel during the Technical Meeting held at NAS Brunswick on 18 June 2002. The soil boring locations are shown on Figure 2.

Activities to be conducted at the Southern Boundary include:

- At each of the 7 locations, direct-push ground-water samples will be collected at 5-ft intervals starting at 40 ft below ground surface (bgs) and continuing until the Presumpscot clay is encountered (estimated at approximately 80 ft bgs).

- Advancement of soil borings at the 7 locations to collect split-spoon samples and identify site geology.

- Based on the results of the initial ground-water samples, 4 of 7 borings will be converted to deep monitoring wells. Three of the deep overburden monitoring wells will have a shallow overburden well installed at the same location.

- Monitoring wells will be developed, sampled, and surveyed.

Prior to the start of drilling activities, EA personnel will contact Digsafe (1-800-225-4977) to confirm the presence/absence of utilities at each drilling location. NAS Brunswick Work Control personnel will be notified (prior to commencement of field activities) so they can mark/identify underground utility locations within the facility grounds. Additionally, EA personnel will coordinate subsurface investigation activities with MEDEP and EPA prior to the commencement of work.

2.1 SOIL BORING PROGRAM

A total of 7 soil borings will be advanced at the locations selected and staked during the Technical Meeting held at NAS Brunswick on 18 June 2002. The locations of each soil boring are shown on Figure 2. Soil borings will be installed using drive and wash drilling methods and a temporary 4-in. inner diameter steel casing which will be driven up to 6 ft into the Presumpscot clay. The total depth of each boring is estimated to be 80 ft bgs. Soil samples will be collected continuously to at least 4 ft into the Presumpscot clay using a 2-in. inner diameter, 2-ft length, split-spoon sampler and a 140-lb drive hammer. Soil samples will be collected continuously for the length of the boring. The EA Field Geologist will log the soil characteristics of each sample along with any other pertinent information on the Log of Soil Boring field form (Appendix B) in accordance with American Society for Testing and Materials Method D 2488-93. Particular consideration will be given to grain size distribution (relative percentages of different size materials), presence of lamination or layering, and soil consistency. An estimate of mineralogy will be made for coarser-grained material.

Closed-container headspace vapor monitoring will be used as a screening tool for determining the relative concentrations of volatile organic compounds (VOCs) in soil samples collected during split-spoon sampling of the overburden. Headspace measurements will be collected using a photoionization detector and the static headspace analysis method described below:

- Approximately 2 oz of soil will be collected (composite sample of soil in split-spoon) from the open split-spoon and placed in a laboratory-cleaned glass jar. The mouth of the jar will then be immediately covered with aluminum foil prior to sealing the jar lid to minimize the loss of VOCs. Headspace samples will be collected for every split-spoon soil sample. An additional biased grab soil sample may be collected from intervals of interest (i.e., fine- or coarse-grained intervals) and/or any zones exhibiting an odor or visual evidence of impact (i.e., staining) from each split-spoon.

- The jar will be shaken to break up compacted soil or material, and will be placed in a warm location, out of direct sunlight, for a period of no less than 15 minutes to equilibrate prior to field monitoring.

- The jar lid will be removed from the jar. Headspace will be monitored within the jar by piercing the aluminum foil with the photoionization detector probe. Care will be taken to prevent unnecessary mixing of jar headspace and outside air. Monitoring with the photoionization detector will continue for at least 1 minute. The highest photoionization detector concentration observed will be recorded along with the sample interval in the field notebook, and on the Log of Soil Boring field form provided in Appendix B.

Fluids and soil cuttings derived from drilling processes will be containerized in accordance with the procedures detailed in Section 2.7. The drill rig, drill augers, rods, split-spoons, and other down-hole equipment will be decontaminated in accordance with the procedures detailed in Section 2.7 prior to soil boring activities at each soil boring location and after the completion of the task. Soil boring locations will be flagged in the field and cordoned off with caution tape, pending a decision as to the location of the monitoring wells after reviewing the direct-push ground-water sampling data and the findings related to the soil boring investigation by EA, the Navy, MEDEP, and EPA. The soil boring locations will be backfilled with bentonite chips or pellets to seal each location. Once a determination has been made regarding placement of the monitoring wells, the Navy will re-mobilize to install the monitoring wells as described in Section 2.3.

2.2 DIRECT-PUSH GROUND-WATER SAMPLING

Direct-push ground-water samples will be collected at the 7 soil boring locations in order to determine which subsurface intervals may contain elevated concentrations of VOCs.

Direct-push ground-water samples will be collected at 5-ft intervals from 40 ft bgs to the bottom of the boring. It is assumed that the approximate boring depth will be 80 ft bgs extending into the Presumpscot clay. The depth of the clay will be determined based on previously completed nearby geologic data (boring logs, electrical conductivity logs), and will be confirmed during the soil boring task (Section 2.1) as this formation should contain limited water.

Up to 8 ground-water samples will be collected from each boring and analyzed for VOCs by EPA Method 8260B. Ground-water samples will be submitted to the contracted laboratory (Katahdin Analytical Laboratory) for a normal turnaround time of 2 weeks to ensure that the results are available for review prior to monitoring well installation.

Ground-water sampling will be accomplished using a truck-mounted hydraulic probe direct-push system. This method involves the use of a direct-push water sampling probe, which is pushed under hydraulic pressure to the selected sample depth without boring a pilot hole. The sample probe consists of a 1.0- to 1.4-in. outside diameter steel probe rod with either slotted screen sections or an expendable point attached. Upon arrival at the site, the direct-push sampler will be decontaminated in accordance with the procedures described in Section 2.7. Ground-water samples will be extracted using dedicated polyethylene sample tubing and a variable speed peristaltic pump. Ground-water samples may also be extracted using dedicated polyethylene tubing and a bottom check valve via the "waterra" method. The direct-push probe will then be backed out of the hole using the system hydraulic cylinder. The direct-push probes should be pulled straight out to prevent the direct-push point from bending. The direct-push probes will then be disassembled prior to decontamination in accordance with the procedures detailed in Section 2.7. The direct-push probe assembly will be decontaminated after each use. The O-rings and piston screen will be checked for wear and abrasion. The O-rings will be changed as necessary (after approximately every 3-4 samples) or after high levels of VOCs have been encountered. If the screen does not need to be replaced, it may be left attached to the probe assembly during decontamination.

2.3 MONITORING WELL INSTALLATION

Following soil boring activities, well construction will be performed according to the procedures described in this section. A total of 4 deep overburden monitoring wells will be installed. Three of the deep overburden monitoring wells will have a shallow overburden well installed in the same location to create shallow-deep well couplets. A determination as to the location of the monitoring wells will be made by EA, the Navy, MEDEP, and EPA (Technical Evaluation Group [TEG]) pending review of the direct-push ground-water sampling data and the findings relating to the soil boring investigation. It is anticipated that permanent monitoring wells will be installed at locations where elevated VOCs are present (if detected), or at locations that will act as sentinel wells in the future. Soil boring locations are shown on Figure 2.

It is anticipated that each deep monitoring well will have a total depth of 70 ft bgs. The accompanying shallow monitoring wells are anticipated to have a total depth of 40 ft bgs. The monitoring wells will be installed and constructed in accordance with the procedures presented in this section and with EPA guidelines as specified in the *Handbook of Suggested Practices for* *the Design and Installation of Ground-Water Monitoring Wells* (Document No. EPA/600/4-89/034; U.S. EPA 1991[1]). The monitoring wells will be installed using temporary 4-in. steel casing and drive and wash drilling methods through the overburden down into the top 6 ft of the Presumpscot clay. The Navy anticipates constructing each monitoring well with a 10-ft screen interval, although the site managers and EA Field Geologist may make changes to the screen interval as site conditions warrant. Monitoring wells will be constructed in accordance with the details provided in this section. Actual well completion data will be recorded in the field notebook. A Daily Drilling Report will also be completed and is included in Appendix B. Fluids and soil cuttings derived from drilling processes will be containerized in accordance with the procedures detailed in Section 2.8.

The monitoring wells will be installed using new polyvinyl chloride riser casing and well screens. Material will be delivered directly to the field in packaging from the manufacturer. Well riser casing and screen sections will be steam-cleaned onsite prior to placement in the borehole if the packaging is not intact to ensure that oil, grease, or wax have been removed. After the borehole has been drilled to completion depth, 2-in. inner diameter Schedule 40, threaded, flush-jointed polyvinyl chloride riser casing and attached screen will be set through the temporary 4-in. inner diameter steel casing into the borehole. The screen interval will be placed at the bottom of the boring at the proper depth. The monitoring wells will be completed with 10 ft of well screen (0.010 slot) and filter pack, depending on site-specific conditions as determined by the Project Geologist. No sediment traps will be used to cap the screen bottom. The riser casing will be finished and constructed with 8-in. diameter protective steel casing (approximately 2-ft stickup) grouted in place with cement collar and a lockable cap. Each well will be capped with an expandable and lockable well cap. A vent hole will be drilled in the cap to permit equalization at atmospheric and interior well pressure. A schematic monitoring well construction diagram for the shallow and deep monitoring wells is shown on Figure 3.

Each newly installed monitoring well will be developed (for a maximum of 2 hours) using pump and surge methods until ground-water parameters (pH, temperature, and conductivity) stabilize and turbidity is minimized (with a goal of less than 10 nephelometric turbidity units [NTUs]). Well development procedures are detailed in Section 2.4.

2.3.1 Filter Pack

The filter pack of each monitoring well will consist of inert silica sand, certified as chemically clean by the manufacturer, and texturally clean as seen through a 10X hand lens. Nominal grain size will be No. 1 silica sand unless geologic conditions, in the judgement of the Project Geologist, dictate differently. Prior to installing the well screen, a bedding of filter pack up to 6-in. thick will be placed in the bottom of the hole. Sand will extend to approximately 2 ft above the top of the well screen. The 2 ft of filter pack above the top of the screen allows for some settlement of the filter pack and a buffer between the top of screen and the annular seal. The depth to the top of the filter pack will be sounded frequently with a weighted measuring tape.

1. U.S. Environmental Protection Agency (U.S. EPA). 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells (Document No. EPA/600/4-89/034).

If ridging of the material does occur, a small amount of potable water may be used to remove the bridge and allow the filter pack to settle correctly.

2.3.2 Bentonite Seal

The bentonite seal for each monitoring well will include the use of commercially available bentonite pellets (or chips). Pellet seals will be a minimum of 2-ft thick as measured immediately after placement, without allowance for swelling. The bentonite seal will be placed directly above the filter pack of each well. Following placement of the pellets, potable water will be poured down the annular space to hydrate the pellets. The bentonite will be allowed to hydrate for 1 hour prior to grouting the remainder of the borehole.

2.3.3 Annular Seal

The annular seal of each monitoring well will consist of cement-bentonite grout, composed by weight of 10 parts cement (Portland cement, any Type I-V) to one-half part bentonite, with a maximum of 7 gal of potable water per 94-lb bag of cement. Bentonite will be added after the required amount of cement is mixed with water. Additives or borehole cuttings will not be mixed with the grout. Annular seal materials will be combined in an aboveground rigid container and mixed onsite to produce a thick, lump-free mixture. The annular seal will be placed utilizing a tremie pipe, initially located within 1 ft of the top of the bentonite seal. The tremie pipe should be placed in the annulus between the protective casing and the riser pipe. Grout will be pumped through this pipe to the bottom of the open annulus until a continuous, undiluted column of grout is formed from the top of the bentonite seal to approximately 2-3 ft bgs.

2.3.4 Surface Completion

The surface completion of each monitoring well will be constructed with an 8-in. diameter steel protective casing, 5-ft long (2-ft stickup above ground surface with a lockable cap), placed such that the bottom of the protective casing extends into the grout. At the ground surface, the cement collar will form a 3-ft diameter, 4-in. thick concrete pad sloping outward around the well. The top outer edge of the pad will be flush with the ground. An internal grout collar will be placed in the annular space between the inner casing and the outer protective polyvinyl chloride casing from below the frost line to the ground surface. Brass locks that are keyed alike will be used to secure the outer lids of the protective casing of the wells. The protective casing will be washed with clean water or steam-cleaned prior to placement, so it is free from extraneous openings, encrusting, and/or coating material (except primer/paint applied by the manufacturer). Each well will be provided with vented well caps and keyed-alike locks.

Each newly installed monitoring well will be surveyed by a State of Maine-licensed land surveyor, who will determine the horizontal (± 0.01-ft) and vertical (± 0.01-ft) positioning of each well. Control points will be established onsite using previously established local benchmarks, or Global Positioning System techniques, if required. The horizontal control of each well will be determined and reported based on the State Plane Maine West NAD-27

Coordinate System. Vertical control will be established in accordance with National Geodetic Vertical Datum.

2.4 WELL DEVELOPMENT

The newly installed monitoring wells will be developed in order to remove silt from the well screen and to ensure that representative ground-water samples can be collected. Wells will be developed for a maximum of 2 hours by EA personnel. Ground-water parameters will be monitored during well development. Monitoring wells will be developed within 2 weeks of the completion of well construction (but no sooner than 48 hours after final grouting is completed).

Each well will be alternately mechanically surged with a surge block and pumped clear of sediment with a submersible pump. If the addition of water is required to facilitate surging, water from the well or water from an approved potable water source will be used, and at least as much water that was introduced during development will be removed from each well. Care will be taken during surging to ensure that low pressures within the well casing and screened interval do not cause implosion of the well screen. Surging will continue until little or no sediment enters the well. Following surging, the well will be continuously pumped using a submersible pump (i.e., Grundfos® pump). Temperature, pH, specific conductivity, and turbidity will be monitored during pumping at a rate of one reading per well casing volume removed. Water quality data will be recorded on the Field Record of Well Development form provided in Appendix B. Turbidity will be measured as soon as the sample is brought to the surface. Pumping will continue until these parameters have stabilized (less than 0.2 pH units or a ±10 percent change for the other parameters between three consecutive readings) and the turbidity does not exceed 10 NTUs, or for a maximum of 2 hours. The purged ground water derived from well development will be containerized in accordance with the procedures detailed in Section 2.7. Failure to obtain satisfactory results (parameter stabilization) will be noted on the well development record form, and the Project Manager will be notified should this occur.

2.5 WATER LEVEL GAUGING AND GROUND-WATER SAMPLING

Ground-water sampling will occur as part of the monitoring event after the well is installed (anticipated to be April 2003). Ground-water sampling will be performed in accordance with the general methodologies established in the current Long-Term Monitoring Plan (EA 2000[2]) for NAS Brunswick. Prior to well sampling, a permanent submersible pump will be installed in each monitoring well. Ground-water sampling will be accomplished using low-flow techniques to minimize sample-induced turbidity, as per the procedures outlined in EPA guidelines and explained in detail in Appendix C. Water quality parameters, including temperature, pH, specific conductivity, turbidity, Eh, and dissolved oxygen, will be monitored before and after the well is purged. Turbidity will be measured as soon as the sample is brought to the surface. Water quality parameters will be recorded on the Field Record of Well Gauging, Purging, and Sampling Form (Appendix B) for each monitoring well. Monitoring wells will be sampled for

2. EA Engineering, Science, and Technology. 2000. Final Revision 0 Long-Term Monitoring Plan, Sites 1and 3 and Eastern Plume, Naval Air Station, Brunswick, Maine. February.

Target Compound List VOCs by EPA Method 8260B. The newly installed monitoring wells will be gauged prior to sampling with an electronic water level meter capable of measuring water levels to within 0.01 ft. The ground-water gauging data will be logged on the Field Record of Well Gauging Form provided in Appendix B.

2.6 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control procedures will include the collection of field and laboratory quality control samples. Quality assurance/quality control samples associated with ground-water samples collected from the newly installed monitoring wells will be submitted for laboratory analysis in accordance with the general methodologies established in the current Long-Term Monitoring Plan (EA 2000) for NAS Brunswick. Quality assurance/quality control samples associated with direct-push ground-water samples collected are summarized in this section.

2.6.1 Field Quality Control Samples

Quality control samples are not included specifically as laboratory quality control samples but are analyzed when submitted. Data for these quality control samples are reported with associated samples and are counted in the maximum batch size of 20 samples.

2.6.1.1 Trip Blanks

Trip blanks are containers of reagent-grade de-ionized water that are kept with the field sample container from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of trip blanks is to determine whether samples have become contaminated during transit or sample collection. Trip blanks apply only to aqueous VOC analyses; therefore, the containers must contain no headspace. One trip blank is needed for each sample cooler containing volatile organic analyte sample bottles per shipment event.

2.6.1.2 Field Duplicates

Field duplicates are two samples of the same matrix which are collected, to the extent possible, from the same location at the same time using the same techniques. Field duplicates provide information on the precision of the sampling and analysis process. Field duplicates will be collected at a frequency of 1 duplicate per 20 sample media.

2.6.1.3 Rinsate Blanks

A rinsate blank is a water sample collected after having been poured through or over a decontaminated piece of sampling equipment to assess and document the thoroughness of the decontamination process. A rinsate blank will be collected on the re-usable steel probe rods and slotted screen section used during direct-push sampling.

2.6.1.4 Source Water Blank

Source water blanks are samples of water used for field decontamination purposes. Specifically, source water blank samples will include laboratory-supplied, reagent-grade, deionized water used for decontamination purposes. Source water blank samples are typically analyzed for all parameters sampled during the field mobilization period. One water source sample will be collected from the water source used for equipment decontamination and will be analyzed for VOCs by EPA Method 8260B.

2.6.2 Laboratory Quality Control Samples

Laboratory quality control samples are included in each analysis to provide information on both method performance and sample measurement bias, and are included in each analytical batch. A batch is defined as a group of field samples of similar matrix, not to exceed 20, which are processed as a unit using the same method and the same lots of standards and reagents. The laboratory quality control samples discussed in the following subsections are counted in the maximum batch size of 20.

2.6.2.1 Method Blank

The method blank is used to monitor laboratory contamination. This is usually a sample of laboratory reagent water processed through the same analytical procedure as the sample. One method blank is prepared and analyzed with each analytical batch.

2.6.2.2 Laboratory Control Spike

The fortified method blank is analyzed with each analytical method. These samples generally consist of laboratory reagent water fortified with the analytes of interest for single-analyte methods and selected analyte for multi-analyte method according to the appropriate analytical method. The analyte recovery from each is used to monitor analytical accuracy and precision.

2.6.2.3 Matrix Spike

A matrix spike is an aliquot of a field sample that is fortified with the analytes of interest and analyzed to monitor measurement bias associated with the sample matrix. A matrix spike and matrix spike duplicate will be performed for every analytical batch.

2.6.2.4 Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatograph, but are not normally found in environmental samples. Surrogates are added to field and quality control samples in every batch. These compounds are used to monitor system performance as well as sample measurement bias. Percent recoveries are calculated for each surrogate, and evaluated against acceptance criteria.

2.7 DECONTAMINATION PROCEDURES

To minimize the potential for cross-contamination between soil boring locations, reusable sampling equipment and drilling equipment will be decontaminated via steam cleaner wash before and after the first boring is advanced and after each subsequent boring. Split-spoon samplers will be steam-cleaned and then decontaminated as described below. Steam cleaning will be conducted on a pre-approved (by NAS Brunswick personnel), centrally located decontamination pad.

The procedure for cleaning steel split-spoon samplers, submersible pumps, water level/interface probes, direct-push rods, etc., is as follows:

- Wash with potable water and laboratory-grade detergent (e.g., Alconox® detergent)
- Rinse with potable water
- Rinse with deionized water
- Rinse with methanol
- Rinse with deionized water
- Air dry
- Wrap in polyvinyl chloride sheeting/foil wrap if equipment will be stored.

The decontamination area will contain a wash solution collection system. The collected decontamination liquids will be temporarily containerized in U.S. Department of Transportation-approved, 55-gal drums and transported to Building 50 (Wastewater Treatment Plant) for disposal and treatment.

2.8 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Waste materials generated during the field investigation at the Southern Boundary of the eastern plume will include:

- Drill cuttings (soil) derived from soil boring, direct-push investigation, and during monitoring well installation

- Well development and sampling fluids

- Decontamination fluids

- Used personal protective equipment.

These wastes will be contained, labeled, and handled in the following manner:

- Soil cuttings generated from soil boring and monitoring well installation activities above the water table will not be containerized as this soil is unimpacted by the VOC ground-water plume. Soil cuttings generated below the water table will be containerized in U.S. Department of Transportation-approved, 55-gal drums. The drums will be temporarily staged at an approved location (NAS Brunswick Building 50), dated, and labeled as investigation-derived waste. Final disposal options will be determined pending the review of the direct-push ground-water data, the closed-container headspace vapor monitoring results, and comparison with the established screening levels for the contaminants of concern. It is anticipated that soil concentrations of VOCs will be very low and that this material will not require offsite disposal. The determination for disposal options will be coordinated with site personnel and regulators after the results of ground-water sampling are received.

- Liquids derived from well development and sampling activities, and decontamination fluids will be collected and temporarily containerized in U.S. Department of Transportation-approved, 55-gal drums and transported to Building 50 (Wastewater Treatment Plant) for disposal and treatment.

- Used personal protective equipment will be double-bagged and disposed of on the NAS as general refuse.

3. FIELD ACTIVITIES AND PROCEDURES – SITE 11

This section provides a summary of the field activities that will be conducted as part of the additional investigation at Site 11. One bedrock monitoring well will be installed to assess the potential for VOCs in the bedrock aquifer, as discussed during the Technical Meeting held at NAS Brunswick on 18 June 2002. The location of the monitoring well is at the discretion of Navy personnel, pending TEG review of the results of the geophysical survey to be conducted by EPA.

Activities to be conducted at Site 11 include:

- Advancement of 1 soil boring to the top of bedrock, with subsequent rock coring to an additional depth of approximately 60 ft
- Collection of ground-water samples from 10-ft intervals of the cored boring. Pneumatic packers will be used to isolate each interval during ground-water sampling
- Installation of 1 bedrock monitoring well
- Monitoring well development, low-flow ground-water sampling, and surveying.

Prior to the start of drilling activities, EA personnel will contact Digsafe (1-800-225-4977) to confirm the presence/absence of utilities at the drilling location. NAS Brunswick Work Control personnel will be notified (prior to commencement of field activities) so they can mark/identify underground utilities locations within the facility grounds. Additionally, EA personnel will coordinate subsurface investigation activities with MEDEP and EPA prior to the commencement of work.

3.1 SOIL BORING PROGRAM

One soil boring will be advanced at the location selected by Navy personnel for the bedrock monitoring well, on the basis of the review of the final geophysical survey findings report and following discussions with the TEG.

The soil boring will be installed using drive and wash drilling methods and temporary 6-in inner diameter steel casing to the top of bedrock (to be interpreted at refusal). The total depth of the boring is estimated to be 40 ft bgs (estimated refusal). Soil samples will be collected during the soil boring installation using a 2-in. inner diameter, 2-ft length, split-spoon sampler and a 140-lb drive hammer. Soil samples will be collected continuously for the length of the boring. The EA Field Geologist will log the soil characteristics of each sample along with any other pertinent information in accordance with American Society for Testing and Materials Method D 2488-93. Particular consideration will be given to grain size distribution (relative percentages of different size materials), presence of lamination or layering, and soil consistency. An estimate of mineralogy will be made for coarser-grained material. Soil characteristics will be logged on a Log of Soil Boring field form (Appendix B).

After completion of the soil boring, a roller bit will be used to ream out 3-5 ft of bedrock to create a socket into which the 4-in. inner diameter steel protective casing will be set. Once the casing is installed in the socket, the 4-in. casing will be grouted and the 6-in. temporary steel casing will be removed. The grout will be allowed to set up for a minimum of 24 hours prior to coring the bedrock. Details pertaining to bedrock coring, *in situ* ground-water sampling with pneumatic packers, and monitoring well installation are provided in Sections 3.2, 3.3, and 3.4, respectively.

Closed-container headspace vapor monitoring will be used as a screening tool for determining the relative concentrations of VOCs in soil samples collected during split-spoon sampling of the overburden. Headspace measurements will be collected using the static headspace analysis method described below:

- Approximately 2 oz of soil will be collected from the open split-spoon and placed in a laboratory-cleaned glass jar. The mouth of the jar will then be immediately covered with aluminum foil prior to sealing the jar lid to minimize the loss of VOCs. Headspace samples will be collected for every split-spoon soil sample.

- The jar will be shaken to break up compacted soil or material, and will be placed in a location, out of direct sunlight, for a period of no less than 15 minutes to equilibrate prior to field monitoring.

- The jar lid will be removed from the jar. Headspace will be monitored within the jar by piercing the aluminum foil with the photoionization detector probe. Care will be taken to prevent unnecessary mixing of jar headspace and outside air. Monitoring with the photoionization detector will continue for at least 1 minute. The highest photoionization detector concentration observed will be recorded along with the sample interval in the field notebook, and on the Log of Soil Boring field form provided in Appendix B.

Fluids and soil cuttings derived from drilling processes will be containerized in accordance with the procedures detailed in Section 3.8. The drill rig, drill augers, rods, split-spoons, and other downhole equipment will be decontaminated in accordance with the procedures detailed in Section 3.8 prior to soil boring activities and bedrock coring.

3.2 BEDROCK CORE LOGGING AND ROCK QUALITY DESIGNATION

Bedrock coring will be completed for 60 ft and ground-water samples will then be collected and analyzed. An additional amount of coring (up to 60 ft) may be completed in the unlikely event that VOC concentrations show a significant increasing trend with depth. The need for any additional rock coring will be determined based on the decision by the TEG after reviewing the field results from the first 60 ft of rock core and the results of the *in situ* ground-water sampling with the pneumatic packers.

Following completion of the soil boring and grouting of the 4-in. inner diameter protective steel casing approximately 3-5 ft into competent rock, 60 ft of bedrock will be cored. Rock will be cored with a 3.93-in. hazard quotient wireline core barrel.

During rock coring, the onsite EA Maine Certified Geologist or Project Geologist will pay particular attention to potential fracture zones when describing the rock cores. Descriptions of the rock cores and details specific to each core run will be recorded on the Log of Core Boring field form (Appendix B). Rock cores will be identified and visually described by the Maine Certified Geologist for the following parameters:

- Lithology
- Grain size and texture
- Color
- Bedding/foliation/banding/schistocity
- Weathering/fractures
- Solution or void conditions/staining.

In addition to the visual description of each core, the EA Maine Certified Geologist, or geologist under his/her control, will record the following:

- Total elapsed time for each core run will be recorded. Interruptions in coring will be documented by time of occurrence and description of the problem, as well as the resolution. Coring rates and depths of significant changes in coring rate will be recorded. The intervals of any non-recovered core will be estimated, along with an explanation for no recovery.

- Changes in color of circulating water/drilling fluid will be recorded. Quantitative estimates of discernable fluid losses and gains to the geological formation and the estimated interval over which they occur will be indicated.

- Total core recovery will be measured to within 0.1 ft, and total core recovery as a percent of the length of the core run will be determined for each 5-ft core run.

- The angles of any bedding planes and schistocity will be recorded as a dip angle (as measured from perpendicular to the core axis).

- The angle of any fractures, joints, faults, or seam surfaces will be measured from the perpendicular to the core axis and recorded. If fractures are encountered, they will be examined and described in detail to assess whether ground water may have been present or moving through the fractures.

- Any dominant coatings or fillings (i.e., slickensides) present in fractures or seams will be recorded.

The rock quality designation as a percent of the length of the core run will be calculated for each core run and recorded in the field notebook and the Log of Core Boring field form (Appendix B). The rock quality designation method for determining rock quality is as follows:

- The sum of the total length of core pieces recovered in each run that are at least 4 in. in length and that are hard and sound, divided by the total length of the run, represented as a percentage. If the core is broken by handling or by the drilling process, the freshly broken pieces will be fitted together and counted as one piece.

Rock cores will be placed in wooden core boxes with the top and bottom of each run clearly labeled. Core boxes will be clearly marked on the inside and outside, and will identify the boring number, date, numerical sequence of the box (e.g., 2 of 7), and the footage interval contained within the box.

3.3 COLLECTION OF BEDROCK AQUIFER GROUND-WATER SAMPLES WITH PNEUMATIC PACKERS

In situ ground-water samples will be collected from discrete zones within bedrock to assess whether VOCs are present within bedrock ground water. Discrete 10-ft sections of the open bedrock borehole will be sealed off with pneumatic packers for ground-water collection. Water will then be pumped out of the open borehole from the discrete interval for collection and laboratory analysis with the packer pump. The packer pump will be decontaminated prior to each use in accordance with the procedures detailed in Section 3.8. Ground-water samples will initially be collected from 10-ft sections of the top 60 ft of bedrock. A total of two packer interval volumes will be evacuated from the discrete interval prior to sample collection to ensure ground water being sampled is from the formation material. During packer sampling, care will be taken to note the achievable ground-water flow rate from the interval, and whether the interval yields water. If after purging two packer volumes insufficient water is present for sampling, the field team will contact the Project Manager for direction. A total of 6 ground-water samples will be analyzed for VOCs by EPA Method 8260B from the top 60 ft of bedrock. Ground-water samples will be submitted to the contracted laboratory for an expedited turnaround time of 24 hours to ensure that the results are available for review by Navy personnel and others. If necessary, an additional *in situ* ground-water sample will be collected from each discrete 10-ft section of the additional 60 ft of bedrock. These additional ground-water samples will be submitted to the contracted laboratory for an expedited turnaround time of 24 hours to ensure that results are available prior to monitoring well installation.

3.4 BEDROCK MONITORING WELL INSTALLATION

Following soil boring and *in situ* ground-water sample collection activities, well construction will be performed according to the procedures described in this section. One bedrock monitoring well will be installed at Site 11. A determination as to the placement of the screened interval will be made by EA, the Navy, MEDEP, and EPA (TEG) pending the review of the field results from the bedrock coring activities and the results of the *in situ* ground-water sampling with the pneumatic packers. It is anticipated that the bedrock monitoring well will have a total depth of 100 ft bgs (assuming 40 ft of overburden and 60 ft of bedrock coring). However, additional coring may be necessary and the maximum well depth could be 160 ft.

The monitoring well will be installed and constructed in accordance with the procedures presented in this section and with EPA guidelines as specified in the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* (Document No. EPA/600/4-89/034; U.S. EPA 1991). The monitoring well will be installed using temporary 6-in. steel casing and drive and wash drilling methods through the overburden down to the top of rock, as detailed in this section. After completion of the soil boring activities, 4-in. inner diameter protective steel casing will be grouted in place and set approximately 3-5 ft into competent rock that will be reamed out using a 5.875-in. roller bit. The grout will be allowed to set for 24 hours prior to bedrock coring. The protective steel casing will be grouted in place to prevent migration of ground water from the overburden into bedrock. It is assumed that the monitoring well will be constructed with a 10-ft screen interval, although the Field Geologist, in consultation with the EA Project Manager, may make changes to the screen interval as field results from the bedrock coring activities and the results of the *in situ* ground-water sampling with the pneumatic packers warrant. Monitoring wells will be constructed in accordance with the details provided in this section. Actual well completion data will be recorded in the field notebook. A Daily Drilling Report will also be completed and is included in Appendix B. All fluids and soil cuttings derived from drilling processes will be containerized in accordance with the procedures detailed in Section 3.9. The newly installed bedrock monitoring well will be developed (for a maximum of 2 hours) using pump and surge methods until ground-water parameters (pH, temperature, and conductivity) stabilize and turbidity is minimized (with a goal of less than 10 NTUs). Well development procedures are detailed in Section 3.5.

The bedrock monitoring well will be installed using new polyvinyl chloride riser casing and well screens. Material will be delivered directly to the field in packaging from the manufacturer. Well riser casing and screen sections will be steam-cleaned onsite prior to placement in the borehole if the packaging is not intact to ensure that oil, grease, or wax have been removed. After the borehole has been drilled to completion depth, 2-in. inner diameter Schedule 40, threaded, flush-jointed polyvinyl chloride riser casing and attached screen will be set through the permanent 4-in. inner diameter protective steel casing into the borehole. The screen interval will be placed at the bottom of the boring at the proper depth. The open borehole will be backfilled with Holeplug® to the desired depth for monitoring well installation, if deemed necessary by the TEG after reviewing the results of the bedrock coring activities and the results of the *in situ* ground-water sampling with the pneumatic packers. The monitoring wells will be completed with 10 ft of well screen (0.010 slot) and filter pack, depending on site-specific conditions as determined by the Project Geologist. No sediment traps will be used to cap the screen bottom. The riser casing will be finished and constructed with 8-in. diameter protective steel casing (approximately 2-ft stickup) grouted in place with cement collar and a lockable cap. The monitoring well will be capped with an expandable and lockable well cap. A vent hole will be drilled in the cap to permit equalization at atmospheric and interior well pressure. A schematic monitoring well construction diagram for the bedrock monitoring well is shown on Figure 4.

3.4.1 Filter Pack

The filter pack of the monitoring well will consist of inert silica sand, certified as chemically clean by the manufacturer, and texturally clean as seen through a 10X hand lens. Nominal grain size will be No. 1 silica sand unless geologic conditions, in the judgement of the Project Geologist, dictate differently. Prior to installing the well screen, a bedding of filter pack up to 6-in. thick will be placed in the bottom of the hole. Sand will extend to approximately 2 ft above the top of the well screen. The 2 ft of filter pack above the top of the screen allows for some settlement of the filter pack and a buffer between the top of screen and the annular seal. The depth to the top of the filter pack will be sounded frequently with a weighted measuring tape. If bridging of the material does occur, a small amount of potable water may be used to remove the bridge and allow the filter pack to settle correctly.

3.4.2 Bentonite Seal

The bentonite seal for the monitoring well will include the use of commercially available bentonite pellets (or chips). Pellet seals will be a minimum of 2-ft thick as measured immediately after placement, without allowance for swelling. The bentonite seal will be placed directly above the filter pack of each well. Following placement of the pellets, potable water will be poured down the annular space to hydrate the pellets. The bentonite will be allowed to hydrate for 1 hour prior to grouting the remainder of the borehole.

3.4.3 Annular Seal

The annular seal of the monitoring well will consist of cement-bentonite grout, composed by weight of 10 parts cement (Portland cement, any Type I-V) to one-half part bentonite, with a maximum of 7 gal of potable water per 94-lb bag of cement. Bentonite will be added after the required amount of cement is mixed with water. Additives or borehole cuttings will not be mixed with the grout. Annular seal materials will be combined in an aboveground rigid container and mixed onsite to produce a thick, lump-free mixture. The annular seal will be placed utilizing a tremie pipe, initially located within 1 ft of the top of the bentonite seal. The tremie pipe should be placed in the annulus between the protective casing and the riser pipe. Grout will be pumped through this pipe to the bottom of the open annulus until a continuous, undiluted column of grout is formed from the top of the bentonite seal to approximately 2-3 ft bgs.

3.4.4 Surface Completion

The surface completion of the monitoring well will be constructed with an 8-in. diameter steel protective casing, 5-ft long (2-ft stickup above ground surface with a lockable cap), placed such that the bottom of the protective casing extends into the grout. At the ground surface, the cement collar will form a 3-ft diameter, 4-in. thick concrete pad sloping outward around the well. The top outer edge of the pad will be flush with the ground. An internal grout collar will be placed in the annular space between the inner casing and the outer protective polyvinyl chloride casing from below the frost line to the ground surface. Brass locks that are keyed alike will be used to secure the outer lids of the protective casing of the wells. The protective casing will be washed with clean water or steam-cleaned prior to placement, so it is free from extraneous openings, encrusting, and/or coating material (except primer/paint applied by the manufacturer). The well will be provided with vented well caps and keyed-alike locks.

The newly installed bedrock monitoring well will be surveyed by a State of Maine-licensed land surveyor, who will determine the horizontal (± 0.01-ft) and vertical (± 0.01-ft) positioning of each well. Control points will be established onsite using previously established local benchmarks, or Global Positioning System techniques, if required. The horizontal control of each well will be determined and reported based on the State Plane Maine West NAD-27 Coordinate System. Vertical control will be established in accordance with National Geodetic Vertical Datum.

3.5 WELL DEVELOPMENT

The newly installed monitoring well will be developed in order to remove silt from the well screen and to ensure that representative ground-water samples can be collected. The monitoring well will be developed for a maximum of 2 hours by EA personnel. Ground-water parameters will be monitored during well development. The monitoring well will be developed within 2 weeks of the completion of well construction (but no sooner than 48 hours after grouting is completed).

The well will be alternately mechanically surged with a surge block and pumped clear of sediment with a submersible pump. If the addition of water is required to facilitate surging, water from the well or water from an approved potable water source will be used, and at least as much water that was introduced during development will be removed from each well. Care will be taken during surging to ensure that low pressures within the well casing and screened interval do not cause implosion of the well screen. Surging will continue until little or no sediment enters the well. Following surging, the well will be continuously pumped using a submersible pump (i.e., Grundfos® pump). Temperature, pH, specific conductivity, and turbidity will be monitored during pumping at a rate of one reading per well casing volume removed. Water quality data will be recorded on the Field Record of Well Development form provided in Appendix B. Turbidity will be measured as soon as the sample is brought to the surface. Pumping will continue until these parameters have stabilized (less than 0.2 pH units or a ±10 percent change for the other parameters between three consecutive readings) and the turbidity does not exceed 10 NTUs, or for a maximum of 2 hours. The purged ground water derived from well development will be containerized in accordance with the procedures detailed in Section 3.9. Failure to obtain satisfactory results (parameter stabilization) will be noted on the well development record form, and the Project Manager will be notified should this occur.

3.6 WATER LEVEL GAUGING AND LOW-FLOW GROUND-WATER SAMPLING

Ground-water sampling will occur as part of the next monitoring event (anticipated to be April 2003), and will be performed in accordance with the general methodologies established in the current Long-Term Monitoring Plan (EA 2000) for NAS Brunswick. A permanent submersible pump will be installed in the bedrock well prior to well sampling. Ground-water sampling will be accomplished using low-flow techniques to minimize sample-induced turbidity, as per the procedures outlined in EPA guidelines and explained in detail in Appendix C. Water quality parameters, including temperature, pH, specific conductivity, turbidity, Eh, and dissolved oxygen, will be monitored before and after the well is purged. Turbidity will be measured as soon as the sample is brought to the surface. Water quality parameters will be recorded on the Field Record of Well Gauging, Purging, and Sampling Form (Appendix B) for the bedrock monitoring well. The monitoring well will be sampled for Target Compound List VOCs by EPA Method 8260B and submitted to the contracted laboratory for an expedited turnaround time of 14 days. The newly installed monitoring well will be gauged prior to sampling with an electronic water level meter capable of measuring water levels to within 0.01 ft. The ground-water gauging data will be logged on the Field Record of Well Gauging Form provided in Appendix B.

3.7 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control procedures will include the collection of field and laboratory quality control samples. Quality assurance/quality control samples associated with the low-flow ground-water sample collected from the newly installed bedrock monitoring well at Site 11 will be submitted for laboratory analysis in accordance with the general methodologies established in the current Long-Term Monitoring Plan (EA 2000) for NAS Brunswick. Quality assurance/ quality control samples associated with the *in situ* ground-water samples collected with the pneumatic packers are summarized in this section.

3.7.1 Field Quality Control Samples

These samples are not included specifically as laboratory quality control samples but are analyzed when submitted. Data for these quality control samples are reported with associated samples and are counted in the maximum batch size of 20 samples.

3.7.1.1 Trip Blanks

Trip blanks are containers of reagent-grade deionized water that are kept with the field sample container from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of trip blanks is to determine whether samples have become contaminated during transit or sample collection. Trip blanks apply only to aqueous VOC analyses, therefore, the containers must contain no headspace. One trip blank is needed for each sample cooler containing volatile organic analyte sample bottles per shipment event.

3.7.1.2 Field Duplicates

Field duplicates are two samples of the same matrix which are collected, to the extent possible, from the same location at the same time using the same techniques. Field duplicates provide information on the precision of the sampling and analysis process. Field duplicates will be collected at a frequency of 1 duplicate per 20 sample media.

3.7.1.3 Rinsate Blanks

A rinsate blank is a water sample collected after having been poured through or over a decontaminated piece of sampling equipment to assess and document the thoroughness of the decontamination process. A rinsate blank will be collected on the re-usable packer pump and associated rods used during *in situ* ground-water sampling with the pneumatic packers.

3.7.1.4 Source Water Blank

Source water blanks are samples of water used for field decontamination purposes. Specifically, source water blank samples will include laboratory-supplied, reagent-grade, deionized water used for decontamination purposes. Source water blank samples are typically analyzed for all parameters sampled during the field mobilization period. One water source sample will be collected from the water source used for equipment decontamination and will be analyzed for VOCs by EPA Method 8260B.

3.7.2 Laboratory Quality Control Samples

Laboratory quality control samples are included in each analysis to provide information on both method performance and sample measurement bias, and are included in each analytical batch. A batch is defined as a group of field samples of similar matrix, not to exceed 20, which are processed as a unit using the same method and the same lots of standards and reagents. The laboratory quality control samples discussed in the following subsections are counted in the maximum batch size of 20.

3.7.2.1 Method Blank

The method blank is used to monitor laboratory contamination. This is usually a sample of laboratory reagent water processed through the same analytical procedure as the sample. One method blank is prepared and analyzed with each analytical batch.

3.7.2.2 Laboratory Control Spike

The fortified method blank is analyzed with each analytical method. These samples generally consist of laboratory reagent water fortified with the analytes of interest for single-analyte methods and selected analyte for multi-analyte method according to the appropriate analytical method. The analyte recovery from each is used to monitor analytical accuracy and precision.

3.7.2.3 Matrix Spike

A matrix spike is an aliquot of a field sample that is fortified with the analytes of interest and analyzed to monitor measurement bias associated with the sample matrix. A matrix spike and matrix spike duplicate will be performed for every analytical batch.

3.7.2.4 Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatograph, but are not normally found in environmental samples. Surrogates are added to field and quality control samples in every batch. These compounds are used to monitor system performance as well as sample measurement bias. Percent recoveries are calculated for each surrogate, and evaluated against acceptance criteria.

3.8 DECONTAMINATION PROCEDURES

To minimize the potential for cross-contamination between overburden and bedrock, reusable sampling equipment and drilling equipment will be decontaminated via steam cleaner wash before the boring is first advanced in the overburden and prior to the commencement of bedrock drilling and *in situ* ground-water sampling activities. Split-spoon samplers will be steam-cleaned and then decontaminated as described below. Steam cleaning will be conducted on a pre-approved (by NAS Brunswick personnel), centrally located decontamination pad.

The procedure for cleaning steel split-spoon samplers, submersible pumps, water level/interface probes, etc., is as follows:

- Wash with potable water and laboratory-grade detergent (e.g., Alconox® detergent)
- Rinse with potable water
- Rinse with deionized water
- Rinse with methanol
- Rinse with deionized water
- Air dry
- Wrap in polyvinyl chloride sheeting/foil wrap if equipment will be stored.

The decontamination area will contain a wash solution collection system. The collected decontamination liquids will be temporarily containerized in U.S. Department of Transportation-approved, 55-gal drums and transported to Building 50 (Wastewater Treatment Plant) for disposal and treatment.

3.9 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Waste materials generated during the field investigation at Site 11 will include:

- Drill cuttings (soil) derived from soil boring, direct-push investigation, and during monitoring well installation

- Well development and sampling fluids

- Decontamination fluids

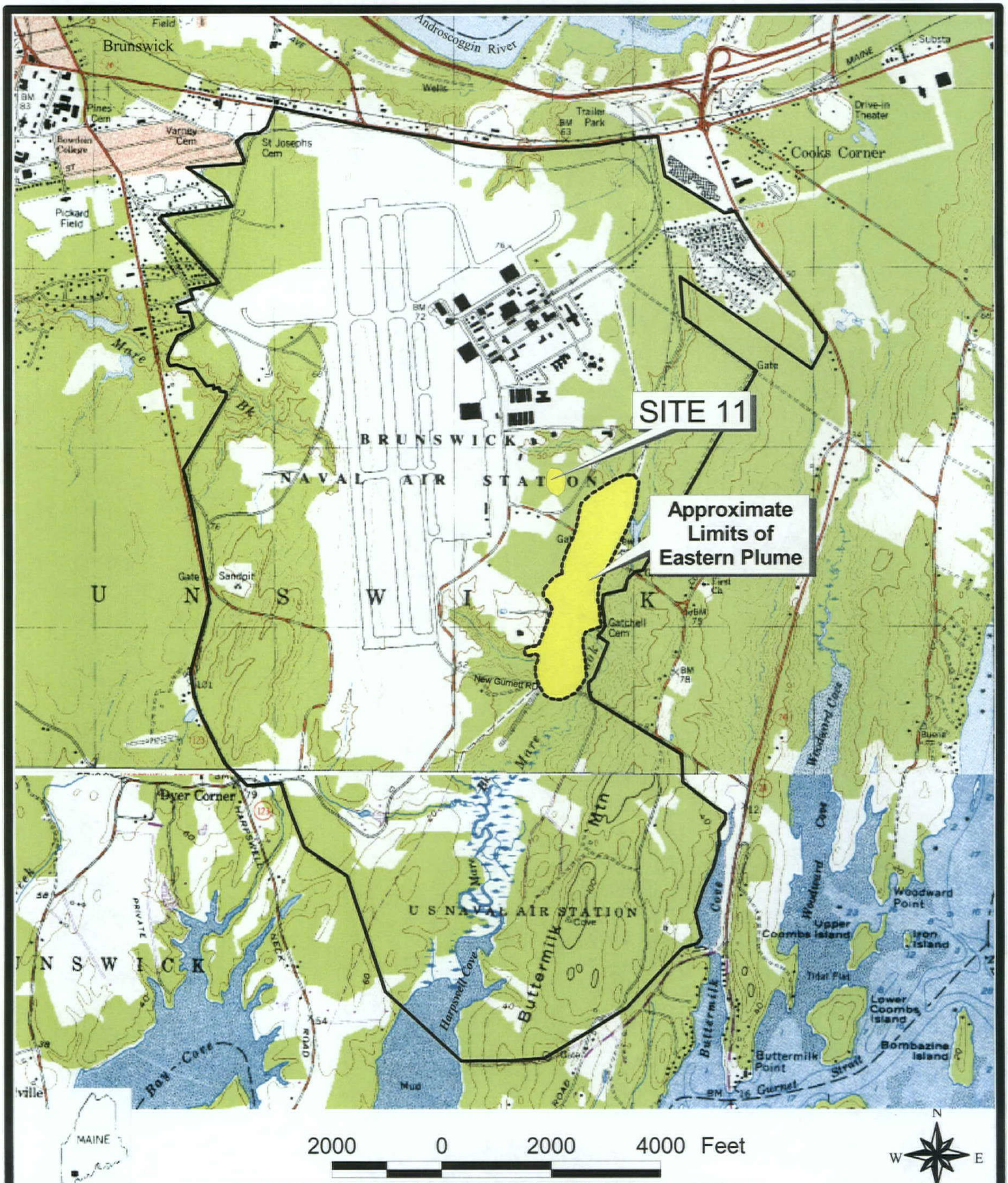
- Used personal protective equipment.

These wastes will be contained, labeled, and handled in the following manner:

- Soil cuttings generated from soil boring and monitoring well installation activities above the water table will not be containerized. Soil cuttings generated below the water table will be containerized in U.S. Department of Transportation-approved, 55-gal drums. The drums will be temporarily staged at an approved location (NAS Brunswick Building 50), dated, and labeled as investigation-derived waste. Final disposal options will be determined pending the review of the packer sampling data, the closed-container headspace vapor monitoring results, and comparison with the established screening levels for the contaminants of concern. A final determination of the disposal options for this material will be made after consultation with Navy personnel and others.

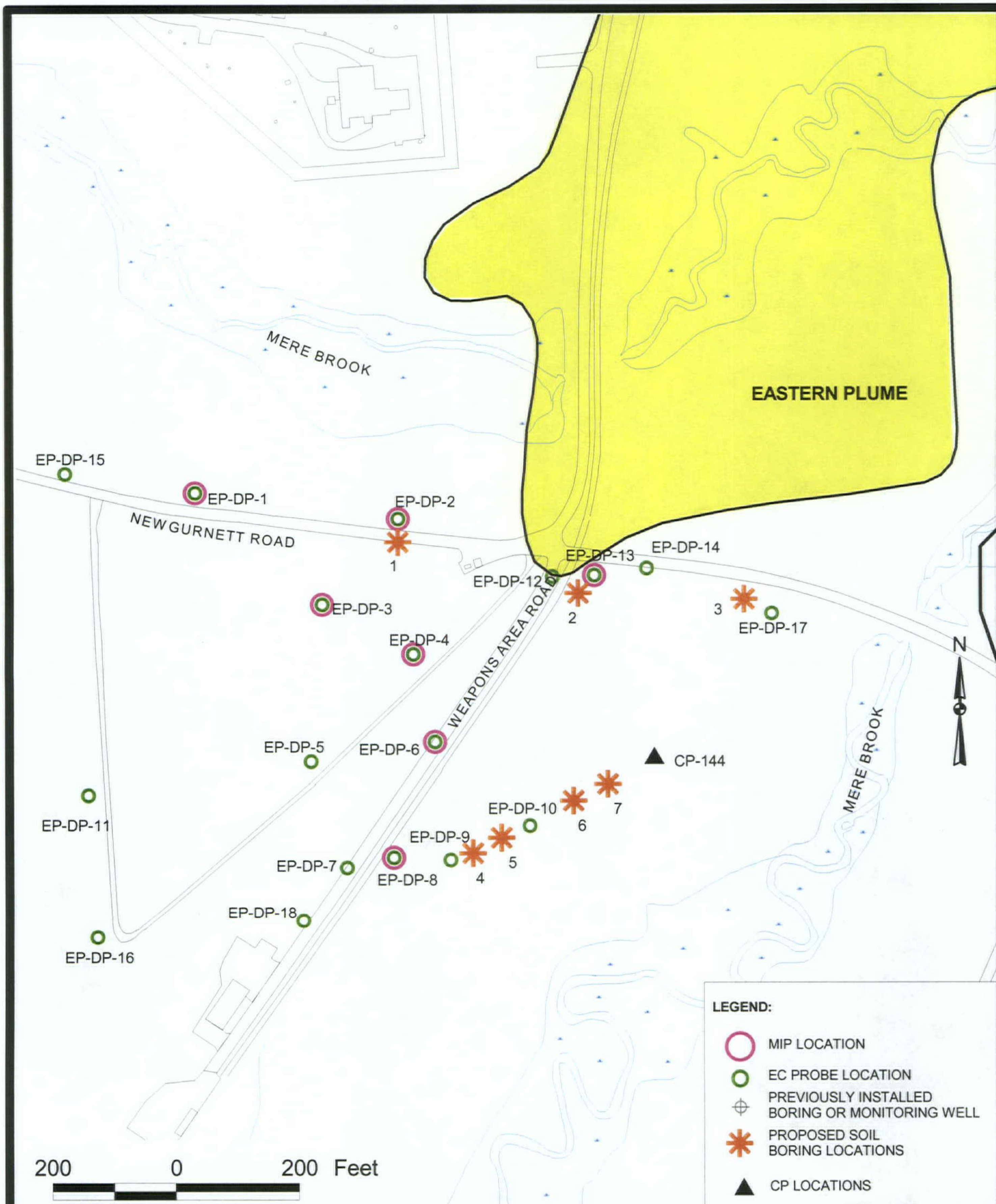
- Liquids derived from well development and sampling activities, and decontamination fluids will be collected and temporarily containerized in U.S. Department of Transportation-approved, 55-gal drums and transported to Building 50 (Wastewater Treatment Plant) for disposal and treatment.

- Used personal protective equipment will be double-bagged and disposed of on the NAS as general refuse.



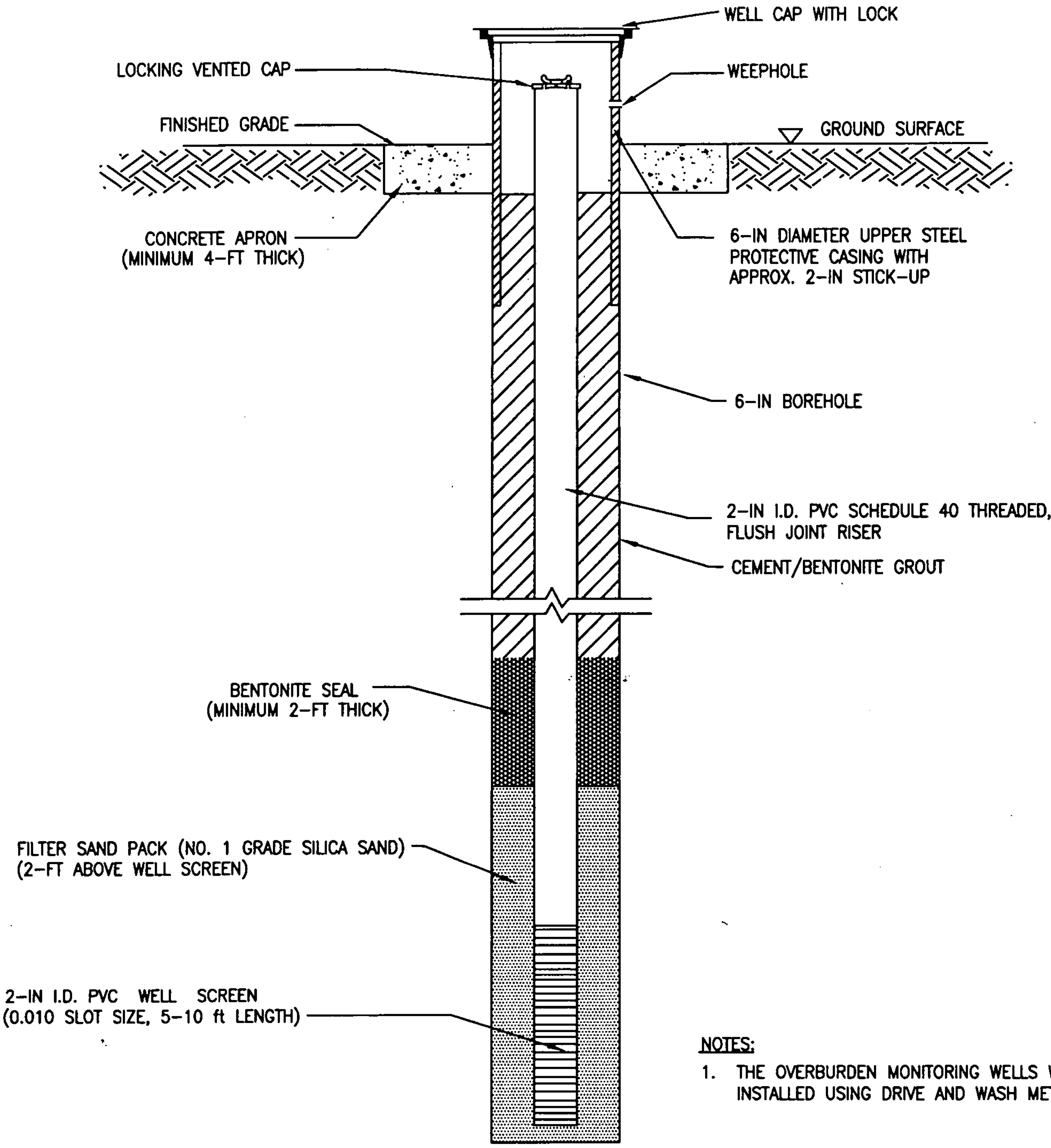
SOURCE MAPS: USGS ORRS ISLAND (1978) AND BRUNSWICK (1980) 7.5 MINUTE QUADRANGLES.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY		SITE II AND EASTERN PLUME NAVAL AIR STATION, BRUNSWICK, MAINE				FIGURE I SITE LOCATION MAP	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
ACE	DC	DC	ACE	AS SHOWN	10 SEPT 2002	29600.47	I:\NASB_GIS \NAVY.APR



EA ENGINEERING, SCIENCE, AND TECHNOLOGY		NAVAL AIR STATION BRUNSWICK, MAINE			FIGURE 2 PROPOSED SOIL BORING LOCATIONS IN SOUTHERN BOUNDARY OF THE EASTERN PLUME		
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
ACE	GMC	DC	GMC	AS SHOWN	10 SEPT 2002	29600.47	I:\NASB_GIS \NAVY.APR

OVERBURDEN SHALLOW AND DEEP MONITORING WELL SCHEMATIC CONSTRUCTION DIAGRAM



MONITORING WELL SECTION
N.T.S.

NOTES:

1. THE OVERBURDEN MONITORING WELLS WILL BE INSTALLED USING DRIVE AND WASH METHODS.

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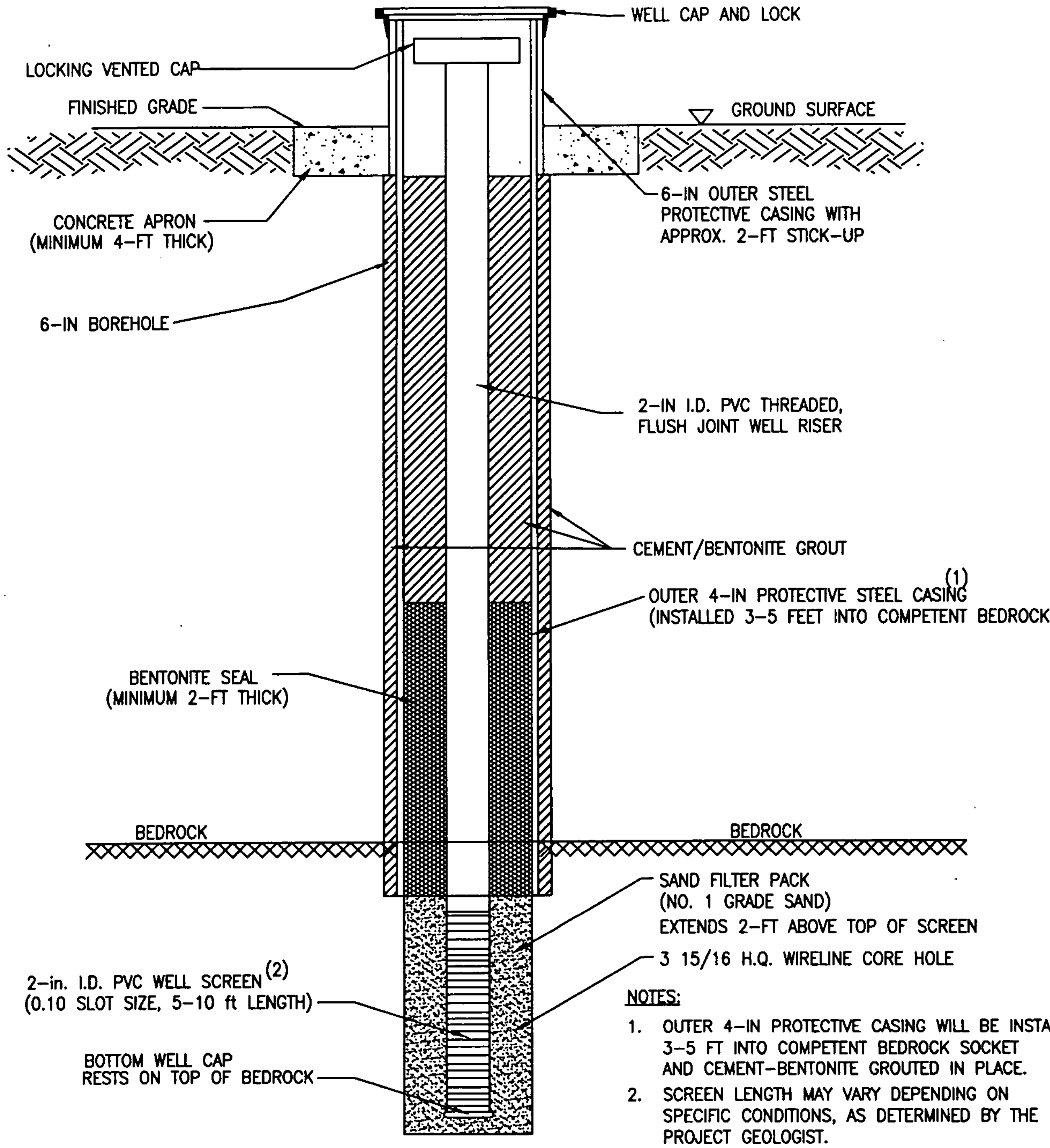
EA ENGINEERING, SCIENCE, AND TECHNOLOGY	NAVAL AIR STATION BRUNSWICK, MAINE	FIGURE 3 OVERBURDEN SHALLOW AND DEEP MONITORING WELL SCHEMATIC CONSTRUCTION DIAGRAM

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
AE	GMC	JG	GMC	NONE	9/6/02	29600.47	3

BEDROCK MONITORING WELL SCHEMATIC CONSTRUCTION DIAGRAM



MONITORING WELL SECTION
N.T.S.

NOTES:

1. OUTER 4-IN PROTECTIVE CASING WILL BE INSTALLED 3-5 FT INTO COMPETENT BEDROCK SOCKET AND CEMENT-BENTONITE GROUTED IN PLACE.
2. SCREEN LENGTH MAY VARY DEPENDING ON SPECIFIC CONDITIONS, AS DETERMINED BY THE PROJECT GEOLOGIST.
3. THE BEDROCK WELLS WILL BE INSTALLED USING DRIVE AND WASH DRILLING METHODS AND DIRECT ROTARY DRILLING METHODS THROUGH TOP 3-5 FT OF BEDROCK.
4. BEDROCK WILL BE CORED USING 3.93-IN H.Q. WIRELINE (UP TO 120-FT OF ROCK CORING).

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EA® EA ENGINEERING, SCIENCE, AND TECHNOLOGY	NAVAL AIR STATION BRUNSWICK, MAINE	FIGURE 4 BEDROCK MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
AE	GMC	JG	GMC	NONE	9/6/02	29600.47	4

Appendix A

Response to Comments

RESPONSE TO COMMENTS FROM THE MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION ON THE DRAFT WORK PLAN FOR ADDITIONAL INVESTIGATION FOR THE DIRECT-PUSH INVESTIGATION OF THE SOUTHERN BOUNDARY OF THE EASTERN PLUME AND SITE 11 AT THE NAVAL AIR STATION, BRUNSWICK, MAINE 9 OCTOBER 2002

COMMENTOR: Larry Dearborn, Certified Geologist **DATED: 25 October 2002**

GENERAL COMMENTS

1. MEDEP concurs with the proposed subject investigation at the Southern Boundary of the Eastern Plume, but has several minor concerns expressed below for the Navy's consideration. Previously the Navy has stated that the exact locations will be jointly staked in the field in the presence of the regulators. The State expects that its staff will be afforded this opportunity, and therefore this task should not be scheduled for a weekend day or holiday (i.e., 11 November).

   As Claudia Sait stated in the 22 October 2002 Technical Meeting, the State is not sending comments on the proposed Site 11 work.

   Response—On 18 June 2002, during an NAS Brunswick Technical Meeting, the soil boring locations in the Southern Boundary were jointly staked with representatives of the Navy (Lonnie Monaco, Michael Fohner, and Tony Williams), MEDEP (Claudia Sait and Larry Dearborn), EPA (Mike Barry and Alastair Lough), EA (Al Easterday, Peter Nimmer, and Gina Calderone), and Lepage Environmental (Carolyn Lepage). During the site visit to the soil boring locations, regulators requested adjustments to certain soil boring locations, which the Navy concurred as well, and the staked locations were adjusted accordingly. At the end of the site visit, it was agreed that these were the locations of the soil borings as proposed by the Navy in the proposal letter dated 8 April 2002. Based on the 18 June 2002 Technical Meeting site visit, the Southern Boundary soil boring locations have been staked and agreed to by the regulators; therefore, the drilling of the soil borings can proceed once the Work Plan is finalized. MEDEP and EPA will be notified of the field schedule for the soil borings and direct-push ground-water sampling to allow the regulators to participate during the execution of this field work. Tentative dates have been established for executing the soil borings (12-15 November 2002) and the direct-push ground-water sampling (18-22 November 2002).

SPECIFIC COMMENTS

2. ***Section 1.1, Work Plan Objectives, p. 1, 1st para.***—In light of the recent technical meeting, please clarify the second sentence as follows:

The objectives of these investigations are to satisfy EPA's and MEDEP's regulatory concerns that were expressed at the 12 February 2002 Technical Meeting related to potential data gaps in the Southern Boundary area, and EPA's concern for potential bedrock contamination impact in the Site 11 area.

Response—Referring to MEDEP's letter dated 30 May 2002, although not formally commenting on specific Site 11 tasks presented in the Navy's draft Work Plan, MEDEP is cooperating with, supportive of, and concurs with EPA comments regarding Site 11 proposed tasks for the bedrock well. During the 22 October 2002 NAS Brunswick project meeting, EPA verbally concurred with the Navy's draft Work Plan and had no comments regarding the Navy's proposed tasks at Site 11.

The second sentence from Section 1.1, first paragraph, as presented in the Work Plan is:

The objectives of these investigations are to satisfy regulatory concerns that existed at the 12 February 2002 Technical Meeting related to potential data gaps in the Southern Boundary area and the potential for bedrock impact at Site 11.

The text as currently written in the draft is clear and concise; therefore, no edits will be made to this text as presented in the draft Work Plan.

3. ***Section 1.1, Work Plan Objectives, p. 1, 1st bullet***—Installation of 4 deep monitoring well and 3 shallow monitoring wells at the southern end of the Eastern Plume. Please modify the second item to read as follows to improve clarity:

   Installation of 4 deep monitoring wells and 3 shallow monitoring wells just beyond the end of the presently mapped Eastern Plume.

   Response—The text that the MEDEP has suggested is more subjective (i.e., "just beyond"), than the text that the Navy has presented in the draft Work Plan and it does not improve the clarity of the text. The Navy respectfully requests to let the text stand as it is presented in the draft version.

4. ***Section 2.1 and Section 2.2 Order of Completion***—It is our understanding via a telephone call with Mr. Easterday of EA Engineering, Science, and Technology on 24 October 2002 that the continuous split-spoon soil sampling will now precede direct-push groundwater sampling. MEDEP believes that this change is very logical and will provide for better overall results. If possible, the order of presentation within the Work Plan should also be switched. In the last sentence of the first paragraph under the Section 2.1 (draft), "ground-water sampling" should be replaced by "*soil sampling.*"

   Given that the order of data collection will be reversed between ground water and soil, an opportunity is now afforded to more specifically locate the allocated vertical ground-water samples than just using a default spacing of very 5 ft. A more effective and efficient sampling plan for each direct-push location should be achievable.

Response—The order of these tasks will be changed to reflect the current schedule of completion of the direct-push ground-water sampling and the soil boring sampling for the final Work Plan. MEDEP's suggestion for changing "ground-water sampling" to "soil sampling" will be incorporated.

5. ***Section 2.2, Soil Boring Program, p. 5, top bullet***—This paragraph implies that a single 2-oz sample of soil will be containerized in a jar for each 2-foot soil core for the purpose of obtaining a headspace reading. A PID scan should be done along the full length of each core prior to selecting which 2 oz of soil to collect for the headspace jar. An alternative is to collect 2 oz of soil from each 6 in. along the core (emphasizing the finest grained intervals) for compositing into a larger jar.

   Response—Comment noted. Text will be added to clarify the field screen process for 2-in. split-spoon samplers for the final Work Plan.

   The revised text will indicate that each 2-ft split-spoon soil sample will be opened and immediately scanned with a photoionization detector (PID). Additionally, a composite soil sample will be collected from the 2-ft core and field screened using the PID. The finest grained intervals and any soil zones with an odor or appearing to be impacted will be selected for the PID composite sampling. The PID measurements from each soil sampler will be recorded by the field geologist. The soil intervals identified to have elevated PID measurements, odor, and/or impacted appearance will be targeted for subsequent ground-water sampling.

6. ***Section 2.3, Monitoring Well Installation, p. 5, 2nd para***—It is anticipated that each deep monitoring well will have a total depth of 70 ft bgs. The Navy should not assume that all deep wells will have the same depth. The average of the four wells might be close to 70 ft, but MEDEP believes that a range between 60 and 90 ft should be anticipated, and planned for.

   Response—Agreed.

7. ***Section 2.8, Management of Investigation-Derived Waste, p. 12, last bullet***—Used personal protective equipment will be double-bagged and disposed on onsite as general refuse. Please reword so that "onsite" cannot be interpreted as where the work is occurring at the Southern Boundary area.

   Response—The following edit will be made to the text:

   > *Used personal protective equipment will be double-bagged and disposed of ~~onsite~~ <u>on the NAS</u> as general refuse.*

8. ***Figure 2***—Only one cone penetrometer exploration (CP-144) is shown on this map, although 12 other CPs occur in the displayed area along and south of New Gurnett Road. All CPs shown be shown as each contributes to the understanding of the subsurface hydrogeology, and also serves as a locational reference.

As received, the figure is displayed at a scale of 1 in. equals 190 ft. The figure would be more user-friendly for locational purposes in the field if the map scale were changed slightly to 1 in. equals 200 ft.

Response—Only this cone penetrometer location (CP-144) was shown on the Work Plan Figure 2 since it is a boundary endpoint for soil boring location nos. 6 and 7. This new boring/monitoring wells location figure will be used in the field and will be more useful if kept simple. Once this work is completed, the new boring and monitoring well locations will be surveyed, and the final summary report will be generated which will include all existing site wells, cone penetrometers, direct-push locations, etc. on the figures. However, detailed proposed soil boring and monitoring well location maps will not be included in this Work Plan. The scale of Figure 2 in this Work Plan is considered to be adequate for field use and will, therefore, not be changed for the final Work Plan. The 7 soil boring locations have already been located and staked in the field in coordination with the Navy, EA, EPA, and MEDEP on 18 June (see response to MEDEP's general comment).

"Sait, Claudia B"
<Claudia.B.Sait@state.me.us>

11/04/2002 04:11 PM

To: "Barry, Michael" <Barry.Michael@epamail.epa.gov>, "Easterday, Al" <aeasterd@eaest.com>, "Fohner, Michael R (EFANE)" <FohnerMR@efane.navfac.navy.mil>, Larry Dearborn <Larry.L.Dearborn@state.me.us>, "LePage, Carolyn" <clepagegeo@AOL.com>, "monaco, lonnie" <monacolj@efane.navfac.navy.mil>, "Williams, Anthony" <williamsa@NASB.Navy.Mil>

cc:

Subject: Southern Boundary & Site 11 workplan

I have reviewed the Navy's draft response to MEDEP's comments on the draft Workplan for Addtional Investigation for the Direct Push Investigation of the Southern Boundary of the Eastern Plume and accept the responses. If I can be of futher assistance please email or call me at 207 287-7713. CBS

**RESPONSE TO COMMENTS FROM THE
U.S. ENVIRONMENTAL PROTECTION AGENCY
ON THE DRAFT WORK PLAN FOR
ADDITIONAL INVESTIGATION FOR THE SOUTHERN BOUNDARY
OF THE EASTERN PLUME AND SITE 11
NAVAL AIR STATION BRUNSWICK, MAINE**

COMMENTOR: Michael S. Barry **DATED: 30 October 2002**

Thank you for the opportunity to review the above referenced work plan which was submitted by EA Engineering, Science, and Technology on behalf of the Navy on 9 October 2002. Our comments are attached.

EPA appreciates the Navy's commitment of resources to resolving MEDEP/EPA's concerns regarding the Eastern Plume. In addition to resolving our concerns, a prime objective of EPA's is that the scope of this work is such that all parties will be confident of the results, whatever they may be. For any questions, please contact me at 617.918.1344 or barry.michael@epa.gov.

Southeastern Plume Boundary Area

1. Request boring 1 be moved 30 ft west. Previous direct push work at EP-DP-1, 2, & 15 wasn't sufficient to capture linear depressions in the clay 30-65 ft. in width. Good information has already been obtained at the location of EP-DP-2/CP-118 and offsetting boring 1 from previous CP/MIP/EC locations slightly (as in borings 2-7), would provide the opportunity to gain additional information. Request moving west rather than east since the area to the east has been more densely and extensively investigated (when geometric projection is considered).

   Response—The Navy will attempt to move this boring as requested during the field operations. However, rig access in the area specified will not be known until fieldwork is proceeding. Figure 2 has not been changed due to the relatively small change in location.

2. At the top of page 4 the plan says up to 8 groundwater samples will be collected from each direct-push boring. We assume this is a planning figure rather than an upper limit in event the actual boring footage in the field is more than 280 ft (7 borings @ assumed 40 ft/boring from 40 ft bgs to clay assumed at 80 ft, bgs).

   Response—The eight samples noted in the report are planning figures. Our plan is to collect ground-water samples at 5-ft intervals from each boring until the top of clay is reached.

3. Though a standard method, soil headspace by PID will only reliably detect VOCs above the order of several 100's to 1000's of ppb and is at best a rough method for the VOC concentrations likely (<100 ppb). PID readings have also been regarded with low confidence in the past. EPA thus fears the PID will provide no useful data to aid in well screen location. Use of a GC-ECD with prepared 40ml or larger VOA vial samples with septum should be considered as they would be much more sensitive, accurate and eliminate the need to use

tinfoil as a crude septum. These vials can be purchased prepared with a small amount of methanol, and preweighed, thus saving technicians from having to perform that on site. EPA can make the regional mobile lab available to run the approximate 280 VOC samples if this work is performed in December. Note that the lab could also run the 24-hour turnaround water samples for the Navy. We feel this is important for the best placement of the well screens as this area is not planned to be investigated again.

Response—The Navy agrees that PID use will detect VOC concentrations in the low parts per million range, and that concentrations of VOCs are likely to be below this detectable range. However, because ground water is the primary media of concern in the Southern Boundary region, the soil concentrations of VOCs are expected to be very low. If ground-water concentrations are in the low parts per billion range, soil concentrations could be below detection limits for soil. Because ground water is the primary concern, we will be collecting ground-water samples at 5-ft intervals for fixed-base laboratory analysis to delineate intervals for the permanent well screen. We believe this approach will be sufficient to provide a clear delineation of any ground-water impacts that may be present.

The Navy appreciates the offer for use of the EPA mobile laboratory. However, as noted during the 22 October Technical Meeting, the Navy's goal is to complete this work during this year. Our concern is that waiting until December may jeopardize the schedule as weather conditions may become considerably worse. In addition, EA personnel and subcontractors (driller and laboratory) have been scheduled for November, approval for working on Saturday, 16 November, has been obtained from NAS Brunswick, and EA is in the process of obtaining access to the base and the Weapons Compound for all EA and subcontractor personnel, which requires at least 1 week of advance notice to NAS Brunswick Security. Our current schedule is to complete the soil boring between 12 and 16 November 2002, and collect ground-water samples between 18 and 20 November 2002. If the EPA laboratory can be made available during this time, we can consider changing the field program accordingly.

Site 11 Bedrock Well

1. The primary goal of the geophysical work EPA is undertaking is to support locating bedrock monitoring and we will endeavor to focus upon the one most likely location for a bedrock well. However, until the geophysical results are available for the TEG to review, it would be premature for EPA to concur with a specific number of well(s) or bedrock footage as denoted in Section 1.1 (Page 1) and 3.0 (Page 13) of the work plan. We note that the Navy anticipates this possibility in Section 3.4, on the top of Page 17.

   Response—The Navy agrees that discussions with the TEG will be required to determine the location of the Site 11 bedrock well. Note that existing data do not show evidence of bedrock impact; therefore, installation of more than one bedrock well will require compelling evidence from the scheduled geophysical investigation at Site 11 to install more than one bedrock well under this Work Plan.

2. Use of a nested multi-level casing should be considered to prevent drawdown of overburden contamination into the bedrock.

Response—The currently proposed method of bedrock well installation (6-in. diameter temporary casing to top of bedrock, with a 4-in. diameter inner casing installed 3-5 ft into competent rock, and grouted in place) is believed to be sufficient to prevent water migration into the bedrock borehole from the overburden. The well installation method detailed in the Work Plan will be discussed with the driller subcontractor to ensure that final well construction will prevent overburden/bedrock flow.

3. Use of a multilevel sampler to sample discrete fracture zones rather than a single well screen over a 10-ft interval which can dilute samples should be considered.

   Response—The bedrock sampling method that has been proposed (i.e., packing off 10-ft intervals for sampling) is considered to be adequate for assessing whether bedrock ground water has been impacted by VOCs. This method is analogous to sampling from a 10-ft long monitoring well screen from multiple intervals in bedrock. Use of multi-level samplers could be problematic as unique sampling apparatus would require construction, and this method is not often used in long, open hole rock wells. This well may have an open interval of up to 60 ft; therefore, use of individual samplers would be difficult, and is not likely to provide additional information that could not be obtained from the proposed sampling method.

4. Video analysis of the borehole should be considered to provide added information on bedrock characteristics. Also, use of a heat pulse flow meter should be considered to evaluate the conductivity of any fractures, since not all are conductive.

   Response—The proposed geophysical investigation will provide additional data on fracturing and hydraulic conductivity of fractures. We believe that VOC analytical data from each 10-ft interval will be the most accurate way in determining what interval should be screened in the monitoring well.

5. EPA will make a hydrogeologist available to be onsite at the time of well installation for consultation with final well placement in addition to the evaluation of the interval to be screened as denoted in Section 3.4 on the bottom of Page 16.

   Response—The Navy appreciates this offer. We anticipate the TEG will review the geophysical data and the bedrock well logs, and will decide on the most appropriate screen interval.

6. The use of 40 ml sampling vials with septum for headspace sampling and analysis with an ECD instrument instead of a PID should be considered for the same reasons as in Comment 3.

   Response—Please see response to Comment No. 3. The Navy does not believe ECD screening for soil will provide significant insight on the location of any ground-water plume that may be present.

Barry.Michael@epamail.epa.gov

11/06/2002 12:28 PM

To: aeasterd@eaest.com, monacolj@efane.navfac.navy.mil
cc: jlough@gfnet.com, clepagegeo@aol.com, claudia.b.sait@state.me.us, larry.l.dearborn@state.me.us, williamsa@nasb.navy.mil
Subject: Navy Draft Work Plan, OCT 2002

6 November 2002

EPA accepts the Navy's response to EPA comments on the Draft Work Plan for additional investigation of the southern boundary of the Eastern Plume at NAS Brunswick.

Subsequent to and per the conference call from 1000-1100 on 6 Nov 2002, the EPA and MEDEP hydrogeologists concurred upon a requested location of approximately 30 ft east of proposed for boring number 1.

Assuming the above location is acceptable to the Navy and in concert the Navy's responses, EPA concurs with the work plan for work on the Eastern Plume southern boundary.

EPA will defer concurrence to the work plan and responses to comments regarding work at Site 11 until a later date as discussed at the conference call referenced above.

(signed via email)
Mike Barry
Remedial Project Manager
Federal Facilities Superfund

1 Congress St, Suite 1100 (HBT)
USEPA-New England 02114
617.918.1344

Appendix B

Field Forms

EA Engineering, Science, and Technology

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Turbidity (nTu)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (EF)						
Conductivity (µmhos/cm)						
eH (mV)						
Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Turbidity (nTu)						
Purge Rate (gpm)						
Volume Purged (gal)						
PH						
Temperature (EF)						
Conductivity (µmhos/cm)						
eV (mV)						

COMMENTS AND OBSERVATIONS:

EA® EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING

Project Name:	Project No:	Date:
Weather/Temperature:		
EA Personnel:	Equipment:	

Well Number	Well Elevation	Depth to Water	Depth to LNAPL	LNAPL Thickness	Corrected Water Table Elevation

NOTE: All measurements in feet.
LNAPL = Light, non-aqueous phase liquid.

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME

A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	

G. Measurable LNAPL? Yes ________ /ft No ________

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (μmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L): ____________

Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	

Sample Bottle IDs: ____________

Sample Parameters: ____________

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING (OVERFLOW PAGE)

Site Name: ____________ Project Number: ____________ Date: ____________

Well ID: ____________ Field Personnel: ____________

Parameter	6	7	8	9	10	11
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Parameter	12	13	14	15	16	17
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Comments and Observations:

EA Engineering, Science, and Technology

LOG OF SOIL BORING

Job. No.	
Client	
Location	
Drilling Method:	
Boring No.	
Sampling Method:	
Sheet of	
Drilling Start	
Drilling Finish	

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Description:

Water Lev.				
Time				
Date				
Reference				

Sample Type	Inches Drvn/In. Recvrd	Dpth. Csg.	Samp. # /samp. depth	PID (ppm) HNu	Blows per 6 in.	Depth in Feet		USCS Log	Surface Conditions:
						0			
						1			
						2			
						3			
						4			
						5			
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			SS = Split barrel sample.

Logged by: Suzanne Y. Chase Date: 4 April 1995

Drilling Contractor: Soiltesting, Inc. Driller: Ralph DeStefano

WELL SPECIFICATIONS:

Diam. of casing:	2"	Screen Interval:	10 - 4 ft	Sandpack	10 - 3 ft	Grout:	2 - 0 ft
BOH:	10 ft	Riser Interval:	4 - 0 ft	Bentonite	3 - 2 ft	Cover:	8" bolt down curb box

DAILY DRILLING REPORT

Contractor: ______________________ Date: ______________________

Drilling Equipment: ______________________ Weather: ______________________

Crew Members ______________________

Drill Time Log

Category	Total Hours	A.M.							P.M.												A.M.				
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
Mob/Demob																									
Drilling – Overburden																									
Drilling – Rock																									
Well Installation																									
Development/Testing																									
Grouting																									
Steam/Decon																									
Down Time																									
Standby																									
Other:																									

Remarks:

Consumable: Describe nature, quantity, size, etc.

Item or Service	Quantity	Notes

Borehole No.	From (ft)	To (ft)	Footage Drilled (ft)	Method, Size, etc.

Comments:

Inspector:	Consultant's Representative:
Driller:	Contractor's Representative:

EA Engineering, Science, and Technology, Inc.

LOG OF CORE BORING

Coordinates:
Surface Elevation:
Well Riser Elevation:

Job. No.	Client:	Location:
Drilling Method:		Boring No.
Core Barrel used:		Sheet 1 of 1

Packer Test

Tested		
Interval		

See packer test log if applicable

Start	Drilling Times	Finish

Core Run Run # REC / RQD	Strat-igraphy	Bedding / Fractures (dip & angle)	Filling	Depth in feet	Graphic Log	LITHOLOGIC LOG	DRILLING LOG
							Core run Length (ft) / Drill Time/ft (min:sec) / Total Depth (ft bgs)

NOTES:

Logged by:

Drilling Contractor:

Driller:

Appendix C

Standard Operating Procedure for Ground-Water Sampling by Low-Flow Purge Method

APPENDIX C

STANDARD OPERATING PROCEDURE FOR GROUND-WATER SAMPLING BY LOW-FLOW PURGE METHOD

C.1 SCOPE OF APPLICATION

The purpose of this standard operating procedure is to establish the protocol for collecting ground-water samples using the low-flow purge technique. The procedure is designed to permit the collection of ground-water samples with minimum turbidity, and is intended to be used to collect samples for extractable total petroleum hydrocarbons and inorganic compounds. This standard operating procedure was prepared based on guidance prepared by U.S. Environmental Protection Agency (U.S. EPA 1996)[1] Region 1.

C.2 EQUIPMENT/MATERIALS

- Work Plan.
- Well construction data, location map, field data from last sampling event, (if available).
- Field logbook; Field Record of Well Gauging, Purging, and Sampling forms; and Field Record of Well Gauging forms.
- Electric water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations.
- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon®.
- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene tubing will be used.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (generator, etc.).
- Water quality indicator parameter monitoring instruments—pH, turbidity, specific conductances, and temperature. Optional indicators—Eh and dissolved oxygen. Water quality indicator parameters will be measured in the field in accordance with EPA-600/

1. U.S. Environmental Protection Agency (U.S. EPA). 1996. Ground-Water Issue Low-Flow Sampling (Minimal Drawdown) Ground-Water Sampling Procedures. April.

4-79-020 using the following methods: temperature (Method 170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1).

- Flow-through cell (preferred) or clean container for water quality probes.
- Decontamination supplies.
- Disposable bailers (for sampling).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Cooler with bagged ice for sample bottles.
- Drum for purge water containment.

C.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and ground-water sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.
- Check well for damage or evidence of tampering and record pertinent observations in field logbook and sampling form.
- Lay out sheet of polyethylene for monitoring and sampling equipment.
- Unlock well and remove well cap (if applicable).
- Measure volatile organic compounds with an ionization detector (flame or photo) instrument at the rim of the well and in the breathing zone, and record the readings in the field logbook and the sampling form.
- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Sampling pumps should be positioned with the pump intake mid-point in the screened interval.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will be measured following the completion of sampling.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and to the pump.

C.4 WELL PURGING AND SAMPLING PROCEDURE

The following general procedure should be followed to obtain representative ground-water samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and depth to water. Total depth of the well will be measured following the completion of sampling.

- Connect the flow-through cell, or clean container, containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/minute, unless a different purge rate has been previously established for that well. Fill the flow cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/minute) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and ground-water samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Record purge rate, volume purged, depth to water, water quality indicator parameter values, and clock time at 3- to 5-minute intervals in field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 nephelometric turbidity unit goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water will be containerized in U.S. Department of Transportation-approved, 55-gal drums for offsite disposal.

- Prior to sampling, remove the pump from the well.

- Using a factory cleaned, new disposable bailer to collect ground water. Begin filling sample containers by allowing water to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the samples in the order below, as applicable:

  — Volatile organic compounds
  — Extractable total petroleum hydrocarbons
  — Inorganics (including metals and hexavalent chromium).

Note that the field and shipping activities must account for the short 24-hour holding time for all aqueous samples collected for hexavalent chromium analysis.

- Label each sample as collected and place into an ice cooler for delivery to the laboratory.

- After collection of the samples, lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

C.5 DECONTAMINATION

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Project Manager prior to the sampling event. Decontamination fluids will be collected in U.S. Department of Transportation-approved, 55-gal drums and staged for offsite disposal.

C.5.1 Procedure

The following decontamination procedures will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.