N62578.AR.001568
NCBC DAVISVILLE
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WORK PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03 NORTH KINGSTOWN, RI

CONTRACT NUMBER DACA31-94-D-0025
DELIVERY ORDER NO. 0181

Prepared for:

U.S. Army Corps of Engineers, New England District
696 Virginia Road
Concord, MA 01742-2751

Prepared by:

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FINAL
60957.56.0001
April 2000

WORK PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03 NORTH KINGSTOWN, RI

CONTRACT NUMBER DACA31-94-D-0025
DELIVERY ORDER NO. 0181

James A. Shultz, CPG
Project Manager

19 April 2000
Date

Brenda Herman
Program Manager

4/18/00
Date

FINAL
60957.56.0001
April 2000

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LETTER OF TRANSMITTAL

TO:
Department of the Army
USACE – New England District
696 Virginia Road
Concord, MA 01742-2751
Attn: Mr. Peter Hugh

DATE: 6 June 2000 | JOB NO. 60957.56.0001

ATTENTION: PETER HUGH

RE: REVISED FINAL pages for the FINAL WORK PLAN under Contract No. DACA31-94-D-0025, DO No. 0181

WE ARE SENDING YOU [X] Attached [ ] Under separate cover via _____ the following items:

[ ] Shop drawings [ ] Prints [ ] Plans [ ] Samples [ ] Specifications

[ ] Copy of letter [ ] Change order [ ] _____

COPIES	DATE	NO.	DESCRIPTION
4	May 2000		Revised Final pages to replace the related pages in the 24 April 2000 Work Plan for Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy Property, including: **Work Plan** – revised Chapters 3 & 4, & Tables 1a, 1b, 1c, 3-2, 3-3, & 3-4; new Attachment 5. **QAPP** – complete text and tables (some Chapters not revised, and thus, retain the April 2000 date); new Tables 7-2 & 13-1; new Attachments A-2 & A-3, the previous Attachment A-2 is now A-4. **SSHSP** – revised Sections 2 and 10; revised Tables 2-1 & 7-1.

THESE ARE TRANSMITTED as checked below:

[ ] For approval [ ] Approved as submitted [ ] Resubmit _____ copies for approval

[X] For your use [ ] Approved as noted [ ] Submit _____ copies for distribution

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[ ] For review and comment [ ] _____

[ ] **FOR BIDS DUE** _____19_____ [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS

Peter, Enclosed are 4 copies of the subject Revised Final pages to replace the related pages now in your 24 April 2000 Final Work Plan for your use and file. These revised pages reflect revisions related to comments received from USACE, EPA, and RIDEM to the Final WP version. Responses to those comments will be emailed.

Thank you,

COPY TO ____See Below_____ **SIGNED** _____

J. Mayhew – Navy NorthDiv (2 copies), W. Davis – Navy CSO (1 copy), G. Jablonski – RIDEM (2 copies), C. Williams – EPA (3 Copies), H. Cohen – RIEDC (1 copy), S. Licardi – TONK (1 copy), E. Curry – Dynamac (2 copies), S. Simons – ATSDR (1 copy), A. Heffron – AET (1 copy), J. Shultz – EA Boston (1 copy), J. Norberg – EA Boston (1 copy), Project File – Boston (1 copy), R. Pace, PMO (1 copy), B. Weissman – EA Islin (1 copy), B. Lesinski, PMO (w/o enclosure).

If enclosures are not as noted, kindly notify us at once.

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LETTER OF TRANSMITTAL

TO:
Department of the Army
USACE – New England District
696 Virginia Road
Concord, MA 01742-2751
Attn: Mr. Peter Hugh

DATE: 24 April 2000 | JOB NO. 60957.56.0001

ATTENTION: PETER HUGH

RE: FINAL WORK PLAN under
Contract No. DACA31-94-D-0025, DO No. 0181

WE ARE SENDING YOU [X] Attached [ ] Under separate cover via _____ the following items:

[ ] Shop drawings [ ] Prints [ ] Plans [ ] Samples [ ] Specifications

[ ] Copy of letter [ ] Change order [ ] _____

COPIES	DATE	NO.	DESCRIPTION
4	April 2000		Final Work Plan for Characterization of CVOC Contamination at the Nike PR-58 Site and Adjacent Navy Property

THESE ARE TRANSMITTED as checked below:

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[X] For review and comment [ ] _____

[ ] **FOR BIDS DUE** _____19_____ [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS

Peter, Enclosed are 4 copies of the subject final work plan for your use, review and comment. Please provide me your review comments on or before 16 May 2000.
The project schedule assumes receipt of concurrence and/or comments from EPA and RIDEM by 16 May 2000. Comments would need to be resolved by 19 May 2000, so the fieldwork could begin as scheduled on 23 May 2000.
Thank you,

COPY TO (See Below) **SIGNED** Jim Shultz

J. Mayhew – Navy NorthDiv (3 copies), G. Jablonski – RIDEM (2 copies), C. Williams – EPA (3 Copies), H. Cohen – RIEDC (1 copy), S. Licardi – TONK (1 copy), E. Curry – Dynamac (2 copies), S. Simons – ATSDR (1 copy), A. Heffron – AET (1 copy), J. Shultz – EA Boston (1 copy), J. Norberg – EA Boston (1 copy), Project File – Boston (1 copy), R. Pace, PMO (1 copy), B. Weissman – EA Islin (1 copy), B. Lesinski, PMO (w/o enclosure)

If enclosures are not as noted, kindly notify us at once.

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3. FIELD SAMPLING PLAN

3.1 INTRODUCTION

The Field Sampling Plan states the field program and rationale. The field procedures are presented in Chapter 4.

3.2 FIELD PROGRAM

The field program is comprised of the following 5 key elements:

1. **Seismic Refraction profiling.** Previous site investigations have shown that the configuration of the surface of competent bedrock appears to have influenced the migration of the CVOC plume. In general, seismic refraction interpretive data is available for the areas of additional characterization except for the area of the northeast plume beyond EA-112D/R. Therefore, this task shall include up to 4,000 linear ft of seismic refraction survey to aid in locating: (1) the northeast trending valley in the competent bedrock surface, and (2) the location of the two planned monitoring well clusters (EA-116 and EA-117) in that area.

   Geophysical Applications, Inc. completed the seismic refraction profiling, as planned, in October 1999. A copy of the field procedures is provided as Attachment 1. The profiling lines were oriented as referenced in Figure 2.

2. **Soil Gas Study.** This task will include performance of a soil gas survey (up to 10 points) in the area east of the former 'bermed area' and west of Seabee Avenue. The purpose is to gather possible source area information to help select the location for the new monitoring well clusters EA-114D,R, and R2. Refer to Figure 2 for the planned location of this well cluster.

   EA completed the soil gas study as planned on 7 October 1999. A copy of the field procedures is provided as Attachment 2. Nine (9) soil gas samples were collected from six (6) locations at intervals ranging between four to eight feet below grade (bg). Soil gas samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX); 1,1,2,2-PCA; PCE; TCE; 1,1,2-TCA; and 1,2-DCE onsite by means of a Varian gas chromatograph (GC) interfaced with a Varian DS 654 data station. Analytical results indicated that the analytes were not detected above the method detection limit.

3. **Drilling/Installation of Monitoring Wells.** This task includes the installation of 15 new monitoring wells for the USACE and 5 for the Navy, plus the option of up to 7 additional wells for the USACE as listed on Tables 1a, 1b, and 1c. The approximate locations of these planned wells are shown on Figure 2. Based upon the available subsurface data, the planned depths and zones to be screened are also provided in the Tables. The rationale for each location and zone is also stated in Tables 1a, 1b, and 1c. The wells will be installed in accordance with the field procedures presented in Chapter 4. After completion of well

development, a dedicated bladder pump will be installed in each well for use during ground-water sampling. The pumps shall be compatible with the pumps in the existing monitoring wells (TIMCO Manufacturing, Inc.). All rock wells will require the performance of packer tests in cored holes or geophysical borehole logging in downhole air hammer drilled holes. The general method to be used for the respective wells is noted in Tables 1a, 1b, and 1c.

Monitoring well clusters EA–114, and EA-116 and MW03-14R2 are planned to be drilled first, so the need for optional wells EA-115, EA-117, and MW03-13R2, respectively, can be assessed and planned with the BCT early in the field program.

4. **Geophysical Borehole Logging**. Geophysical logging of the open rock portions of selected boreholes, as noted on Tables 1a, 1b, and 1c will be performed by a subcontractor after completion of the drilling activity. The selected borings will be logged to aid in the assessment of bedrock fractures and areas of ground-water flow. The planned geophysical methods are caliper, single-point resistivity, fluid temperature, heat-pulse, and acoustic televiewer logging. The related field procedures will be obtained from the related firm after selection and contracting has been completed. A copy of these field procedures will be provided at that time to be incorporated into the Work Plan as Attachment 3.

5. **Sampling and Analysis**. At four (4) monitoring well locations [i.e., EA-114D, EA-115D (an 'optional well'), EA-116D, and EA-117D (an 'optional well')], two soil samples will be collected and analyzed for the Target Compound List (TCL) VOC. The soil samples collected from EA-114D will also be analyzed for semi-volatile organic compounds (SVOC) and the Target Analyte List (TAL) inorganics (Tables 3-1 and 3-2). The soil samples will be selected base upon the criteria described in Section 4.4.1.1.

   For USACE, sampling and analysis of the 15 planned new and 19 existing deep ('D') and rock ('R') wells (Table 3-1) at the NCBC Site 03 vicinity to aid in assessment of the nature and extent of the CVOC plume in shallow competent bedrock. Additionally for USACE, are the 7 optional monitoring wells which may be installed as stated in Item Number 3, above. For the Navy, sampling and analysis of the 5 new and 31 existing deep ('D') and rock ('R') wells (Table 3-1) at the NCBC Site 03 vicinity to aid in assessment of the nature and extent of the CVOC plume in shallow competent bedrock.

   Ground-water samples will be collected using the low-flow sampling technique as has been used during previous Navy investigations at this site and in accordance with Section 4.7. Prior to sampling, depth to water will be measured in these wells for use in interpreting ground-water flow direction(s). To provide data that is consistent with the large existing database, the samples will be analyzed in accordance with Test Methods for Evaluating Solid Waste, SW-846, for the parameters shown on Tables 3-2 through 3-4.

   In general, ground-water samples to be collected from the monitoring wells will be analyzed by Ceimic Corporation for TCL VOC, methane, and selected general chemistry parameters (i.e., alkalinity, chloride, nitrate, sulfate, and sulfide). Ground-water samples to be collected from the EA-114 well cluster will also be analyzed for TCL SVOC and TAL

inorganics, in addition to TCL VOC, methane, and selected general chemistry parameters. Ground-water samples to be collected from EA-104D/R/R2, EA-106D/R, EA112D/R/R2, and EA-113D/R will also be analyzed for TAL inorganics, in addition to TCL VOC, methane, and selected general chemistry parameters.

A TAL inorganics aliquot of ground water will also be collected from EA-116D/R/R2 and EA-117D/R/R2 (an 'optional well' cluster), submitted to CEIMIC Corp, but held for up to 6 months (analysis will be required only if exceedance of related RIDEM ground-water standards is detected in the samples collected from EA-112D/R/R2 and EA-113D/R).

EPA plans to collect split samples of the ground water to be collected from EA-116D/R/R2.

4. FIELD PROCEDURES

Procedures for seismic refraction profiling; soil gas study; drilling activities and monitoring well installation, development, and testing; sampling; IDW management; and decontamination of reused field equipment are presented in this chapter.

The seismic refraction profiling, soil gas sampling, and drilling activity will be performed using the following guidelines:

- Obtain USACE, NCBC Davisville, and RIEDC approval for profiling and boring locations.
- Obtain all USACE (978-318-8452), NCBC Davisville (401-294-6108), RIEDC (401-277-3134), and Digsafe (888-344-7233) clearances for profiling and boring locations.
- Mitigate potential contamination of the aquifer by the drilling equipment.

All field work described here in will also be performed in accordance with the QAPP (Appendix A) and the SSHSP (Appendix B).

4.1 SUBSURFACE UTILITY CLEARANCE

NCBC Davisville, RIEDC, and Digsafe clearance will be obtained prior to conducting any subsurface drilling activities. Location and marking of all underground utilities in the vicinity of each site will be done prior to any drilling. The drilling subcontractor will obtain required drilling permits necessary for completion of the field work. This clearance will be coordinated by the EA Project Manager.

4.2 SEISMIC REFRACTION PROFILING

The seismic refraction profiling was performed by Geophysical Applications, Inc of Foxboro, MA, in October 1999, in accordance with their standard operating procedures, a copy of which is provided as Attachment 1.

4.3 SOIL GAS STUDY

The soil gas sampling was conducted by EA, on 7 October 1999, in accordance with the field procedures provided as Attachment 2.

4.4 DRILLING AND SUBSURFACE SOIL SAMPLING

Borings will be drilled for the installation of "deep" ('D') zone (overburden and weathered bedrock) monitoring wells, "shallow competent bedrock" ('R') zone monitoring wells, and "deeper competent bedrock" ('R2') zone monitoring wells listed on Tables 1a, 1b, and 1c and shown on Figure 2.

Drilling will be performed using the hollow stem auger (HSA) or air rotary/downhole hammer method with 4- to 5-in diameter steel casing which has been steam cleaned (in accordance with the Decontamination Procedure in Section 4.11) prior to use at each boring. The following presents the various methods for the monitoring wells listed on Tables 1a, 1b, and 1c:

Hollow Stem Auger (HSA) for Overburden and Weathered Bedrock ('D') Screened Monitoring Well – 6.25 in. inner diameter (ID) HSA to the top of competent bedrock, tri-cone drill 3-ft into rock to confirm rock, then obtain a 5-ft length of HQ-core of the rock. The overburden will be sampled using a 2.5-in to 3-in inner diameter (ID) split-barrel sampler that is 18 in. or 24 in. in length. Split-barrel samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be continuous to the top of bedrock or refusal.

For EA-114D and EA-116D that will be drilled by this method, the following special field testing will be performed during the drilling of each of these borings/wells: the 3-ft interval just above competent bedrock will be slug tested, the 3-ft interval just below the top of competent bedrock will be slug tested, and the 5-ft cored interval will be packer tested.

Place a bentonite seal within the core hole to top of competent rock unit [following the special hydraulic conductivity tests in EA-114D and EA-116D (i.e., slug and packer tests)]; and then, construct a 2-in ID PVC well with 10-ft length of screen (6-to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space as the HSA is removed. The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Hollow Stem Auger (HSA) and Coring for Shallow Competent Bedrock ('R') Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' companion well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. There will be no sampling of the overburden. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the HSA is removed (allow grout to setup for 24-hours before beginning coring). HX-core (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. Perform packer testing of each of the 5 cored intervals of rock.
[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]

The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Hollow Stem Auger (HSA) and Coring for Deeper Competent Bedrock ('R2') Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' and 'R' companion wells, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5 in. ID drill casing. There will be no sampling of the overburden. Continue with wash drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed (allow grout to setup for 24-hours before beginning coring). HX-core (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. Perform packer testing of each of the 5 cored intervals of rock.

[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]

The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Air Rotary/Downhole Hammer for Shallow Competent Bedrock ('R') Monitoring Well – Because of concerns due to potential air emissions during drilling, this method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. There will be no sampling of the overburden. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the HSA is removed (allow grout to setup for 24-hours before continuing drilling). Air/downhole hammer drill 25 ft of the bedrock beyond the bottom of the 4-in steel casing.

The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Air Rotary for Deeper Competent Bedrock ('R2') Monitoring Well – This method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep and shallow bedrock wells, 6.25-in ID HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5-in ID drill casing. There will be no sampling of the overburden. Continue with air drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed (allow

grout to setup for 24-hours before continuing drilling). Air/downhole hammer drill 25 ft of the rock below the bottom of the 4-in ID steel casing.

The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Additional drilling, soil sampling, and monitoring well construction procedure details are described in the following sections.

4.4.1 Soil Boring and Sampling

Drill cuttings will be containerized and handled in accordance with the Investigative Derived Waste (IDW) procedures (Section 4.12). The area above the borehole will be monitored with a photoionization detector (PID) equipped with an 11.7 electron volt (eV) probe. The PID will be calibrated each work day before work begins, after lunch, and as required in the field. The PID calibration will be checked with the appropriate span gas at the end of the work day to ensure that the last measurements taken are acceptable. The procedures for the calibration of the PID are included in Attachment F of the SSHSP (see Appendix B of the Work Plan).

Drilling and sampling equipment including drill pipe, sampling tools, and drill casing will be freed of potentially contaminating materials by steam cleaning prior to use at each boring as stated in Section 4.11. The drill rig will be steam cleaned prior to use at the former Nike PR-58 Site and NCBC Davisville Site 03 areas and as required by the EA Geologist or Engineer. The rig will be free of leaks which could potentially contaminate the borings. No petroleum-based lubricant will be used on drill pipe joints.

Samples will be obtained in soil by driving a 2-in to 3-in ID split-barrel sampler that is 18 in. or 24 in. in length. The sampler will be driven into undisturbed soil by a 140-lb drop hammer free-falling 30 in. The number of "blows" (hammer drops) required to effect each successive 6 in. of penetration are recorded on the log. The sampler is advanced until one of the following occurs.

a. A total of 50 blows have been applied during any one of the first, second, or third 6-in increment;

b. A cumulative total of 100 blows have been applied;

c. There is no observed advance of the sampler during the application of 10 successive blows of the hammer; or

d. A 24-in sampler is advanced a total of 24 in. or, an 18 in. long sampler is advanced a total of 18 in. without the limiting blow counts, as described above, occurring.

Using the split-barrel sampler, soil samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be

continuous (i.e., back-to-back split-barrel sample collection) to the top of bedrock or refusal for each of the 'deep' ('D') zone. Soil sampling will not be preformed during the drilling of the adjacent shallow rock and deeper rock wells of a well pair or cluster.

4.4.1.1 Collection of Soil for Analysis

An aliquot (10 grams) of each soil sample collected by split-barrel sampler from EA-114D, EA-115D (an 'optional well'), EA-116D, and EA-117D (an 'optional well') will be quickly placed in the appropriate containers with a pre-measured amount (10 mL) of methanol preservative supplied by Ceimic Corp and placed on ice in a cooler for potential TCL VOC analysis. At the completion of each one of these, the PID headspace measurements will be reviewed and the 2 highest elevated (at least 3 times above background) measurements will be submitted to the laboratory for TCL VOC analysis. If there are no elevated PID headspace measurements for the soil samples from the boring, then 2 stained or discolored samples will be submitted to the laboratory for TCL VOC analysis. If there are no elevated PID headspace measurements or stained, discolored soil samples from a boring, then the samples collected from the apparent water table interval and from the interval just above competent bedrock will be submitted to the laboratory for TCL VOC analysis.

In addition, an aliquot of each soil sample collected from EA-114D will be composited in a stainless steel bowl, placed in the appropriate containers supplied by Ceimic Corp, and placed on ice in a cooler for potential TCL SVOC and TAL inorganics analyses. The two (2) soil sample intervals selected for TCL VOC analysis from EA-114D will also be analyzed for TCL SVOC and TAL inorganics.

Handling, labeling, and shipping of samples is presented in Section 4.10.

4.4.2 Water Source

Water for drilling, steam cleaning, and other necessary field activities will be arranged by the drilling contractor from the potable water system/hydrant at NCBC Davisville as coordinated with the RIEDC. The drilling contractor will be responsible for obtaining and transporting all water to the drilling areas for required uses. EA will sample the water at each source and analyze it for the same parameters specified for ground-water samples. This information and documentation of the source of the water (i.e., fire hydrant location, etc.) will be is used to evaluate the potential effect the water source may have on the analytical results for samples collected from the borings.

4.4.3 Borehole Logging

The drilling activities will be observed by an EA Geologist or Geotechnical Engineer. The Geologist or Engineer will log the subsurface conditions encountered in the boring and record the information on a soil boring log and rock core log as follows:

4.4.3.1 Soil Borehole Logging Requirements

Soil samples will be visually classified in the field using a modified Unified Soil Classification System (USCS). An example of a soil boring log is provided in Attachment 4. Soil borehole logging requirements are:

1. Logs will be prepared in the field, as borings are drilled, by an EA Geologist or Geotechnical Engineer. Each log will include the name of the preparer and the date of the logging activity, and Quality Control (QC) checked in the office by a Senior Geologist.

2. Borehole depth information will be direct measurements from land surface accurate to 0.1 ft.

3. Logs will be prepared on a Soil Boring Log Form. A copy of which is supplied in Attachment 4.

4. Relevant information in the log heading will be completed. Location sketches referenced by measured distances or prominent surface features (where present), will be shown on, or attached to the log.

5. Log scale will be as shown on the Soil Boring Log Form (Attachment 4).

6. Material type encountered will be described on the log form. Unconsolidated materials will be described as follows:

   - Descriptive modified USCS classification modified from American Society of Testing and Materials (ASTM) *Practice for Description and Identification of Soils (Visual-Manual Procedure)* ASTM D 2488-84
   - Consistency of cohesive materials or apparent density of non-cohesive materials
   - Moisture content assessment, (e.g., dry, moist, wet)
   - Color
   - Other descriptive features (e.g., bedding characteristics, organic materials, macrostructure of fine-grained soils, e.g., root holes and fractures)
   - Fill material will be described including organic and inorganic material and content (e.g., wood, plastic, glass, paper, metal)

   The number of hammer blows required to advance a split-barrel sampler shall be recorded for each 6 in. advance for each sampling attempt. The number of blows and the number of inches penetrated for an incompleted 6 in. interval shall be recorded (e.g., 75/3 in.). "WOR" or "WHO" will indicate that the sampler was advanced by the weight of the drill rods (WOR) or the weight of the drill rods and hammer without driving (WHO). For the Standard Penetration Test (and only for the Standard Penetration Test), when less than 18 in. (but greater than 12 in.) are penetrated by a total (maximum allowable) of 100 blows, the number of blows for the 6in. to 18 in. of

penetration (N) shall also be recorded (e.g., N = 63).

7. For each soil sampling attempt the type and diameter of sampler shall be indicated at the appropriate depth.

8. Depth of casing during sampling.

9. Borehole refusal—The maximum depth to which 4-in diameter casing can be advanced.

10. Borehole and sample diameters and depths at which drilling or sampling methods or equipment change.

11. Total depth of penetration and sampling. The bottom of the hole will be clearly identified on the log with the notation "Bottom of Boring."

12. Document the use of drilling fluids, including source water and additives by brand and product name.

13. Document discernable drilling fluid losses, including the estimated volume, to the geological formation or discernable gains including depths at which they occur, and estimated volume lost or gained.

14. Depth and type of temporary casing used, if any.

15. Visual/olfactory observations of contamination in samples, cuttings, or drilling fluids (e.g., staining, odors).

16. PID measurements.

4.4.3.2 Bedrock Borehole Logging Requirements

Bedrock borehole logging requirements are:

1. Logs will be prepared on a Log of Core Boring.

2. The core bit size shall be indicated on the first sheet of each Core Log Form. A copy of which is supplied in Attachment 4.

3. Information will be recorded on the log in reference to the depth scale of the log.

4. The Geologist or Geotechnical Engineer will record drilling activities in chronological sequence and with respect to the depth scale in the "Drilling Log". Equipment changes will be documented with notation of time (24 hour clock), date of occurrence and depth of the boring at the time of occurrence.

5. Start and stop time (24 hour clock) for each core run will be recorded. Interruptions in coring shall be documented by time of occurrence and description of the problem and its resolution. Coring rates and depths of significant changes in coring rate shall be recorded.

6. The intervals of nonrecovered core will be estimated and an evaluation of the reason for loss recorded.

7. Casing depth, changes in core bit size, and 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. Air/water pressure and downhole bit pressure will be recorded at approximately 15-minute intervals.

8. A description of special problems and their resolutions will be recorded on the boring log, (e.g., hole caving, recurring problems at a particular depth, plugging of the core barrel, unrecovered tools).

9. A summary description of the completion of the monitoring well will be summarized on the boring log.

10. Core runs will be numbered consecutively down the hole as performed and indicated on the log with horizontal lines at the appropriate depth and the core run number recorded in the lower left quadrant of the Core Log Form for the indicated core run.

11. Total core recovery will be measured to within 0.1 ft and recorded on the log.

12. Total core recovery as a percent of the length of the core run will be determined for each core run and recorded on the log.

13. The Rock Quality Designation (RQD) as a percent of the length of the core run will be calculated for each core run and recorded on the log. The RQD method of 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 which 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 fresh broken pieces will be fitted together and counted as one piece.

14. The angle of bedding and schistosity will be recorded as the dip angle as measured from the perpendicular to the core axis.

15. The angle of fracture, joint, fault, or seam surfaces shall be measured from the perpendicular to the core axis and graphically illustrated.

16. The dominant type of coatings or fillings present in fractures or seams will be recorded. Slickensides shall be identified as apparent dip-slip or strike-slip.

17. Standard rock symbols will be used in the graphic log to show major variations in lithology. Minor changes will be documented in the written lithologic log.

18. Rock cores will be visually described for the following parameters:

- Lithology
- Grain Size and Texture
- Color
- Bedding/Foliation/Banding
- Hardness
- Weathering
- Solution or Void Conditions
- Permeability

4.4.3.3 Handling and Storage of Rock Core

Rock cores will be placed in wooden core boxes with the top and bottom of each run clearly labeled. Core will be placed with the top at upper left and bottom at lower right of the core box. For the standard hinged core box, the hinged side is designated the upper side of the box. Any breaks that are made to fit the core into the boxes will be marked.

Wooden spacers showing the footage at the beginning of each run will be placed in the boxes. In addition, core boxes will be clearly marked on the inside and outside of top cover and each outside end to identify the job, the boring number, the numerical sequence of the box (e.g., 2 of 7), and the footage interval within the box.

When it is necessary to split cores for detailed examination, the cores will be handled carefully and put back into the box in the same position they were prior to splitting.

4.4.4 BOREHOLE BACKFILLING

If a borehole must be abandoned, bentonite chips will be placed in the borehole as the backfilling material from the bottom of the boring up to ground surface as the HSA or temporary casing is removed. Depth to the top of the bentonite backfill will be measured/monitored with a weighted tape.

4.5 MONITORING WELLS

This section presents procedures for monitoring well installation, well material specifications, well development, and permeability testing. Monitoring wells will be constructed in only the 'deep' (overburden) zone and in the bedrock borings, drilled by coring only if the bedrock is of

poor quality and the borehole is unstable (i.e., not those drilled using the downhole air hammer method).

4.5.1 Installation

4.5.1.1 Screened Interval

Refer to Section 4.4 and Tables 1a, 1b, and 1c for the screened zones of the wells to be installed. For monitoring wells to be screened in the 'deep' zone, screens for such wells will be set so the base of the screen is set at the top of competent bedrock. For monitoring wells to be screened in cored bedrock borings, only where the bedrock is of poor quality and the borehole is unstable (collapsing), the well screen will be installed so it is adjacent to the most water conducting interval, based upon the field results of the packer testing. These screened intervals will allow the collection of ground-water samples, from which the analytical results will aid in the evaluation of the ground-water quality in the deep and bedrock zones. The wells will also be used to assess ground-water flow and ground-water levels. Well construction materials are specified in Section 4.5.2.

4.5.1.2 Construction

The screen and riser pipe, as specified in Section 4.5.2.1, will be installed through the driven casing with the screen positioned as described in Tables 1a, 1b, and 1c and Section 4.4. For the deep ('D') borings/wells, the 5-ft cored rock portion of the hole will be backfilled with bentonite chips or pellets prior to placement of approximately 6 inches of filter sand, and then, the PVC well screen.

Following placement of the well screen, sand for the filter pack (specified in Section 4.5.2.2) will then be poured through the annular space between the well pipe and sides of the driven casing. If drilling mud is used to maintain borehole stability during drilling and soil sampling, the mud will be thinned to approximately water viscosity prior to placement of the filter sand. The casing will be withdrawn incrementally as the sand is placed into the annular space. The sand will be placed to approximately one to two ft above the top of the screen. A steel-weighted surveyor's tape, or similar, will be used to sound the top of the filter pack during emplacement of the sand pack.

Following placement of the sand, a bentonite seal (specified in Section 4.5.2.3) will be placed through the casing in a manner similar to the filter pack. The bentonite seal will be placed above the filter pack to prevent intrusion of the grout into the filter sand. The minimum thickness of the bentonite seal will be two ft. The bentonite seal will be allowed to hydrate a minimum of one hour before grouting begins. The quantities of sand and bentonite introduced to the well will be measured and compared to a calculated estimate of the materials required based on well/borehole dimensions.

Following placement of the bentonite seal, the casing will be withdrawn as the remainder of the annular space is sealed with a cement-bentonite grout (specified in Section 4.5.2.4). The grout will be placed in the annular space between the well casing and the boring (or steel casing) from the top of the bentonite seal to the ground surface. Grout will be placed by pumping through a

tremie pipe with the lower end of the pipe approximately three ft above the top of the bentonite seal. Pumping will continue until undiluted grout flows from the annular space at the ground surface. Should the top of the bentonite seal occur within five ft of the ground surface, the grout will be poured into the borehole annular space from the ground surface.

Following completion of the grouting operation, each well will be completed by venting the side of the riser pipe approximately 6-in from the top with a small drilled hole. A locking expandable cap and a surficial protective steel casing or box will be used to secure the well (Section 4.5.1.3).

4.5.1.3 Protection and Completion of Wells

Throughout the progress of the work, precautions will be taken to mitigate tampering with the well or entrance of foreign material into it. If rain occurs during construction of a well such that sheet flow across ground surface is probable, runoff will be prevented from entering the well during the construction by placing a temporary earthen berm around the well. The well will be further secured by placing a suitable cover over the well at the end of the day until the well construction activity resumes.

The riser pipe of each well will be completed above grade and will be surrounded by a 4-in to 6-in ID protective steel casing rising approximately 2-3 ft above ground level and set an approximately equal distance below the ground surface into the cement-bentonite grout. The casing will be installed in a manner that does not hinder access to the monitoring well for purposes of obtaining samples or water level measurements.

A minimum 2-ft by 2-ft by 4-in thick concrete pad, sloped away from the well, will be constructed around each well casing with the top outer edge at ground surface.

4.5.2 Well Construction Materials

4.5.2.1 Well Riser and Screen

Well riser pipe will consist of new 2-in ID threaded, flush-joint, Schedule 40 PVC. The pipe will bear markings that will identify the material. No organic solvents or glue will be used in joining the pipe. The use of a Teflon tape on threaded joints is acceptable on an as-needed basis, and will be noted on the well construction log.

Well screens for the shallow and deep wells will consist of new, commercially fabricated, threaded, 10-ft, flush-joint, machine slotted 6- to 10-slot, 2-in ID PVC. The 6- to 10- slot screens will be used to mitigate turbidity of the future water samples to be collected from these wells. A threaded PVC cap or plug will be placed on the bottom of the well.

Well screens and riser will be steam-cleaned prior to installation unless they arrive and are maintained on site in the factory provided packaging.

4.5.2.2 Filter Pack

The annular space around the well screen will be backfilled with a clean, washed, silica sand to perform as a filter between the formation material and the well screen in accordance with RIDEM Ground-Water Regulations. It is anticipated that grade 00 sand is an appropriate size for the 6- to 10-slot well screens. The grade/type of the filter pack which is used will be included on the well construction diagram.

4.5.2.3 Bentonite Seal

The well seal will be comprised of commercially manufactured bentonite pellets or granules, not exceeding ½ -in diameter.

4.5.2.4 Grout Mixture

The cement-bentonite grout will consist of Type I or II Portland cement (ASTM-C150) and water added in the proportion of no more than seven gal per 94-lb bag of cement. Additionally, three percent by weight of granular bentonite will be added to the mixture to help reduce shrinkage.

4.5.3 Well Numbering and Labeling

Monitoring wells will be numbered sequentially for each well or well cluster location. The following suffixes will also be included: 'D' for wells completed in the deep overburden/weather rock zone, 'R' for wells completed in the shallow competent bedrock zone, 'R2' for wells completed in the deeper competent bedrock zone (e.g. EA-114D, EA-107R, and MW03-14R2). A permanent monitoring well designation will be stenciled on each well with oil-based paint.

4.6 MONITORING WELL DEVELOPMENT and BLADDER PUMP INSTALLATION

The monitoring wells will be developed no sooner than 48 hours after grouting is completed. Development protocol will be as follows:

a. Measure static water level. Water levels will be measured using a properly decontaminated water level indicator capable of measuring liquid depth to an accuracy of 0.01 ft.

b. Measure total well depth.

c. Develop the well by alternately surging (via a clean surge block, bailer or small diameter submersible pump) and pumping to remove "fines" from the well screen and filter sand. When pumping results in discharged water that appears to be relatively clear of turbidity, the well will be surged. Continue this procedure until little or no sediment enters the well but for no less than 2 hours. The well will be pumped using a decontaminated electric submersible pump (or centrifugal pump may be used, if the depth

to water is less than 15-20 ft below grade). Temperature, pH, specific conductivity, dissolved oxygen (DO), and turbidity of the ground water will be monitored during pumping. Pumping will continue until these parameters have stabilized (less than ± 0.2 pH units variation and less than a 10 percent change for other parameters between four consecutive readings) and the water is clear and free of "fines". If the parameters have not stabilized after 3 hours of development, the EA Project Manager will be informed who will in turn notify the USACE or Navy Project Manager.

If well yield is too low to permit continuous pumping or bailing, the well will be bailed or pumped dry three times. The well will be allowed to recharge for up to 0.5 hr between each bailing or pumping session.

If water was "lost" to the geological formation during drilling operations, at a minimum, a volume equivalent to the estimated amount "lost" will be removed during development.

d. Development water investigative derived waste (IDW) management will be performed in accordance with the IDW procedures (Section 4.12).
e. Install a dedicated adjustable rate bladder pump in each well. For monitoring wells constructed with PVC pipe and slotted screen, the pump intake will be set at the approximate center of the screened interval. For monitoring wells completed as open boreholes in bedrock, the pump intake will be set adjacent to the most water conducting interval, based upon the results of the borehole geophysics.

4.6.1 Well Development Records

A Well Development Form will be prepared and completed for each monitoring well installed. A copy of this Well Development Form is provided in Attachment 4. The form will be prepared by the EA representative present during the well development operations. Information provided on the Well Development Form will include the following:

- Client, name of project and site, project number, well identification number, and date(s).
- Date, time, and elevation of the static water level and bottom of well before development.
- Determination of the gallons of water per well volume.
- Method used for development, to include: equipment; size, type, make of bailer and/or pump used during development; and decontamination procedures.
- Time spent developing the well by each method, to include the typical

pumping rate, as possible, if a pump was used in development.

- Estimated volume and physical character of water removed, to include changes in clarity, color, particulates, and odor during development.
- Volume and source of water added to the well.
- Readings of pH, DO, PID screening, specific conductance, temperature, and turbidity taken before, during and at the end of development.
- Name(s) of individual(s) developing well.
- Location of the temporary storage area for the water removed during development.

4.7 GROUND-WATER SAMPLING

The following ground-water monitoring well sampling procedures include water level measurements, well purging, field measurements, and sample collection at each well. Ground-water samples will be collected from the monitoring wells and analyzed for organic and inorganic constituents. The field sampling log, a copy of which is in Attachment 4 is used to record well purging and sampling measurements. The objective of the ground-water sampling protocol is to obtain samples that are representative of the aquifer in the well vicinity so the analytical results reflect the composition of the ground water as accurately as possible.

Wells will be allowed to stabilize at least five days after development prior to collecting samples for analysis. Rapid and significant changes can occur in ground-water samples upon exposure to sunlight, temperature, and pressure changes at ground surface. Therefore, ground-water sampling will be conducted in a manner which will minimize interaction of the sample and the surface environment. The equipment and protocol for collecting ground-water samples is as follows.

4.7.1 Purging and Sampling Equipment

Well purging will be performed and ground-water samples will be collected from monitoring wells using a dedicated adjustable rate bladder pump and where not already present, new, dedicated lengths of Teflon-lined polyethylene tubing for each well sampled, i.e. EA-112R where no bladder pump has been installed because the well is only 1½ -in diameter.
Equipment

- Dedicated adjustable rate bladder pumps
- Tubing:
  - Teflon-lined polyethylene dedicated and in each well.

- Teflon-lined polyethylene between the well cap and the flow-through-cell.
- Teflon insert fittings (where required)

- Electronic water level measurement unit with accuracy of 0.01 ft.
- Flow measurement device (containers graduated in milliliters) and stop watch.
- Water Quality meter (Grant YSI 3800 or similar) with flow-through-cell (flushed with distilled water before use at each well) for field measurement of pH, specific conductance, temperature, Eh, and DO.
- Turbidity meter.
- HACH field kits for ferrous iron detection. A copy of the SOP from the HACH DR2000 (wavelength of 510 nM will be used) is included in Attachment 5. The same SOP can be used for the HACH DR700 (wavelength of 510 nM is preset for this unit)
- PID instrument (HNU or similar) to monitor vapor concentrations during purging and sampling as required by the SSHSP.

4.7.2 Field Analytical Equipment

Field equipment to be used at the site will include a Grant YSI 3800 water quality meter, or similar, with a flow-through-cell (which includes probes for measurement of pH, Eh, dissolved oxygen (DO), temperature, and conductivity). Additional equipment will include an organic vapor analyzer with a PID, turbidity meter, and field analytical kits to measure dissolved ferrous iron concentrations. Each piece of equipment will be checked by EA to be in proper working order before its use and calibrated as required by the manufacturer. Prior to each use, field analytical equipment probe(s) will be decontaminated in accordance with Section 4.11. After each use, the instrument will be checked and stored in an area shielded from weather conditions.

Instruments will be calibrated before sampling each day, before afternoon work, and on an as-needed basis in accordance with the manufacturer's instructions. The instrument calibration will be checked at the end of the work day to make sure that the readings are within an acceptable range.

4.7.3 Ground-Water Sampling

The low flow sampling protocol will be as follows:

a. Measure Water Level

Using a properly cleaned (Section 4.11) electronic water level indicator and/or oil/water interface probe, measure and record the depth to ground water from the top of the monitoring well casing.

b. Purge Well

- Purge each well with a adjustable rate bladder pump dedicated to the well (and dedicated length of Teflon-lined polyethylene tubing also to be left in each well) until the pH, specific conductance, DO, Eh (if DO is not detected), turbidity [5 nephelometric turbidity units (NTU) goal] and temperature have stabilized [less than ± 0.1 pH units and within 10% for turbidity (above 1 NTU values) and DO, 3% for specific conductance and temperature, and ± 10 millivolts for Eh between three consecutive readings at 5 minute intervals].

- Dedicated, inplace Teflon-lined polyethylene tubing with attached bladder pump will already have been installed so that the pump intake is at the approximate middle of the screened interval of the well or within 5 feet of the well bottom, if this zone is screened. For well screens which breach the water table, the pump intake will be placed at the approximate middle of the water column in the well. To minimize sediment/silt mobilization (turbidity) from the bottom of the well, the pump intake should be kept a minimum of 2-3 feet above the bottom of the well.
- Using the Teflon insert fitting in the well cap, connect the Teflon-lined polyethylene tubing (in the well) with a new short length of Teflon-lined polyethylene tubing. Connect the other end of this short length of tubing to the cleaned flow-through-cell of the water quality meter (Grant / YSI 3800 or equivalent). A "T" fitting will be installed in the tubing prior to the flow-through cell to allow for turbidity sample collection.

- Care will be taken to keep the Teflon-lined polyethylene tubing full of water in that portion of the tubing above the top of the well during purging and sampling (i.e., to mitigate the presence of air pockets).

- Using the variable speed bladder pump, purge the monitoring well. Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Once water reaches the well cap / flow-through-cell, decrease the flow rate and check the water level. Adjust pump speed until water level drawdown stabilizes (ideally less then 0.3 feet). Continue purging until indicator field parameters stabilize. For wells with low recharge rates with screened intervals that are totally below the water table (or potentiometric surface), do not draw the water level in the well down below the top of the screened interval. Stop the pump when the water level is just above the top of the screened interval, allow time for recharge, and then resume pumping. Repeat this as necessary until the water quality parameters have stabilized as stated above. For very low yield wells, if the recharge rate of a well is lower than the extraction rate capability of the bladder pump and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples. Then notify the

EA Project Manager and record the information on the Field Sampling Form. A copy of the Field Sampling Form is provided in Attachment 4.

- Every five (5) minutes, measure and record the depth to water (below the top of the well casing), the pumping rate (in milliliters/minute), pH, turbidity, specific conductance, temperature, Eh, and DO.

- Stabilization of the water level in the well should be achieved. This is defined as no more than 0.02 ft drawdown between the 5-minute measuring intervals and/or 0.3 ft drawdown overall during the purging event. The pumping rate should be adjusted (decreased) to mitigate drawdown of the water level to within the specified target range. (Ideally at the pumping rate of 100 ml/min, there would be no drawdown of the water level). If no more than 0.3 ft of drawdown occurs, the drawdown is considered negligible and sampling can begin after achieving stabilization of the field measured water quality parameters.

- If more than 0.3 ft of drawdown occurs during the purging process, then at a minimum, the volume of water discharged to that point must again be removed from the well, e.g., if 0.5 gals of water was purged from the well prior to stabilization of the water level, then an additional 0.5 gals must be purged whether or not the field measured water quality parameters have stabilized. The final purge volume must be greater than the stabilized drawdown volume plus pump/tubing volume.

- If the stabilization of the water level or water quality parameters or the recharge rate requires more than 2 hours of purging time for the well, call the EA Project Manager for discussion and decision as to how to proceed. Purged water will be containerized in drums and labeled in accordance with Section 4.12.

c. Collect Sample

- Ground-water sampling will continue directly after completion of purging using the same pump and Teflon-lined polyethylene tubing. The short length of tubing connecting the well cap with the flow-through-cell will be disconnected from the cell and ground-water samples will then be taken. VOC samples will be collected first directly into the pre-cleaned, pre-preserved sample containers provided and designated by the laboratory. A test VOC sample container will be checked with pH paper to confirm adequate preservation (i.e. pH<2). Additional HCl will be added to the VOA vials if necessary. VOA vials will be completely filled without headspace above the liquid portion (to minimize volatilization). A check to see that the Teflon-lined silicone septum is correctly placed in the cap will be undertaken prior to tightly securing the cap. After the cap is sealed, the vials will be inverted, lightly tapped and checked for air bubbles. If air bubbles are present, they will be eliminated by adding additional sample water before the vial is resealed. The water sample aliquots for the additional analytical parameters, as listed in Table 9.1 of the QAPP (Appendix A) will then be collected in the proper containers, labeled and sent to the laboratory for analysis. Methods and QC criteria are stated in Chapter 8 of the QAPP. As each

sample is obtained, observations made will be recorded on the Field Sampling Form and the field notebook.

- Ground water will be analyzed for **ferrous iron** in the field using HACH field kits following procedures as outlined in the field kits (copy provided as Attachment 5 for the HACH DR2000 at wavelength of 510 nM or the HACH DR700 with a preset wavelength of 510 nM). **Duplicate field analysis** will be performed on 10% of the samples

- The sequence for the collection of the sample aliquots will be as follows:

  —TCL VOC;
  —TCL SVOC;
  —TAL inorganics;
  —General Chemistry Parameters (nitrate, sulfate, sulfide, manganese, chloride, alkalinity, and methane), and
  —**Ferrous iron (duplicates** of 10% of the samples will also be field analyzed).

One **trip blank** will be included per shipping cooler containing water samples to be analyzed for TCL VOC. A **temperature blank** (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp. **Field duplicate** of each ground-water sample type will be collected at the rate of 1 per every 10 samples. The field duplicate samples will be analyzed for the same parameters as the duplicated samples.

Sample container handling, chain-of-custody and shipping to Ceimic Corp will be performed in accordance with Section 4.10. Investigative derived waste management will be performed in accordance with Section 4.12

4.8 *IN-SITU* HYDRAULIC CONDUCTIVITY TESTING/LOGGING

4.8.1 Slug Testing

An *In Situ* permeability test will be performed on each of the newly installed PVC wells after development and return of the water level to static conditions. The permeability tests will be "slug out" or "rising head" tests. A known volume (slug) of water will be removed from each well using a decontaminated pre-made solid slug which should instantaneously and temporarily lower the water level in the well. Immediately, recording of the water level rise (recovery) will begin and continue using an *In Situ* ™pressure transducer and data logger, or similar equipment, until at least 90 percent (as possible) of the recovery to the static water level is achieved. Data logging will be performed in accordance with the instructions stated in the equipment operator's manual. The recorded data will be evaluated using the Bower & Rice Method (or similar) to estimate the local hydraulic conductivity (K) adjacent to the tested well screen.

4.8.2 Packer Testing

Packer tests are *in situ* tests used to estimate effective permeability of a specific zone in a bedrock borehole for each borehole in which a PVC well will be constructed.

Packer tests will be performed after the borehole development is completed and before PVC well installation. Each section of the borehole will be sealed off with pneumatic packers for testing. Water will then be pumped through each borehole section between the packers at a known pressure. The rate of flow into the formation will be measured and recorded. The permeability of the tested zone is then calculated using the data obtained from the test. The data will be recorded on the Packer Test Form, provided in Attachment 4, and in the field notebook.

4.8.2.1 Methodology

The following packer test preparation will be performed:

1. Maintain the test pressures at the pump below the Maximum Water Pressure (Pmax). This should avoid hydrofracturing and loosening of the rock mass. Pmax is determined by the following formula:

   $$Pmax = (H_1)\ (1\ psi/ft)$$

   Note: (In highly fractured rock this should not exceed 0.75 psi/ft.)

   where,

   H_1 = depth in feet from ground surface to the bottom of the upper packer

   During test operations the water pressures are observed at the gauge. The Maximum Gauge Pressure (GPmax) is calculated by the following formula:

   $$GPmax = (H_1 + H_3)\ (1\ psi/ft) - (H_1 - H_2)\ (0.43\ psi/ft)$$

   where,

   H_1 = depth in feet from ground surface to the bottom of the upper packer.

   H_2 = depth in feet from ground surface to the static water level.

   H_3 = height in feet of pressure gauge above ground surface.

2. Ensure that the packer system is not leaking.

3. Determine the Packer Inflation Pressure (PIP), by performing the following steps:

Step 1 - Establish Minimum Inflation Pressure (MIP) (i.e., the pressure required to inflate the packers in the casing so that they can no longer be pushed or pulled through the casing).

Step 2 - Establish the Static Head Pressure (Ps) in psi at the test depth by the following calculation:

$$Ps = (H_1 - H_2)\ (0.43\ psi/ft)$$

where,

H_1 and H_2 are defined as stated above in Number 1.

Step 3 - Make sure the PIP equals the MIP plus the Ps plus the GPmax of the test zone between the packers:

$$PIP = MIP + Ps + GPmax$$

If the PIP exceeds the maximum pressure rating of the packers, then the PIP will be set at the recommended maximum pressure rating given by the manufacturer.

The following methodology will be used to conduct each packer test.

1. Measure and record the depth to the static water level in the borehole prior to the installation of the packer to set a baseline against which potential water level rise indicating a leak around the packer can be observed. If such occurs, the packers will be reset and the test restarted.
2. Flush the borehole with clean water to remove and check for collapsed borehole debris.
3. Assemble and install the pneumatic packer equipment in the borehole.
4. Before starting the test, review the Packer Test Data Sheets and record the following:

   - Hole location and site
   - Date
   - Driller and inspector conducting test
   - Type, manufacturer, and model of packer system, water meter, water gauge, and surge chamber
   - Test number
   - Length of test section
   - Borehole diameter
   - Height of pressure gauge above ground surface (H_3)
   - Depths below grade to rock surface, ground water, bottom of boring, bottom of upper packer, to top of lower packer, rock type, recovered percentage, and RQD of core interval to be tested.

4a. Calculate Gpmax, MIP, PIP, Ps, Pmax.

5. Before performing the first test, bleed air out of the lines by forcing water through the packer system assembly before the packers are inflated. Inflate both packers to the required packer pressure (PIP).

6. Conduct the bedrock packer test in three steps. During the testing activity, periodically measure and record the depth to water in the tested borehole. A sudden rise in the water level or the presence of bubbles indicates leakage around the packers. This should be resolved by resetting the packers and restarting the test.

   Step 1 - ½ GPmax

   Pump water into the system and record observations of gauge pressure and water meter reading at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 2 - Full GPmax

   Pump water into system and record observations of gauge pressure and water meter reading at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 3 - Full GPmax plus 20 psi increase on the PIP. If no water is lost to formation during Step 2, Step 3 should include 2X Gpmax at the same PIP.

   Increase PIP by 20 psi. Pump water into the system and record observations of gauge pressure and water meter at 30-second intervals for at least three to five minutes after a constant rate of flow is reached. The results of Steps 2 and 3 should be similar. If they are not, Step 3 should be repeated, increasing the PIP by an additional 20 psi. This is done to check for leakage past the packers.

7. If leakage of water from the packed section into the surrounding rock is so great that the GPmax cannot be achieved, operate the pump at its full capacity with the bypass valve closed. Record the volume of water pumped into the test section and the associated pressure readings at timed intervals. This data will give a minimum value of the rock permeability.

8. Upon completion of the test, deflate the packers and move them to the next test interval.

9. Complete data sheets.

4.8.2.2 Computed Rock Mass Permeability

Compute the rock mass permeability. Data required for each calculation are as follows:

- Depth of hole at time of each test
- Depth to bottom of top packer
- Depth to top of bottom packer
- Depth to water level in borehole at frequent intervals
- Elevation of potentiometric level
- Length of test section
- Radius of hole
- Length of packer
- Height of pressure gauge above ground surface
- Height of water swivel above ground surface
- Description of material tested

The formulas used to compute the permeability from pressure test data are:

When L > 10r (length is greater then ten times the radius)

$$K = (Q/2\pi LH) \ \ln(L/r)$$

and,

When 10r > L > r (length is greater than the radius but less than ten times the radius)

$$K = (Q/2\pi LH) \ \sinh^{-1}(L/2r)$$

where,

K = permeability
Q = constant rate of flow into the hole
L = length of the test section
H = differential head on the test section
r = radius of the borehole

It should be noted that when the test is conducted above the water table, H is the distance from the water pressure gauge to the middle of the test section. When the test is conducted below the water table, H is the distance from the gauge to the static water level.

4.8.3 Geophysical Logging of Boreholes

Geophysical logging of the open rock portions of selected boreholes, as noted on Tables 1a, 1b, and 1c will be performed by a subcontractor after completion of the drilling activity. The selected borings will be logged to aid in the assessment of bedrock fractures and areas of ground-water flow. The planned geophysical methods are caliper, single-point resistivity, fluid temperature, heat-pulse, and acoustic televiewer logging. The related field procedures will be obtained from the related firm after selection and contracting has been completed. A copy of these field procedures will be provided at that time to be incorporated into the Work Plan as Attachment 4.

4.9 PROFESSIONAL LAND SURVEYING

Following the completion of the drilling and monitoring well installation program, the horizontal coordinates (with in 1.0 ft) and vertical elevations (within 0.1 ft Mean Sea Level [MSL]) for ground surface and 0.01 ft for top of well casing) will be surveyed for each new monitoring well and soil gas sample location by a Rhode Island registered surveyor

All vertical measurements will be surveyed in 1988 USGS National Geodetic Vertical Datum, and all horizontal measurements will be in Rhode Island State Plane Coordinates, using the 1983 North American Datum.

4.10 SAMPLE DESIGNATION, LABELING, HANDLING, CUSTODY, SHIPPING, AND DOCUMENTATION

4.10.1 Sample Designation and Labeling

Once the soil/sediment or ground-water sample has been collected, label the appropriate sample bottle with the appropriate sample tag and provide the following data for the chain-of-custody (COC): sample identification number, project number and name, date, time, sampler's signature, number of containers per analyte, analysis requested, and preservative(s) added.

EA will employ the following sample designation system:

I. Soil Gas Samples

Example: SG-03-4.0
>SG-03-4.0 - Soil Gas Sample from location SG-03
>First dashed number from left to right indicated the sampling interval in feet (4.0).

II. Soil Samples

Example: EA-114D-1.0-3.0
>EA-114D - Soil Sample from boring/well EA-114D
>First dash number from left to right indicated the top of the sampling interval in feet below grade (1.0).
>Second dash number from left to right indicates the bottom of the sampling interval in feet below grade (3.0).

III. Ground-Water Samples

Example: EA-114D or MW03-14D = the ground-water sample from a specific monitoring well

III. Water Source Sample

Example: WS01 = the first source water sample

IV. QC Samples

Example 1: EA-114D-1.0-3.0RB
>EA-114D - Soil Sample from boring/well EA-114D
>Second dash number from left to right indicated the top of the sampling interval in feet below grade (1.0).
>Third dash number from left to right indicates the bottom of the sampling interval in feet below grade (3.0).
>RB = equipment rinsate blank from this sample location

Example 2: GW-DUP1 or Soil DUP1
>GW or Soil – ground-water or soil sample
> DUP 1 - First duplicate. The actual boring/well number and depth interval from which the sample is collected will be recorded in the field notebook and Field Sampling Form

Example 3: PR-58 TB1 or Site 03 TB1 = the first trip blank for VOC analysis only from the former Nike PR-58 site portion or NCBC Site 03 portion of this investigation.

4.10.2 Handling, Custody, and Shipping

Seal the sample containers with custody tape (for VOC vials, seal the vials in a quart plastic bag and attach the custody seal around the bag). Complete COC document (provided by the Ceimic Corp) entries and record the sampling event in the bound field notebook.

The properly labeled and sealed containers will be placed in a plastic ziplock-type bag and sealed. The samples will be packed with wet ice which has been double bagged with heavy duty polyethylene bags or similar, prior to placement into the cooler. Samples will be packed so as to maintain a temperature of 4° C.

The COC Form will be sealed in a ziploc-type bag and taped to the inside of the cooler lid. The lid of the cooler will be sealed with a custody seal. Clear adhesive tape will be placed over the custody seal to ensure that the seal is not accidentally broken during shipment. The laboratory will be notified by phone of the sample shipment at least 24 hours before arrival and 48 hours before arrival if the arrival is to occur on a Saturday. The laboratory will be notified one week prior to the beginning of sampling. The sample containers for each matrix are listed in Tables 9-1 and 9-2 of the QAPP. Samples are to be shipped overnight to Ceimic Corp in Narragansett, RI for chemical analyses in accordance with the QAPP.

4.10.3 Sample Documentation

The documentation necessary for this investigation includes the following:

- Field Notebook

- Field Sampling Form
- Chain-Of-Custody Form

4.10.3.1 Field Notebook

The EA Project Manager will control all field notebooks. Field notebooks will be issued to the Field Team Leader. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 ½ in. x 7 in. in size. Field notebooks will be maintained by the Field Team Leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include at a minimum the following information:

- Name of author, date and time of entry, and physical/environmental conditions during field activity
- Names and titles of field crew
- Names and titles of any site visitors
- Type of sampling activity
- Location of sampling activity
- Description of sampling point(s)
- Date and time of sample collection
- Sample media (e.g., soil, sediment, ground water)
- Number and volume of sample(s) collected
- Analyses to be performed
- Field observations
- Calibration/Maintenance requirements of field equipment

Original data recorded in either the field notebooks on sample labels, or in the COC records will be written with indelible ink. None of these accountable documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information, initialing and dating the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

4.10.3.2 Chain-of-Custody Forms

A completed COC Form will accompany the samples shipped to the laboratory and will contain the following information:

- Project name and EA project number
- Name of person collecting samples
- Date and time samples were collected

- Type of sampling conducted (e.g., composite, grab)
- Sample matrix (e.g., soil, ground water)
- Parameters and method for analysis
- Location of sampling station
- Field filtration and/or preservation methods
- Number and type of containers used
- Signature of EA field personnel relinquishing sample
- Date and time of custody transfer to overnight courier
- Sample shipper (e.g., UPS, Federal Express)

The COC forms will provided by Ceimic Corp with the sample containers/coolers and will be completed by the sampling team and included with the samples.

4.10.3.3 Field Sampling Form

This document is used by the person sampling to record the physical measurements of the sample information, and also, as a reference. A copy of the form is provided in Attachment 4.

4.11 DECONTAMINATION PROCEDURES

The primary objective of the decontamination process is to prevent the accidental introduction of potential contaminants to non-contaminated areas and/or samples. This section describes the methods associated with decontamination of field equipment. The SSHSP (Appendix B) addresses personnel decontamination.

4.11.1 Decontamination Area

Decontamination will be performed in the vicinity of each boring/well and the area will contain a wash solution collection system. The collected material will be contained in U.S. Department of Transportation (DOT) approved, 17H, 55-gal drums that are suitable for storage of liquid hazardous materials. Drums will be labeled and moved to a designated staging area in the vicinity of Building 224.

Wash tubs used in the field to clean split-barrel soil samplers will be emptied into a DOT approved, 17H, 55-gal drum and labeled.

4.11.2 Decontamination Procedures

4.11.2.1 Drill Rig and Downhole Drill

Equipment (drilling tools/pipe, bits, temporary steel casing) that will be used during drilling activities will be steam cleaned prior to use and before starting each boring. Equipment will be kept off the ground on clean sawhorses, racks, or pallets. If blowing dust is a problem, equipment shall be covered with plastic sheeting during storage. Upon completion of the work, the portions of the drilling rig which came in contact with subsurface soil/drilling fluids will be steam cleaned.

4.11.2.2 Sampling Equipment

Reusable ground-water and soil sampling equipment will be cleaned prior to use in the field. Wherever possible, sampling equipment will be dedicated to a single location to minimize potential for cross-contamination. All other non-dedicated sampling equipment will be decontaminated as described below.

Stainless Steel or Teflon

This includes all split-barrel soil samplers, spoons, spatulas, trowels and bowls, and other stainless-steel or Teflon equipment that may reused for field activities:

1. Wash thoroughly (at each boring/well location) using a brush and Liquinox, or similar non-phosphate detergent, plus clean water from the designated source.

2. Rinse equipment thoroughly with distilled water.

3. Rinse with isopropyl alcohol by spray bottle and allow to air dry.

4. Flush with distilled water to remove isopropyl alcohol.

5. Air dry and store on plastic poly sheeting, or if not being used shortly, in plastic garbage bags to prevent contamination during storage and/or transport to the field.

4.12 INVESTIGATIVE DERIVED WASTE MANAGEMENT

This section addresses the procedures for handling, collection, and storage of investigative derived wastes (IDW) generated during field activities. IDW will be managed in accordance with the RIDEM *Guidelines for the Management of Investigation Derived Waste* (Policy Memo 95-01). Drill cuttings, drill mud, purging/sampling water, decontamination fluid, and other decontamination-related wastes will be containerized in DOT-approved 55-gal steel drums (17H for liquid waste, and 17E for solid wastes) or secured (locked) roll-off containers. Large volumes of well development or purge water will be temporarily stored in 200-1,000 gal polyethylene tanks adjacent to the well from which it was generated, except for wells located in residential property yards. Refer to Section 4.12.5 for an explanation of the Waste Collection Staging Area.

Because no previous analytical data exists for the proposed EA-114 well cluster, soil and ground-water samples collected from this area will be analyzed for TCL VOC and SVOC, and TAL inorganics. The results of these analyses will be used to determine the proper disposal of the drill cuttings and fluids generated from this well cluster.

4.12.1 Drill Cuttings

Refer to Section 4.12.5 for management of IDW related to residential property yards. Drill

cuttings will be containerized in DOT-approved, 17E, 55-gal drums or in secured (locked) roll-off containers, marked as IDW, labeled with the contents (drill cuttings), the soil boring designation number, and the date of collection. Cuttings from the EA-114 well cluster and from the 'deep' and 'bedrock' zones of MW03-14R2 will each be retained in containers separate from those which contain cuttings from the other monitoring wells. The drums or roll-off containers will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending soil analytical results to aid in determining the proper method of disposal.

Non-hazardous soil cuttings generated from drilling activities are planned to be transported to and disposed of at the Resource Conservation and Recovery Act (RCRA) Subtitle D facility at the Central Landfill, in Johnston, Rhode Island. Soil IDW determined to be above regulatory levels for disposal at the Central Landfill will be disposed of appropriately in accordance with state and federal regulations.

4.12.2 Development/Sampling/Purge Water

Development and sampling/purge water will be vented to the atmosphere to reduce the PID reading. Upon obtaining a headspace PID measurement less than or equal to 10 PPM the water will be spread on the ground in the immediate vicinity of the monitoring well where generated, except for water from wells located in residential property yards and water from the EA-114 well cluster. See Section 4.12.5 for handling of IDW related to residential property yards. Water obtained from the EA-114 well cluster will be retained until the soil and ground-water analytical results analyzed for TCL VOC and SVOC, and TAL inorganics are obtained from the laboratory.

Water IDW that exhibits a headspace PID measurement of greater than 10 PPM will be containerized in DOT-approved, 17H, 55-gal drums at the time of generation. The drums will be labeled with the description of the drum contents; site name; boring/well number; and date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending ground-water analytical results to aid in determining the proper method of disposal.

Ground-water IDW determined to be above regulatory levels will be disposed of appropriately in accordance with state and federal regulations.

4.12.3 Decontamination Fluids

Liquid generated as a result of decontamination activities will be collected and containerized initially in DOT-approved, 17H, 55-gal drums at the time of generation. The drums will be labeled with the description of drum contents, related boring/well numbers, and the date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending analytical results to aid in determining the proper method of disposal.

4.12.4 Other Decontamination Waste

Other wastes generated during decontamination activities, including discarded personal

protective equipment, aluminum foil, and other debris, will be collected and containerized in DOT-approved, 17E, 55-gal drums labeled with the description of drum contents, related boring/well numbers, and the date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending subsequent testing and disposal.

4.12.5 Waste Collection Staging Area

Drill cuttings, drill mud, purging/sampling water, decontamination fluid, and other decontamination-related wastes will be containerized in DOT-approved 55-gal steel drums (17H for liquid waste, and 17E for solid wastes) and/or secured (locked) roll-off containers in accordance with the RIDEM IDW policy and as described in Sections 4.12.2 through 4.12.4. The drums and/or secured (locked) roll-off containers, properly designated as IDW, will be transferred and staged by the drilling contractor for temporary storage in a secured area (i.e., series of locked gates) near the EA Field Office trailer located northeast of Building 224 and east of Sanford Road for coordination with and disposal by a licensed disposal firm.

All IDW generated off-site in the residential property yards will be containerized and transferred to the on-site staging area, regardless of detected concentrations.

Table 1a
New Wells within the Former Nike PR-58 Site and Residential (North of Perimeter Road) Area

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	MW03-14R2	37	85	48	Deep Rock	OS		R2_HSA_C		Determine vertical extent @ Former Peabody Drum Transfer Area (potential source), supplements existing shallow rock data.
2	MW03-11R	29	60	31	Shallow Rock	OS	X		R_HSA_A	Determine extent in bedrock @ southern edge (dissolved plume).
3	EA-108R	30	60	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ southwestern edge (dissolved plume). Down gradient from potential source area.
4	EA-107R	40	70	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ lower western edge (dissolved plume). Down gradient from potential source area.
5	EA-105R	30	60	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ upper western edge (dissolved plume). Down gradient from potential source area.
6	EA-114D	32	40	8	Overburden & Weathered Rock	OS		OB-WR_HSA		Determine extent in overburden @ alleged dumping point (potential source).
7	EA-114R	32	65	33	Shallow Rock	OS		R_HSA_C		Determine extent in shallow rock @ alleged dumping point (potential source).
8	EA-114R2	32	95	63	Deep Rock	OS		R2_HSA_C		Determine extent in deep rock @ alleged dumping point (potential source). **Perform EA-114R first; if no indication of contamination, make decision (USACE, EPA, RIDEM) to possibly delete this deep well.**
9	EA-104R	67	95	28	Shallow Rock	OS	X		R_ HSA_A	Determine extent in shallow rock @ northern edge (dissolved plume) within NIKE PR-58 property.
10	EA-104R2	67	125	58	Deep Rock	OS	X		R2_ HSA_A	Determine extent in deep rock @ northern edge (dissolved plume) within NIKE PR-58 property. **Perform EA-104R first; if no indication of contamination, make decision (USACE, EPA, RIDEM) to possibly delete this deep well.**
11	EA-113R	50	80	30	Shallow Rock	OS	X		R_ HSA_A	Sentinel well in residential area. Ensure the deep CVOC plume is not migrating towards drinking water wells (bedrock aquifer).
12	EA-112R2	97	155	58	Deep Rock	OP	X		R2_ HSA_A	Determine the extent in the deeper rock (dissolved plume) in residential area. The existing shallow rock results exceeded RIDEM stds.

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
13	EA-116D	97	105	8	Overburden & Weathered Rock	OP		OB-WR_HSA		Determine edge of the dissolved plume within the overburden (as it heads towards the residential developments).
14	EA-116R	97	125	28	Shallow Rock	OP	X		R_ HSA_A	Determine edge of the dissolved plume within the shallow rock (as it heads towards the residential developments).
15	EA-116R2	97	155	58	Deep Rock	OP	X		R2_ HSA_A	Determine edge of the dissolved plume within the deep rock (as it heads towards the residential developments).

Table 1b
"Optional" Wells within the Former Nike PR-58 Site and Residential (North of Perimeter Rd) Areas

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	EA-115D	24	30	6	Overburden & Weathered Rock	OS		OB-WR_HSA		Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
2	EA-115R	24	55	31	Shallow Rock	OS	X		R_HSA_A	Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
3	EA-115R2	24	85	61	Deep Rock	OS	X		R2_HSA_A	Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
4	MW03-13R2	43	100	57	Deep Rock	OS	X		R2_HSA_A	Decision to install this MW to be based on results from the monitoring well MW03-14R2.
5	EA-117D	97	105	8	Overburden & Weathered Rock	OP		OB-WR_HSA		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.
6	EA-117R	97	125	28	Shallow Rock	OP		R_HSA_C		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.
7	EA-117R2	97	155	58	Deep Rock	OP		R2_HSA_C		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.

Table 1c
New Wells within the Navy Study Area

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	MW01-10R	82	110	28	Shallow Rock	OS	X		R_HSA_A	Determine extent in shallow rock @ the central/eastern edge of the main dissolved plume. Obtain insight to why the plume separates into two lobes.
2	MW01-15R	51	80	29	Shallow Rock	OS	X		R_HSA_A	Determine extent of the dissolved plume in shallow rock @ the northeastern edge of the southern lobe.
3	MW02-03R	42	70	28	Shallow Rock	OS	X		R_HSA_A	Determine extent of the dissolved plume in shallow rock @ the southeastern edge of the southern lobe.
4	MW03-03R	59	90	31	Shallow Rock	OS	X		R_HSA_A	Determine extent of the dissolved plume in shallow rock @ a location in the center of the deep CVOC plume.
5	MW01-13R	75	105	30	Shallow Rock	OS	X		R_HSA_A	Sentinel well in shallow rock.

NOTES:

SUMMARY OF THE DRILLING / MONITORING WELL COMPLETION METHODS TO BE USED

OB-WR_HSA = **Hollow Stem Auger (HSA) for Overburden and Weathered Bedrock ('D') Screened Monitoring Well** – 6.25 in. inner diameter (ID) HSA to the top of competent bedrock, tri-cone drill 3-ft into rock to confirm rock, then obtain a 5-ft length of HQ-core of the rock. The overburden will be sampled using a 2.5-in to 3-in inner diameter (ID) split-barrel sampler that is 18 in. or 24 in. in length. Split-barrel samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be continuous to the top of bedrock or refusal.

For EA-114D and EA-116D that will be drilled by this method, **the following special field testing will be performed during the drilling** of each of these borings/wells: the 3-ft interval just above competent bedrock will be **slug tested**, the 3-ft interval just below the top of competent bedrock will be **slug tested**, and the 5-ft cored interval will be **packer tested**.

Place a bentonite seal within the core hole to top of competent rock unit [following the special hydraulic conductivity tests in EA-114D and EA-116D (i.e., slug and packer tests)]; and then, construct a 2-in ID PVC well with 10-ft length of screen (6-to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space as the HSA is removed. The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R_HSA_C = **Hollow Stem Auger (HSA) and Coring for Shallow Competent Bedrock ('R') Screened Monitoring Well** – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' companion well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. **There will be no sampling of the overburden.** Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the HSA is removed **(allow grout to setup for 24-hours before beginning coring). HX-core** (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. **Perform packer testing of each** of the 5 cored intervals of rock.
[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]
The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R2_HSA_C = **Hollow Stem Auger (HSA) and Coring for Deeper Competent Bedrock ('R2') Screened Monitoring Well** – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' and 'R' companion wells, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5 in. ID drill casing. **There will be no sampling of the overburden.** Continue with wash drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed **(allow grout to setup for 24-hours before beginning coring). HX-core** (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. **Perform packer testing of each** of the 5 cored intervals of rock.
[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]
The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R_HSA_A = Air Rotary/Downhole Hammer for Shallow Competent Bedrock ('R') Monitoring Well – Because of concerns due to potential air emissions during drilling, this method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. **There will be no sampling of the overburden.** Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the HSA is removed **(allow grout to setup for 24-hours before continuing drilling).** Air/downhole hammer drill 25 ft of the bedrock beyond the bottom of the 4-in steel casing.
The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, **i.e. no PVC well will be constructed.**

R2_HSA_A = Air Rotary for Deeper Competent Bedrock ('R2') Monitoring Well – This method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep and shallow bedrock wells, 6.25-in ID HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5-in ID drill casing. **There will be no sampling of the overburden.** Continue with air drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed **(allow grout to setup for 24-hours before continuing drilling).** Air/downhole hammer drill 25 ft of the rock below the bottom of the 4-in ID steel casing.
The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Table 3-2 Sampling and Analytical Program for the USACE Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (15 new wells + 19 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	34	4		8 & 2/2	50
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	34	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	34	4		-- & 2/2	42
In addition to all of the above parameters ground-water samples from EA-104D/R/R2, EA-106D/R, EA-112D/R/R2, and EA-113D/R will also be analyzed for the following:	TAL Inorganics – (Cold Vapor Atomic Absorption (detection limit, < 0.08 ug/L) SW846 7470A (Mercury Only)	10	1		-- & 1/1	13
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3010A/6010B	10	1		-- & 1/1	13

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
In addition to all of the above parameters ground-water samples from EA-114D/R/R2 will also be analyzed for the following:	TCL Semi-Volatile Organics –GC/MS (detection limit, see QAPP) SW-3520C/8270C	3	1		-- & 1/1	6
Soil Samples (EA-114D and EA-116D)	TCL Volatile Organics – (GC/MS (detection limit, ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12
In addition the above parameters soil samples from EA-114D will also be analyzed for the following:	TCL Semi-Volatile Organics –(GC/MS (detection limit, see QAPP) SW-3540C/8270C	2	1	1	-- & 1/1	6
	TAL Inorganics –(Cold Vapor Atomic Absorption (detection limit, < 0.08 mg/kg) SW846 7471A (Mercury Only)	2	1	1	-- & 1/1	6
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3050A/6010B	2	1	1	-- & 1/1	6

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the QA analysis (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 3-3 Sampling and Analytical Program for the USACE Optional Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (up to 7 new wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	7	1		2 & 1/1	12
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	7	1 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	7	1		-- & 1/1	10
Soil Samples (EA-115D and EA-117D)	TCL Volatile Organics – (GC/MS detection limit ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the QA analysis (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 3-4 Sampling and Analytical Program for the Navy Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (5 new wells + 30 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	35	4		9 & 2/2	51
	Field Measured Parameters • Dissolved Oxygen • Turbidity • pH • Eh • Conductivity • Temperature • Ferrous Iron	35	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	35	4		-- & 2/2	43

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

For the Navy portion of this investigation, there will be no samples collected and shipped for QA lab analysis.

ATTACHMENT 5

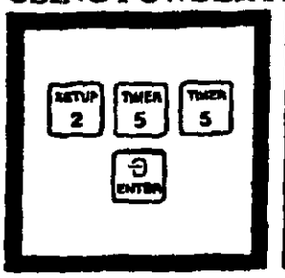
FIELD PROCEDURES FOR FERROUS IRON MEASUREMENT

IRON, FERROUS (0 to 3.00 mg/L)

For water, wastewater, and seawater

1,10 Phenanthroline Method* (Powder Pillows or AccuVac Ampuls)

USING POWDER PILLOWS



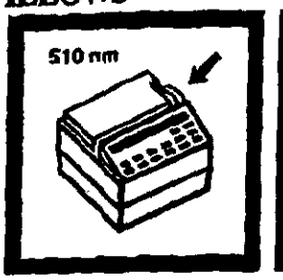
1. Enter the stored program number for ferrous iron, (Fe^{2+})-powder pillows.

Press: **2 5 5 ENTER**

The display will show:

Dial nm to 510

Note: The Pour-Thru Cell can be used with this procedure.



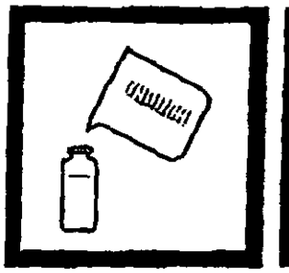
2. Rotate the wavelength dial until the small display shows:

510 nm

When the correct wavelength is dialed in, the display will quickly show:

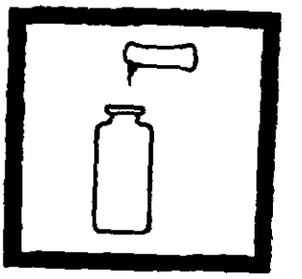
Zero Sample

then: **mg/L Fe^{2+}**



3. Fill a sample cell with 25 mL of sample.

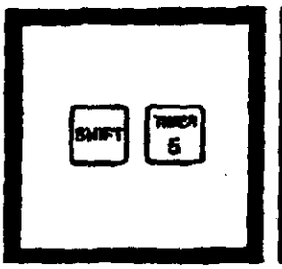
Note: Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric, which is not determined.



4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Swirl to mix.

Note: An orange color will form if ferrous iron is present.

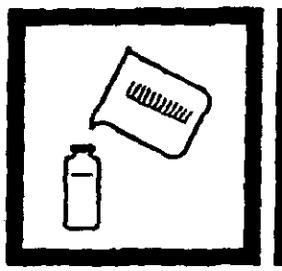
Note: Undissolved powder does not affect accuracy.



5. Press:

SHIFT TIMER

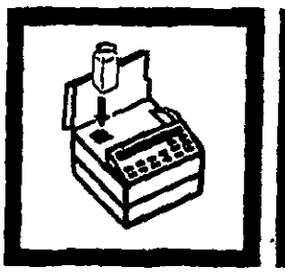
A three-minute reaction period will begin.



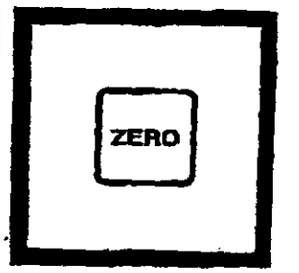
6. When the timer beeps, the display will show:

mg/L Fe^{2+}

Fill a second sample cell with 25 mL of sample (the blank).



7. Place the blank into the cell holder. Close the light shield.



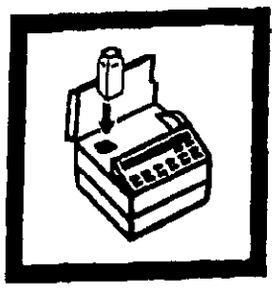
8. Press: **ZERO**

The display will show

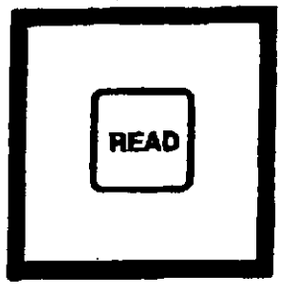
Zeroing...

then: **0.00 mg/L Fe^{2+}**

* Adapted from *Standard Methods for the Examination of Water and Wastewater.*



9. Place the prepared sample into the cell holder. Close the light shield.



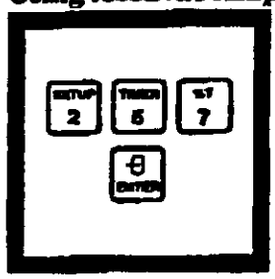
10. Press: **READ**

The display will show:

Reading. . .

then the result in mg/L Fe^{2+} will be displayed.

Using Accuvac Ampuls



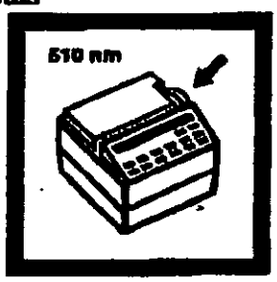
1. Enter the stored program number for ferrous iron (Fe^{2+})-AccuVac ampuls.

Press: **2 5 7 ENTER**

The display will show:

Dial nm to 510

Note: Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric, which is not determined.



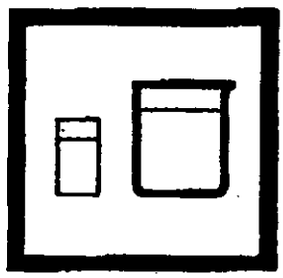
2. Rotate the wavelength dial until the small display shows:

510 nm

When the correct wavelength is dialed in, the display will quickly show:

Zero Sample

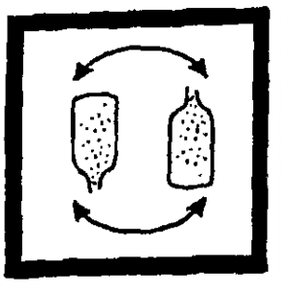
then: **mg/L Fe^{2+} AV**



3. Fill a zeroing vial with at least 10 mL of sample (the blank). Collect at least 40 mL of sample in a 50-mL beaker.

4. Fill a Ferrous Iron AccuVac Ampul with sample.

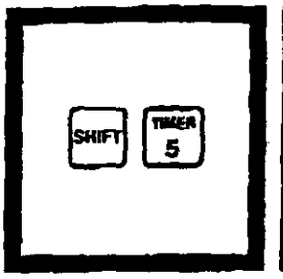
Note: Keep the tip immersed while the ampul fills completely.



5. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: An orange color will form if ferrous iron is present.

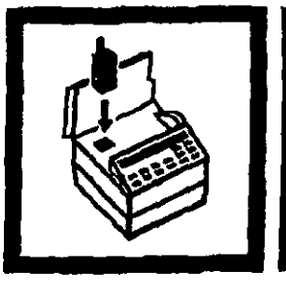
Note: Undissolved powder does not affect accuracy.



6. Press:

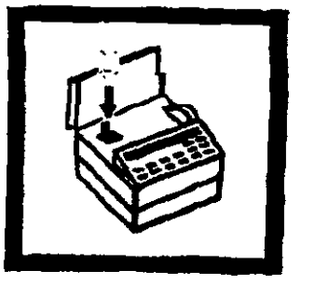
SHIFT TIMER

A three-minute reaction period will begin.



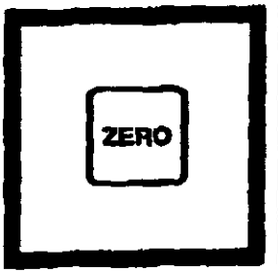
7. Place the AccuVac Vial Adapter into the cell holder.

Note: Place the grip tab at the rear of the cell holder.



8. When the timer beeps, the display will show: **mg/L Fe^{2+} AV**

Place the blank into the cell holder. Close the light shield.

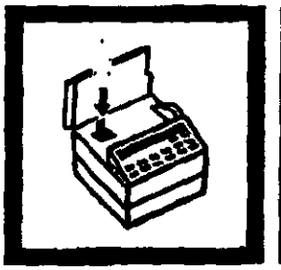


9. Press: **ZERO**

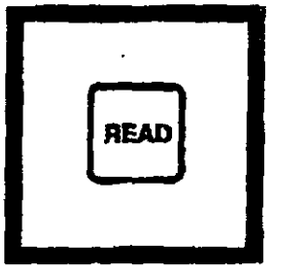
The display will show:

Zeroing. . .

then: **0.00 mg/L Fe^{2+} AV**



10. Place the AccuVac ampul into the cell holder. Close the light shield.



11. Press: **READ**

The display will show:

Reading. . .

then the result in mg/L Fe^{2+} will be displayed.

Accuracy Check

Standard Solution Method

Prepare a ferrous iron stock solution (100 mg/L Fe^{2+}) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate, in deionized water. Dilute to 1 liter. Prepare immediately before use. Dilute 1.00 mL of this solution to 100 mL with deionized water to make a 1.00 mg/L standard solution. Prepare immediately before use.

Run the test using the 1.00 mg/L Fe^{2+} Standard Solution by following either the powder pillow or AccuVac procedure. Results should be between 0.90 mg/L and 1.10 mg/L Fe^{2+}.

Precision

In a single laboratory using an iron standard solution of 1.000 mg/L Fe^{2+} and two representative lots of powder pillow reagents with the DR/2010, a single operator obtained a standard deviation of ±0.006 mg/L Fe^{2+}.
In a single laboratory using a standard solution of 1.000 mg/L Fe^{2+} and two representative lots of AccuVac ampuls with the DR/2010, a single operator obtained a standard deviation of ±0.009 mg/L Fe^{2+}.

Summary of Method

The 1,10-phenanthroline indicator in Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

REQUIRED REAGENTS (USING POWDER PILLOWS)

Description	Quantity Required Per Test	Units	Cat. No.
Ferrous Iron Reagent Powder Pillows	1 pillow	100/pkg	1037-69

REQUIRED REAGENTS (USING ACCUVAC AMPULS)

Ferrous Iron Reagent AccuVac Ampuls	1 ampul	25/pkg	25140-25

REQUIRED APPARATUS (USING POWDER PILLOWS)

Sample Cell, 25 mL, matched pair		pair	20950-00

REQUIRED APPARATUS (USING ACCUVAC AMPULS)

Adapter, AccuVac Vial	1	each	43784-00
Beaker, 50 mL	1	each	500-41
Vial, Zeroing		each	21228-00

OPTIONAL REAGENTS

Ferrous Ammonium Sulfate, hexahydrate, ACS		113g	11256-14
Water, deionized		4 L	272-56

OPTIONAL APPARATUS

AccuVac Snapper Kit		each	24052-00
Flask, volumetric, 100 mL, Class B		each	547-42
Flask, volumetric, 1000 mL, Class B		each	547-53
Pipet, volumetric, Class A, 1.00 mL		each	14515-35
Pipet Filler, safety bulb		each	14651-00
Pour-Thru Cell Assembly Kit		each	45215-00

For technical support and ordering information, see Section V.

In the U.S.A. call 800-227-4224 to place an order. Outside the U.S.A.—Contact the Hach office or distributor serving you.
Outside the U.S.A.—Contact the Hach office or distributor serving you.

QAPP

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INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared for the U. S. Army Corps of Engineers – New England District (USACE) to present the investigative plan and field procedures for the joint USACE-Navy chlorinated volatile organic compound (CVOC) investigation ("Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy Property") under Contract No. DACA31-94-D-0025, Delivery Order No. 0181. As agreed upon by USACE and the Navy, for efficiency and because of the concurrent nature of the joint investigation activities, both the USACE and Navy portions of the joint investigation are included in this Work Plan prepared for USACE with input for the Navy portions. The investigation of the former Nike PR-58 Site will be preformed under the Defense Environmental Restoration Program-Formally Used Defense Sites (DERP-FUDS) Program. The Navy portion of the joint investigation is being performed under the Base Realignment and Closure Act (BRAC) Contract No. N62472-92-D-1296, Contract Task Order (CTO) 0096.

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency overseeing activities within the Navy property (BRAC funded). The Rhode Island Department of Environmental Management (RIDEM) is the lead regulatory agency overseeing the activities within the Nike area (DERP-FUDS funded).

The former Nike PR-58 missile launch site (deactivated in 1962) is located in the Town of North Kingstown, Rhode Island (Figures 1 and 2). A description and history of the site is summarized in Chapter 2 of the Work Plan. The Navy's investigations at the former Naval Construction Battalion Center (NCBC) Davisville, Rhode Island (Figures 1 and 2) identified dissolved Chlorinated Volatile Organic Compounds (CVOC) in the deep ground water. Based upon the findings presented in the Navy's "Nike Source Area and Offsite Investigation" Final Interim Report dated October 1998, the main source area for the CVOC plume detected in deep zone ground-water samples was in the vicinity of monitoring well MW03-14D located just east of the former PR-58 Nike Site and west, up-gradient of Navy property. Based upon these findings and the comments from the EPA-Region 1 and RIDEM, additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the deep and bedrock ground-water zones, particularly the northeast extension of the plume offsite (north of Perimeter Road) beneath a residential area.

The Work Plan (of which the QAPP is Appendix A) describes the field and laboratory activities that will be used. The QAPP has been prepared for use by EA to ensure that data collected are scientifically valid and legally defensible, and to establish the field and analytical protocols and documentation requirements that will ensure the data collected meet the quality objectives of the site investigation.

This QAPP presents the policies, organizations, functions, and quality assurance/quality control (QA/QC) requirements designed to achieve the data quality goals established in the Work Plan. It further presents the criteria and procedures that will be followed during implementation of all activities specified in the Work Plan.

The following provides a brief summary of the work to be performed for USACE and the Navy.

For the USACE:

- Installation, development, and testing of 15 monitoring wells. Two of the wells will be screened in the deep overburden ground-water zone, 8 of the wells will be screened in the shallow competent bedrock ground-water zone, and 5 of the wells will be screened in the deeper competent bedrock ground-water zone.
- Sampling and analyzing of ground water from the 15 new wells, plus 19 existing deep ('D') and rock ('R') wells at the site.
- Performance of data validation of the ground-water analytical results.
- Performance of data management and provide electronic and Geographic Information Systems (GIS) deliverables.
- Preparation of a report documenting the USACE and Navy field investigation results, conclusions, and recommendations.
- Assess, identify, and recommend remedial action alternatives. An elaborate detailed level of effort is not the intent of this assessment. If required at a future date, a Phase III level Feasibility Study (Detailed Assessment of Remedial Alternatives) will be incorporated as a modification to this task order.

For the Navy:

- Installation, development, and testing of 5 monitoring wells screened in shallow competent bedrock ground-water zone.
- Sampling and analyzing of ground water from the 5 new wells, plus 31 existing deep ('D') and rock ('R') wells in the NCBC Site 03 vicinity.
- Performance of data validation of the ground-water analytical results.
- Performance of data management and provide electronic and GIS deliverables.
- Preparation and incorporation of the related Navy field investigation results, conclusions, and recommendations in the USACE report of the joint Navy/USACE investigations.

3. DISTRIBUTION LIST

The following is the list of organization and agency representatives to whom the Work Plan, including this QAPP, will be distributed. The QAPP is a dynamic document and should be revised or updated to reflect changes in organization and procedures needed to meet the Quality Objectives identified in the Work Plan. Whenever revisions are made or addenda added to the QAPP, those listed below will receive the revisions/addenda. This distribution system does not preclude making and using copies of the QAPP. However, those listed below are responsible for distributing the Work Plan and QAPP, and any additional material to update any copies within their organizations.

EA Engineering, Science, and Technology (EA)
James Shultz, EA Project Manager
USACE, New England District
Peter Hugh, USACE Remedial Project Manager
Navy-Northern Division
John Mayhew, Navy Remedial Project Manager
U.S. Environmental Protection Agency, Region I (EPA)
Christine Williams
Rhode Island Department of Environmental Management (RIDEM)
Gary Jablonski
U.S. Fish & Wildlife (USF&W)
TBD
Town of North Kingstown (ToNK)
Richard Kerbel
Rhode Island Economic Development Corporation (RIEDC)
Howard Cohen
Dynamac Corporation
Eileen Curry

4. PROJECT ORGANIZATION

4.1 Project Organization Chart

The project organization is shown on Figure 3.

4.2 Communications Pathways

All official communication shall be through the EA Project Manager, the USACE Remedial Project Manager, and the Navy Remedial Project Manager. All other communication shall be considered shadow communication and shall be non-binding and not official.

4.3 Project Roles and Responsibilities

The individuals directly involved with this joint USACE and Navy project and their specific responsibilities are outlined below.

Peter Hugh, USACE Remedial Project Manager: Overall coordination and decision-maker for the USACE portion of the project. Coordinates all activities within the USACE New England District for the PR-58 Nike Site and the off-site residential (i.e., north of Perimeter Road) portions of the investigation. Coordinates and resolves issues with regulatory case managers.

John Mayhew, Navy Remedial Project Manager: Coordination and decision-maker for the Navy portion of the project. Coordinates all activities within the Navy Northern Division for the NCBC Davisville site 03 portion of the investigation. Coordinates and resolves issues with regulatory case managers. Navy member of the Base Closure Team (BCT).

Christine Williams, EPA Region 1, Remedial Project Manager: EPA Region I decision-maker and oversight of Navy investigation and remediation. Coordinates all activities within EPA for this site. EPA member of the BCT.

Gary Jablonski, RIDEM, Remedial Project Manager: RIDEM decision-maker and oversight of USACE investigation and remediation. Coordinates all activities within RIDEM for this site. RIDEM member of the BCT.

James Shultz, EA Project Manager: Overall coordination and preparation of the site investigation. Includes coordination and scheduling of lab analysis, data review, and validation, and overall coordination of field work. Delivers investigation report to the USACE and regulatory case managers.

USF&W (TBD): Reviews the site investigation in relation to specific trustee responsibilities.

Howard Cohen (RIEDC) and Richard Kerbel (ToNK). Reviews the site investigation in consideration of future use of the site.

4.3.1 Ceimic Corporation

The objective of the QAPP is to provide analytical data that are technically valid and legally defensible, and that meet the user's needs. Accordingly, the management of the selected EPA Certified Laboratory Program (CLP) laboratory, Ceimic Corporation, encourages excellence in analytical testing and provides the necessary resources and environment. A copy of Ceimic's Laboratory Quality Assurance Plan is included as Attachment 1 of this QAPP and identifies the policies, organization, objectives, functional activities, and specific activities designed to achieve the desired quality goals set forth by the laboratory for this project.

All analytical support will be provided by Ceimic Corporation, which is located at 10 Dean Knauss Drive, Narragansett, RI 02882. Neil Pothier is the CEIMIC point of contact with the EA Project Manager. In the event that any analyses must be subcontracted for any reason, it will be done only with the approval of the EA Project Manager.

4.4 Special Training Requirements/Certification

No special training requirements or certifications are required for this project except for the 40-hour HAZWOPER class and annual refreshers.

5. PROJECT PLANNING AND PROJECT DEFINITION

5.1 Project Planning Meetings

Project planning meetings began upon submittal of the draft Work Plan and QAPP. Project meetings will be as requested by either the EA Project Manager, USACE Remedial Project Manager, or Navy Remedial Project Manager .

5.2 Site History, Background, and Problem Definition

The former Nike PR-58 missile launch site (deactivated in 1962) is located in the Town of North Kingstown, Rhode Island (Figures 1 and 2). A description and history of the site is summarized in Chapter 2 of the Work Plan.

The Navy's investigations at the former Naval Construction Battalion Center (NCBC) Davisville, Rhode Island (Figures 1 and 2) identified dissolved CVOC, the contaminants of concern, in the deep ground water. Based upon the findings presented in the Navy's "Nike Source Area and Offsite Investigation" Final Interim Report dated October 1998, the main source area for the CVOC plume detected in deep zone ground-water samples was in the vicinity of monitoring well MW03-14D located just east of the former PR-58 Nike Site and west, up-gradient of Navy property. Based upon these findings and the comments from the EPA-Region 1 and RIDEM, additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the deep and bedrock ground-water zones, particularly the northeast extension of the plume offsite (north of Perimeter Road) beneath a residential area.

The project action levels for ground water are the RIDEM Class GA standards (north of Perimeter Road) and GB standards (south of Perimeter Road) for further assessment of the CVOC plume that has migrated offsite north of Perimeter Road where ground water can and has been used for residential water supply. These standards (project action limits) have been included in Section 12 along with the laboratory's analytical methods and reporting limits. The analytical results of the few soil samples are for comparison to the results of ground-water samples from the related borings/wells and to add to the understanding of nature and extent of the analytes. This project does not include a risk assessment and so project action levels for soil have not been established.

6. PROJECT DESCRIPTION AND SCHEDULE

6.1 Project Overview

The data will be used to address the following:

General objectives of the additional characterization within the NIKE and northern residential areas for USACE are to:

- Further assess the nature and extent (lateral and vertical) of the potential primary CVOC source area in the competent bedrock in the vicinity of MW03-14.
- Assess the nature and extent (lateral and vertical) of the potential second CVOC source area in the sand and gravel/weather rock and competent bedrock zones at the end of a 20-25 ft dirt road just east of former Building (silo) 349 where monitoring well cluster EA-114 is planned to be located (Figure 2). This area was alleged by recent information from RIDEM to have been an area of historical disposal of solvents and acids.
- Assess the nature and extent of the CVOC plume with specific focus on the northeast edge that extends off the former Nike Site and Navy properties (impacting the GA-classified aquifer).
- Further assess natural attenuation (develop isopleth plots).
- Assess remedial alternatives in a focused manner.

General objectives of the additional characterization within the Navy property for the Navy are to:

- Document the direction of ground-water flow.
- Assess the nature and extent in the competent bedrock of the CVOC plume that has extended east beneath the Navy property from the former PR-58 NIKE Site area.
- Further assess natural attenuation within the Navy property.

6.2 Project Schedule

Assuming concurrence of the BCT with the Work Plan, the following schedule is planned:

• Begin Field Work	31 May 2000
• Complete Field Work	24 August 2000
• Lab Results due to EA	21 September 2000
• Data Validation Completed	19 October 2000
• Draft Investigation Report Due to BCT	30 November 2000
• Draft Report Comments Due from BCT	15 January 2000
• Final Investigation Report Submittal	12 February 2000

7. PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA

7.1 Project Quality Objectives

The project data quality objective is to provide valid data of known and documented quality. The data quality indicators to be measured are described below.

Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control sample (LCS) is used to determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference between the duplicate sample results.

Precision is to be expressed as relative percent difference and calculated using the equations in Table 7-1. Project-specific precision criteria are included in Table 7-2

Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy is to be expressed as percent recovery and calculated using the equation in Table 7-1. Project-specific accuracy criteria are included in Table 7-2.

Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations.

The Chapter 4 of the Work Plan contains the sampling and field handling protocols (e.g., storage, handling and shipping) designed to ensure that the collected samples are representative of the media. Proper field documentation is to be used to show that the designated protocols have been followed, and that sample identification and integrity have been maintained during the sampling event.

Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

With regard to field and laboratory analyses and measurements, similar methods with similar reporting limits will be used to the extent possible to ensure comparability of data collected during the planned field work and the future work at the Site. Acceptance criteria will be provided for QC samples such as field duplicates, LCS, and Matrix Spike/Matrix Spike Duplicates in the final Work Plan.

Completeness

Completeness is calculated using the equation in Table 7-1 for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified as unusable. The goal for completeness is 100 percent. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

7.2 Measurement Performance Criteria

The lateral and vertical extent of the ground-water contamination shall be defined as those locations that exceed RIDEM Remediation Regulations (August 1996) for the USACE portion and CERCLA for the Navy portion.

The vertical extent of this investigation shall be from ground surface down to the deep (R2) bedrock ground-water zone.

Analytical results will be needed from at least 50% of the analyzed soil samples collected from EA-114D. Ground-water sample analytical results will be needed from at least 80% of the total number of monitoring well sampled, but from 100% of the sampled monitoring wells located north of Perimeter Road. Ground-water surface elevation data will be needed from at least 80% of the total number of monitoring wells measured, but from 100% of the monitoring wells measured north of Perimeter Road.

8. SAMPLING PROCESS DESIGN

8.1 Sampling Design Rationale

For this project, the sampling design and rationale and planned sampling locations are provided in Chapter 3 of the Work Plan. A summary of the sampling and the analytical program for this joint investigation is provided in Tables 8-1 through 8-3.

8.2 Quality Assurance Samples

As required by USACE, 10% percent of the soil and water samples collected for USACE portion of this investigation will be collected as replicate samples and sent to the following independent government testing laboratory (quality assurance [QA] laboratory) selected by USACE-NED. No QA samples will be collected for the Navy portion of this investigation.

Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

The directions for shipping of the samples to STL is included in Attachment A-3 ("Instruction for Shipment of Quality Assurance Samples").

The "QA Sample Summary" (Attachment A-3) shows the number of QA samples that are planned to be collected for the project. These samples will be preferentially selected from locations that are suspected of containing detectable levels of CVOC. The analytical program for these QA samples will be the same as that stated in Section 8.1 of this QAPP for the related sample that is submitted to Ceimic. The process for collection, handling, custody, and shipment of QA samples will be the same as those stated in Chapters 9 and 10 of this QAPP.

- QA samples for methane need not and will not be collected.
- The specific location for the soil sample will be the deeper of the 2 samples selected from EA-116D.
- The specific USACE ground-water samples to be collected in replicate for the analysis by the QA laboratory will be selected after the new monitoring wells have been installed.

9. SAMPLING PROCEDURES AND REQUIREMENTS

Sampling, decontamination, equipment calibration and maintenance procedures are provided in Chapter 4 of the Work Plan. Sample container, volume, preservation, and holding time requirements are provide in Table 9-1 for aqueous samples and Table 9-2 for soil samples.

10. SAMPLE HANDLING, TRACKING, AND CUSTODY REQUIREMENTS

Sample labeling, handling, tracking, and custody requirements are provided in Section 4.10 of the Work Plan, along with the field notes and documentation requirements.

11. FIELD ANALYTICAL METHODS REQUIREMENTS

The field analyses planned for this work include the use of a water quality unit (for pH, Eh, DO, temperature, conductivity, and salinity) and turbidity meter for measurements during well purging and sampling activities and a HACH field kit for the measurement of ferrous iron as stated in Chapter 4 of the Work Plan. The procedures stated in the manual with each piece of field analytical equipment will be followed.

Instruments will be calibrated before sampling each day and on an as-needed basis in accordance with the manufacturer's instructions. The instrument calibration will be verified after lunch and the end of each sampling day.

Each piece of equipment will be checked by EA to be in proper working order before its use and calibrated as required by the manufacturer. Prior to each use, field analytical equipment probe(s) will be decontaminated in accordance with Section 4.11 of the Work Plan. After each use, the instrument will be checked and stored in an area shielded from weather conditions.

12. FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

The water and soil samples will be analyzed by the selected CLP laboratory (i.e., Ceimic Corporation) using the analytical methods and project-specific reporting limits shown for aqueous and soil samples in Tables 12-1 and 12-2, respectively. The analytical method requirements, instrumentation, calibration, maintenance, and reporting from Ceimic Corporation have been provided in their Laboratory QA Plan, a copy of which is provided as Attachment A-1.

The project-specific analytical methods and reporting limits shown for aqueous and soil samples in Tables 12-1 and 12-2, respectively, and supercede related information in the general Laboratory QA Plan (Attachment A-1). Ceimic's analytical SOPs are maintained at their facility in Narragansett, RI. A copy of the cover page of various SOPs for various analytical methods to be used on this project are provided in Attachment A-2.

13. QUALITY CONTROL REQUIREMENTS

Ceimic's project-specific Quality Control Criteria for Precision and Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates, and Laboratory Control Samples are presented presented in Table 7-2. A summary of Ceimic's project-specific Laboratory Quality Control Criteria and Corrective Action Procedures are also included in Table 13-1. The project-specific criteria shown in Tables 7-2 and 13-1 supercede related information in the general Laboratory QA Plan (Attachment A-1).

The following presents the types of Quality Control Samples planned for this project:

Temperature Blank
One temperature blank will be included per shipping cooler containing soil or water samples submitted to Ceimic for chemical analysis. This will be used by Ceimic to document the temperature of the samples they receive for this project

Trip Blank
One trip blank will be included per shipping cooler containing water samples to be analyzed for Target Compound List (TCL) VOC.

Field Duplicate
Field duplicate of each sample type (i.e., ground-water and soil) will be collected at the rate of 1 per every 10 samples. The field duplicate samples will be analyzed for the same parameters as the duplicated samples.

Method (Reagent) Blank
Method (reagent) blanks are used to monitor laboratory contamination. This is usually a sample of laboratory reagent water or soil matrix treated with all the reagents and in the same manner as the sample (i.e., digested, extracted, distilled). One method blank will be prepared and analyzed every day that samples are prepared.

Fortified Method Blank Spike (Laboratory Control Sample)
Fortified method blank samples are analyzed with each batch of 20 or fewer samples. These samples generally consist of laboratory reagent-grade water or solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. They are prepared and analyzed with the associated sample batch. The analyte recovery from each is used to monitor analytical accuracy.

Fortified Sample (Matrix Spike)
A fortified sample (matrix spike) is an aliquot of a field sample that is fortified with the analyte(s) of interest and analyzed to monitor matrix effects associated with a particular batch of samples. Matrix spike and matrix spike duplicate samples will be performed for every batch of 20 or fewer samples for organic analyses.

Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries are calculated for each surrogate. Surrogates shall be spiked into samples according to the appropriate analytical method (Chapter 8)). Surrogate spike recoveries shall fall within the control limits set in accordance with procedures specified in the method. Surrogate recoveries will not be calculated if sample dilution causes the surrogate concentration to fall below the quantitation limit.

14. DATA ACQUISITION REQUIREMENTS

The validated data for ground-water samples collected during the Navy's Phase III Remedial Investigation (RI) of NCBC Davisville Site 03 will be used for comparison during assessment of the nature and extent of the CVOC plume in the 'deep' and 'bedrock' ground-water zones. Also, the hydrogeological data developed during that Navy RI will be refined with the related data developed during USACE's Nike PR-58 investigation.

15. DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

15.1 Project Documentation and Records

The project documentation, records, and field data files will be retained and maintained by EA.

15.2 Field Data Reporting

Field records are evaluated by the EA Project Manager for the following:

- Completeness
- Identification of valid samples
- Identification of anomalous field test data
- Accuracy and precision of field data and measurement.

The review of field record completeness checks that requirements for field activities in the work plan have been fulfilled, that complete records exist for each field activity, and that the procedures specified in the work plan have been implemented. Field documentation must ensure sample integrity and provide sufficient information to characterize each field event. The results of the completeness check are documented by the site manager, and any data affected by incomplete records are identified at this time.

The identification of valid samples involves interpreting and evaluating the field records to detect problems affecting representativeness of field samples. Field records can indicate whether a well is properly constructed; well-development records can indicate whether correct development has occurred. Field audits are another source of data for review. The EA Project Manager will perform periodic site visits during the field activities to check that the work is being performed in accordance with the Work Plan and to resolve observed deviations. The judgements for data validity will be documented in the technical report, and field data associated with incorrect field work will be identified. Anomalous field data will be identified and explained to the extent possible in the technical report. The field records will be maintained and retained in the project file at the EA Project Managers office.

15.3 Laboratory Reporting

Ceimic has been a participant in the EPA CLP program since 1988. The Ceimic laboratory report will be a Level IV deliverable that follow the CLP guidelines for both organics and inorganics. The intent of Ceimic's level IV data report is to provide a fully validatable report via CLP summary Forms and will include raw data from instruments and bench sheets. The standard Level IV package will include a Sample Data Group (SDG) narrative detailing instrumentation, cross-reference of client to laboratory IDs, and any difficulties encountered during the analysis and tenure of the samples while at Ceimic..

15.4 Data Management

Ground-water level elevation data; sampling locations; and fixed laboratory results of soil and low-flow collected ground-water samples will be added to the GIS database.

Geographic Information Systems Preparation

Software: ARCVIEW Version 3.1

Base Maps: The basis of the ARCVIEW project will be existing base maps which may include USGS Digital Raster Graphs, CADD Base maps, Digital Orthophoto Quadrangle's (DOQ's) and or scanned and geo-rectified aerial photographs. All CADD files should be produced as to be compatible with a GIS. (i.e.; closed polygons for polygonal features, such as buildings, polylines instead of lines, blocks with attributes, elevations assigned to features when appropriate, and a distinct and clear layering system).

GIS Data Integration: Upon compilation of all sample, chemical and positional data (i.e.: Tables 1, 2 and 3 of Attachment A-4), the data shall be incorporated into an ARCVIEW GIS project. Table 2 shall be joined to Table 3 on the SAMPLE_NO field. Table 1 shall be linked to the new table to be named Analytic Results (Tables 2 and 3 combined) on the location field. Within the ARCVIEW Project a separate SAMPLE LOCATION theme per media, shall be provided (i.e.; groundwater, soil, etc.).

NOTE: Tables 1, 2 and 3 (Attachment A-4) allow access to all the data in (XYZ) space. If the environmental project effort requires comparison to various criteria such as MCL's or risk based screening levels than those fields should be incorporated. This allows users to quickly identify exceedances, produce tag maps as necessary and to view spatial relationships. (i.e.; Result > MCL's)

Figure Preparation: The GIS system shall be used as applicable to generate site location maps, sample location maps, contaminant ISO-contour maps, potentiometric surface maps, bedrock contour maps and contaminant tag maps. Any figures or drawings prepared in CADD software packages or EQUIS, shall be included in the ARCVIEW Project deliverable as a theme with attribute tables or layout as appropriate. All site plan view figures generated in a CADD software shall utilize the specified coordinate system and shall not be rotated. (i.e.; north is north!)

GIS Deliverable: The ARCVIEW Project shall be delivered on CD-ROM. The complete EQUIS database shall be delivered on a separate CD_ROM in a MDB format.
Electronic Data Deliverables

The EA Project Manager shall tabulate, organize, and reduce the results of the laboratory analyses. The EQUIS data structure shall be utilized, however the data shall be parceled out, merged, and delivered to the USACE and Navy to be consistent with the data collected and delivered to the USACE and Navy during previous investigations of the site.

Database Format & Structure: Provide electronic deliverable in a Dbase IV file format (file name.dbf). The structure of the database/flat files is described in Tables 1, 2 and 3 in Attachment A-4. It shall be the responsibility of the EA Project Manager to ensure that all data received from the laboratory is in accordance with Table 3. *(USE OF EQUIS DEFINED FIELDS/VALID VALUES IS ACCEPTABLE IN LIEU OF THE STRUCTURE IDENTIFIED IN THE (TABLES)*

Sample Information: Before electronic files are received from the laboratory, sample specific information will be entered into Tables 1 and 2 of Attachment A-4 (with the exception of VALIDATED field and OUR_RESULT field). The sample information file will allow for the Laboratory Analytic Results (Table 3) to be joined on the SAMPLE_NO.field (Table 2).

Field duplicates shall be averaged for statistical purposes for all aqueous data (i.e. groundwater). The maximum concentration will be used to represent field duplicate concentrations in solid media (i.e. soil). The normal, duplicate and average/maximum concentrations will all be reported.

Survey Data: The files will contain a minimum of location, northing, easting, ground surface elevation and elevation of top of casing, Unless otherwise specified the horizontal geodetic datum North American Datum (NAD) 1983 and the North American Vertical Datum (NAVD) 1988 shall be referenced. (USE NAD 27 & NGVD 29 FOR THIS CTO.)

Data Validation: Once all samples and analyses have been accounted for, the electronic data files shall be printed for each Sample Delivery Group (SDG) and analytical fraction and submitted for data validation. Validators will incorporate data qualifiers into the electronic database and report the status/results as identified in Table 2 of Attachment A-4.

A single Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03 will be prepared by EA for the USACE and the Navy in draft and final versions for submittal to the distribution list for review and comment by the BCT.

16. ASSESSMENTS AND RESPONSE ACTIONS

The EA Project Manager, the USACE Remedial Project Manager, or the Navy Remedial Project Manager (or their designee) may conduct audits of the field activities for this project. Two formal field audits are planed by EA during the monitoring well drilling and the ground-water sampling activities. The EA Project Manager (or his designee) will have the authority to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data.

The EPA or RIDEM Remedial Project Managers (or their designee) may at their discretion conduct an audit of the field activities for this project. Upon finding a significant condition that would adversely affect the quality and usability of the data, these Remedial Project Managers (or their designee) shall immediately contact the EA Project Manager, the USACE Remedial Project Manager, and the Navy Remedial Project Manager.

The EA Project Manager will have the responsibility for initiating and implementing response actions associated with findings identified during these on-site audits. Once the response actions have been implemented, the auditor will perform a follow-up audit to verify and document that the response actions were implemented effectively.

17. QA MANAGEMENT REPORTS

Monthly project status reports are prepared by the EA Project Manager and submitted to the USACE and the Navy by the 20th of the following month. Ceimic's related QA reporting is referenced in Chapter 17 of Attachment A-1.

18. VERIFICATION AND VALIDATION REQUIREMENTS

The analytical data from CEIMIC Corp for the soil and low-flow method collected ground-water samples will require validation in accordance with the Tier II US EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analyses (1988) modified to fit the non-CLP analytical methods (SW846). Such modification would include, e.g. comparing the analytical results to the quality control acceptance limits and calibration requirements of the SW846 analytical methods which are different from CLP analytical methods for which the EPA guidelines were developed. Tier III validation will not be necessary because this project does not include human health or eco risk assessment. The EA Project Manager, the USACE Remedial Project Manager, and Navy Remedial Project Manager will be responsible for overall validation and final approval of the data in accordance with project purpose and use of the data.

19. VERIFICATION AND VALIDATION PROCEDURES

The analytical data from CEIMIC Corp for the soil and low-flow method collected ground-water samples will be validated in accordance with the procedures of the Tier II EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analyses (1988), modified to fit the non-CLP analytical methods (SW846). The data validation will be performed by a qualified independent firm contracted to EA. The EA Project Manager (or his designee) will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

20. DATA USEABILITY/RECONCILIATION WITH PROJECT QUALITY GOALS

Once the data results are compiled, the EA Project Manager will review the field and lab QA/QC samples duplicates to determine if they fall within the acceptance limits as defined in this QAPP. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP (including the accuracy for lab spikes), the data may be discarded and re-sampling may occur. The EA Project Manager will evaluate the cause of the failure and evaluate with the USACE and Navy Remedial Project Managers and make the decision to discard the data and re-sample. If the failure is tied to the analysis, calibration and maintenance techniques will be reassessed as identified by the appropriate laboratory personnel. If the failure is associated with the sample collection and re-sampling is needed, the samplers will be retrained.

The project quality goals are considered to have been met if the data quality indicators meet the project requirements as outlined in Section 7 of the QAPP (e.g., if the project quality goals are met, then the investigation has been successful).

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
SW6010B Metals by Inductively Coupled Plasma Atomic Emission Spectroscopy (Water, Sediment, Soil)					
Matrix Spike	Aluminum	75-125	75-125	≤20	≤20
	Antimony (TRACE)	75-125	75-125	≤20	≤20
	Arsenic (TRACE)	75-125	75-125	≤20	≤20
	Barium	75-125	75-125	≤20	≤20
	Beryllium (TRACE)	75-125	75-125	≤20	≤20
	Cadmium (TRACE)	75-125	75-125	≤20	≤20
	Calcium	75-125	75-125	≤20	≤20
	Chromium (TRACE)	75-125	75-125	≤20	≤20
	Cobalt	75-125	75-125	≤20	≤20
	Copper (TRACE)	75-125	75-125	≤20	≤20
	Iron	75-125	75-125	≤20	≤20
	Lead (TRACE)	75-125	75-125	≤20	≤20
	Magnesium	75-125	75-125	≤20	≤20
	Manganese	75-125	75-125	≤20	≤20
	Nickel (TRACE)	75-125	75-125	≤20	≤20
	Potassium	75-125	75-125	≤20	≤20
	Silver (TRACE)	75-125	75-125	≤20	≤20
	Sodium	75-125	75-125	≤20	≤20
	Selenium (TRACE)	75-125	75-125	≤20	≤20
	Vanadium	75-125	75-125	≤20	≤20
	Zinc	75-125	75-125	≤20	≤20
LCS	Aluminum	80 - 120	60-108	≤20	(c)
	Antimony (TRACE)	80 - 120	37-153	≤20	(c)
	Arsenic (TRACE)	80 - 120	71-127	≤20	(c)
	Barium	80 - 120	67-123	≤20	(c)
	Beryllium (TRACE)	80 – 120	80-112	≤20	(c)
	Cadmium (TRACE)	80 – 120	76-108	≤20	(c)

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS, Cont'd:	Calcium	80 – 120	71-130	≤20	(c)
	Chromium (TRACE)	80 – 120	80-112	≤20	(c)
	Cobalt	80 - 120	78-104	≤20	(c)
	Copper (TRACE)	80 - 120	75-111	≤20	(c)
	Iron	80 - 120	46-128	≤20	(c)
	Lead (TRACE)	80 - 120	79-115	≤20	(c)
	Magnesium	80 - 120	70-104	≤20	(c)
	Manganese	80 - 120	82-104	≤20	(c)
	Nickel (TRACE)	80 - 120	68-114	≤20	(c)
	Potassium	80 - 120	78-122	≤20	(c)
	Silver (TRACE)	80 - 120	79-119	≤20	(c)
	Sodium	80 - 120	73-107	≤20	(c)
	Selenium (TRACE)	80 - 120	59-129	≤20	(c)
	Vanadium	80 - 120	73-111	≤20	(c)
	Zinc	80 - 120	79-109	≤20	(c)
SW7470A, SW7471A Mercury by Cold Vapor Atomic Absorption (Water, Sediment, Soil)					
Matrix Spike:	Mercury	75-125	75-125	≤20	≤20
LCS (b)	Mercury	80 - 120	67-117	≤20	(c)
SW6010B Thallium by ICP (Water, Sediment, Soil)					
Matrix Spike	Thallium	75-125	75-125	≤20	≤20
LCS (b)	Thallium	80 - 120	77-127	≤20	(c)
SW5030B/8260B Volatile organic compounds by GC/MS (Water - 25 mL purge)					
Surrogate Spike	1,2-Dichloroethane-d4	76-114	--	--	--
	4-Bromofluorobenzene(BFB)	86-115	--	--	--
	Toluene-d8	88-110	--	--	--
	Dibromofluoromethane	86-118	--	--	--
LCS/MS/MSD	Benzene	78-123	--	≤28	--
	Toluene	77-122	--	≤27	--

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS/MS/MSD, Cont'd	Chlorobenzene	79-123	--	≤27	--
	1,1-Dichloroethene	75-118	--	≤27	--
	Trichloroethene	73-122	--	≤30	--
SW8015B260B Volatile organic compounds by GC/MS (Sediment, Soil)					
Surrogate Spike	1,2-Dichloroethane-d4	--	70-121	--	--
	4-Bromofluorobenzene	--	74-121	--	--
	Toluene-d8	--	81-117	--	--
	Dibromofluoromethane	--	80-120	--	--
LCS/MS/MSD	Benzene	--	78-119	--	≤25
	Toluene	--	73-130	--	≤35
	Chlorobenzene	--	69-139	--	≤43
	1,1-Dichloroethene	--	74-128	--	≤33
	Trichloroethene	--	72-122	--	≤31
SW8270E-SIM (8270D) Semivolatile Organics by GC/MS (Water, Sediment, Soil)					
Surrogate Spike	Nitrobenzene d5	35-114	23-120	--	--
	2-Fluorobiphenyl	43-116	30-115	--	--
	Terphenyl-d14	33-141	18-137	--	--
	2-Fluorophenol	21-100	25-121	--	--
	Phenol-d5	10-94	24-113	--	--
	2,4,6-Tribromophenol	10-123	19-122	--	--
LCS/MS/MSD	Phenol	38-91	35-97	≤33	≤38
	2-Chlorophenol	42-94	39-98	≤32	≤36
	1,4-Dichlorobenzene	28-90	39-102	≤38	≤39
	N-Nitroso-di-n-propylamine	53-115	51-115	≤38	≤39
	1,2,4-Trichlorobenzene	33-94	50-104	≤38	≤33
	4-Chloro-3-methylphenol	45-97	51-96	≤32	≤28
	Acenaphthene	49-103	51-109	≤33	≤36
	4-Nitrophenol	52-117	50-120	≤40	≤43

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS/MS/MSD, Cont'd	2,4-Dinitrotoluene	57-115	54-126	≤35	≤45
	Pentachlorophenol	38-119	16-119	≤50	≤63
	Pyrene	45-114	44-119	≤43	≤46
General Chemistry Parameter EPA 300.0 Anions (water)					
MS/MSD	Nitrate	75-125	--	<25	--
	Sulfate	75-125	--	<25	--
	Chloride	75-125	--	<25	--
LCS	Nitrate	80-120	--	--	--
	Sulfate	80-120	--	--	--
	Chloride	80-120	--	--	--
General Chemistry Parameter EPA 376.2 (water)					
MS/MSD	Sulfide	75-125	--	<25	--
LCS	Sulfide	80-120	--	--	--
General Chemistry Parameters EPA 310.1 (water)					
MS/MSD	Alkalinity	75-125	--	<25	--
LCS	Alkalinity	80-120	--	--	--
General Chemistry Parameters RSK-175 (water)					
MS/MSD	Methane	60-140	--	<40	--
LCS	Methane	60-140	--	--	--

-- not applicable

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 8-1 Sampling and Analytical Program for the USACE Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (15 new wells + 19 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	34	4		8 & 2/2	50
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	34	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	34	4		– & 2/2	42
In addition to all of the above parameters ground-water samples from EA-104D/R/R2, EA-106D/R, EA-112D/R/R2, and EA-113D/R will also be analyzed for the following:	TAL Inorganics – (Cold Vapor Atomic Absorption (detection limit, < 0.08 ug/L) SW846 7470A (Mercury Only)	10	1		– & 1/1	13
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3010A/6010B	10	1		– & 1/1	13

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
In addition to all of the above parameters ground-water samples from EA-114D/R/R2 will also be analyzed for the following:	TCL Semi-Volatile Organics –GC/MS (detection limit, see QAPP) SW-3520C/8270C	3	1		-- & 1/1	6
Soil Samples (EA-114D and EA-116D)	TCL Volatile Organics – (GC/MS (detection limit, ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12
In addition the above parameters soil samples from EA-114D will also be analyzed for the following:	TCL Semi-Volatile Organics –(GC/MS (detection limit, see QAPP) SW-3540C/8270C	2	1	1	-- & 1/1	6
	TAL Inorganics –(Cold Vapor Atomic Absorption (detection limit, < 0.08 mg/kg) SW846 7471A (Mercury Only)	2	1	1	-- & 1/1	6
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3050A/6010B	2	1	1	-- & 1/1	6

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the QA analysis (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 8-2 Sampling and Analytical Program for the USACE Optional Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (up to 7 new wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	7	1		2 & 1/1	12
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	7	1 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	7	1		-- & 1/1	10
Soil Samples (EA-115D and EA-117D)	TCL Volatile Organics – (GC/MS detection limit ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the **QA analysis** (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 8-3 Sampling and Analytical Program for the Navy Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (5 new wells + 30 existing wells)	TCL Volatile Organics – (GC/MS (detection limit , < 1 ug/L) SW-5030B/8260B	35	4		9 & 2/2	51
	Field Measured Parameters • Dissolved Oxygen • Turbidity • pH • Eh • Conductivity • Temperature • Ferrous Iron	35	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	35	4		-- & 2/2	43

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

For the Navy portion of this investigation, there will be no samples collected and shipped for QA lab analysis.

TABLE 9-1 REQUIRED CONTAINERS, PRESERVATION TECHNIQUE, AND HOLDING TIMES FOR AQUEOUS SAMPLES AND BLANKS[a]

Parameter	Volume Required (mL)	Container	Preservative	Recommended Holding Time
METALS				
Mercury	100	250 ml, P	HNO_3 to pH <2	28 days
Other Metals	200	250 ml, P	HNO_3 to pH <2	6 months
METHANE				
Methane	80	40 ml vial, Teflon-lined septum	Cool, 4 C 4 drops conc. HCL to pH <2	14 days
INORGANICS, NONMETALLIC				
Alkalinity	100	250 ml, P	Cool, 4 C	14 days
Chloride	50	250 ml, P	None required	28 days
Nitrate	50	250 ml, P	Cool, 4 C H_2SO_4<2	28 days
Sulfate	50	250 ml, P	Cool, 4 C	28 days
Sulfide	100	500 ml, P	ZnAC/ NaOH>9	7 days
TCL ORGANICS				
Volatile Organics	120 ml	40 ml vial, Teflon-lined septum	Cool, 4 C 4 drops conc. HCL to pH <2	14 days
Semivolatile Organic Compounds: Base Neutrals/Acid Extractables & Polynuclear Aromatic Hydrocarbons	2,000	1 Liter Amber Glass, Teflon-lined cap	Cool, 4 C	7 days to extraction 40 days after extraction

A temperature blank (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp.

(a) From time of sample collection (40 CFR 136).

Notes:
Polyethylene (P) or glass (G).

TABLE 9-2 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES [a]

Parameter	Weight Required (g)	Container	Preservative	Holding Time
METALS				
Mercury	10	8 oz G, P	None required	28 days
Other Metals	20	8 oz G, P	None required	180 days
ORGANICS[c]				
Volatile Organics	5	4 oz G	10 g soil with 10 mL methanol, 4 C	14 days
Semivolatile Organic Compounds: Base Neutrals/Acid Extractables & Polynuclear Aromatic Hydrocarbons	30	8 oz G	Cool, 4 C	14 days to extraction 40 days after extraction

A temperature blank (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp.

(a) From time of sample collection (40 CFR Part 136.3, 40 CFR Part 261).
Notes:
Polyethylene (P) or glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

TABLE 12-1 PROJECT-SPECIFIC REPORTING LIMITS FOR AQUEOUS SAMPLES

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
Semivolatile Organics GC/MS (SW846 Method 3520C/8270C)			
Acenaphthene	µg/L	10	---
Acenaphthylene	µg/L	10	---
Anthracene	µg/L	10	---
Benzo(a)anthracene	µg/L	10	---
Benzo(b)fluoranthene	µg/L	10	---
Benzo(k)fluoranthene	µg/L	10	---
Benzo(a)pyrene	µg/L	10	0.2
Benzo(ghi)perylene	µg/L	10	---
Benzyl butyl phthalate	µg/L	10	---
Bis(2-chloroethyl) ether	µg/L	10	---
Bis(2-chloroethoxy)methane	µg/L	10	---
Bis(2-ethylhexyl) phthalate	µg/L	10	---
4-Bromophenyl phenyl ether	µg/L	10	---
Carbazole	µg/L	10	---
4-Chloroaniline	µg/L	20	---
4-Chloro-3-methylphenol	µg/L	20	---
2-Chloronaphthalene	µg/L	10	---
2-Chlorophenol	µg/L	10	---
4-Chlorophenyl phenyl ether	µg/L	10	---
Chrysene	µg/L	10	---
Dibenz(a,h)anthracene	µg/L	10	---
Dibenzofuran	µg/L	10	---
Di-n-butyl phthalate	µg/L	10	---
1,2-Dichlorobenzene	µg/L	10	---
1,3-Dichlorobenzene	µg/L	10	---
1,4-Dichlorobenzene	µg/L	10	---
3,3'-Dichlorobenzidine	µg/L	20	---
2,4-Dichlorophenol	µg/L	10	---
Diethyl phthalate	µg/L	10	---
2,4-Dimethylphenol	µg/L	10	---
Dimethyl phthalate	µg/L	10	---
2,4-Dinitrophenol	µg/L	40	---
2,4-Dinitrotoluene	µg/L	10	---
2,6-Dinitrotoluene	µg/L	10	---
Di-n-octyl phthalate	µg/L	10	---
Fluoranthene	µg/L	10	---
Fluorene	µg/L	10	---
Hexachlorobenzene	µg/L	10	1
Hexachlorobutadiene	µg/L	10	---
Hexachlorocyclopentadiene	µg/L	10	---
Hexachloroethane	µg/L	10	---
Indeno(1,2,3-cd)pyrene	µg/L	10	---
Isophorone	µg/L	10	---
2-Methyl-4,6-dinitrophenol	µg/L	40	---
2-Methylnaphthalene	µg/L	10	---
2-Methylphenol	µg/L	10	---
4-Methylphenol	µg/L	10	---
Naphthalene	µg/L	10	20

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
2-Nitroaniline	µg/L	40	---
3-Nitroaniline	µg/L	40	---
4-Nitroaniline	µg/L	40	---
Nitrobenzene	µg/L	10	---
2-Nitrophenol	µg/L	10	---
4-Nitrophenol	µg/L	40	---
N-Nitrosodiphenylamine	µg/L	10	---
N-Nitroso-di-n-propylamine	µg/L	10	---
2,2'-Oxybis (1-chloropropane)	µg/L	10	---
Pentachlorophenol	µg/L	40	1
Phenanthrene	µg/L	10	---
Phenol	µg/L	10	---
Pyrene	µg/L	10	---
1,2,4-Trichlorobenzene	µg/L	10	70
2,4,5-Trichlorophenol	µg/L	40	---
2,4,6-Trichlorophenol	µg/L	10	---
Volatile Organics GC/MS (SW846 Method 5030B/8260B)			
Acetone	µg/L	5	---
Benzene	µg/L	1	5
Bromodichloromethane	µg/L	1	---
Bromoform	µg/L	1	---
Bromomethane	µg/L	1	---
2-Butanone	µg/L	5	---
Carbon disulfide	µg/L	1	---
Carbon tetrachloride	µg/L	1	5
Chlorobenzene	µg/L	1	100
Chloroethane	µg/L	1	---
Chloroform	µg/L	1	---
Chloromethane	µg/L	1	---
Dibromochloromethane	µg/L	1	---
1,1-Dichloroethane	µg/L	1	---
1,2-Dichloroethane	µg/L	1	5
1,1-Dichloroethene	µg/L	1	7
1,2-Dichloroethene (total)	µg/L	1	70(cis)/100(trans)
1,2-Dichloropropane	µg/L	1	5
cis-1,3-Dichloropropene	µg/L	1	---
trans-1,3-Dichloropropene	µg/L	1	---
Ethylbenzene	µg/L	1	700
2-Hexanone	µg/L	5	---
4-Methyl-2-pentanone (MIBK)	µg/L	5	---
Methylene chloride	µg/L	1	5
Styrene	µg/L	1	100
1,1,2,2-Tetrachloroethane	µg/L	1	---
Tetrachloroethene	µg/L	1	5
Toluene	µg/L	1	1000
1,1,1-Trichloroethane	µg/L	1	200
1,1,2-Trichloroethane	µg/L	1	5
Trichloroethene	µg/L	1	5
Vinyl chloride	µg/L	1	2
Xylenes (total)	µg/L	1	10000

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
Methane (RSK-175)			
Methane	µg/L	1	
Metals - Cold Vapor Atomic Absorption (SW846 7470A)			
Mercury	µg//L	0.2	2
Metals - Inductively Coupled Plasma (SW3010/6010B)			
Aluminum	µg/L	200	---
Antimony	µg/L	5	6
Arsenic (TRACE)	µg/L	10	---
Barium	µg/L	10	2000
Beryllium	µg/L	10	4
Cadmium	µg/L	10	5
Calcium	µg/L	500	---
Chromium	µg/L	20	100
Cobalt	µg/L	20	---
Copper	µg/L	20	---
Iron	µg/L	100	---
Lead	µg/L	5	15
Magnesium	µg/L	500	---
Manganese	µg/L	10	---
Nickel	µg/L	40	100
Potassium	µg/L	500	---
Selenium	µg/L	5	50
Silver	µg/L	10	---
Sodium	µg/L	500	---
Thallium	µg/L	3	2
Vanadium	µg/L	50	---
Zinc	µg/L	20	---
Inorganic Nonmetals			
Alkalinity (EPA 310.1)	mg/L	1.0	---
Chloride (EPA 300.0)	mg/L	0.1	---
Nitrate (EPA 353.2)	mg/L	0.1	---
Sulfate (EPA 300.0)	mg/L	0.1	---
Sulfide (EPA 376.2)	mg/L	1.0	---

(a) Project Reporting Limit is the Practical Quantitation Limit (PQL), i.e. the lowest point on the calibration curve normalized for mass of sample extracted.
(b) Project Action Limit is based on RIDEM GA Ground -Water Objectives

NOTE: GC/MS = Gas chromatograph/mass spectrometry.
Dashes (---) indicate no Ground-Water GA or GB Criteria available.

TABLE 12-2 PROJECT-SPECIFIC REPORTING LIMITS FOR SOIL SAMPLES

Parameter	Units	Project Reporting Limit[a]	
Semivolatile Organics GC/MS (SW846 Method 3540C/8270C)			
Acenaphthene	µg/kg	330	
Acenaphthylene	µg/kg	330	
Anthracene	µg/kg	330	
Benzo(a)anthracene	µg/kg	330	
Benzo(b)fluoranthene	µg/kg	330	
Benzo(k)fluoranthene	µg/kg	330	
Benzo(a)pyrene	µg/kg	330	
Benzo(ghi)perylene	µg/kg	330	
Benzyl butyl phthalate	µg/kg	330	
Bis(2-chloroethyl) ether	µg/kg	330	
Bis(2-chloroethoxy)methane	µg/kg	330	
Bis(2-ethylhexyl) phthalate	µg/kg	330	
4-Bromophenyl phenyl ether	µg/kg	330	
Carbazole	µg/kg	330	
4-Chloroaniline	µg/kg	670	
4-Chloro-3-methylphenol	µg/kg	670	
2-Chloronaphthalene	µg/kg	330	
2-Chlorophenol	µg/kg	330	
4-Chlorophenyl phenyl ether	µg/kg	330	
Chrysene	µg/kg	330	
Dibenz(a,h)anthracene	µg/kg	330	
Dibenzofuran	µg/kg	330	
Di-n-butyl phthalate	µg/kg	330	
1,2-Dichlorobenzene	µg/kg	330	
1,3-Dichlorobenzene	µg/kg	330	
1,4-Dichlorobenzene	µg/kg	330	
3,3'-Dichlorobenzidine	µg/kg	670	
2,4-Dichlorophenol	µg/kg	330	
Diethyl phthalate	µg/kg	330	
2,4-Dimethylphenol	µg/kg	330	
Dimethyl phthalate	µg/kg	330	
2,4-Dinitrophenol	µg/kg	1330	
2,4-Dinitrotoluene	µg/kg	330	
2,6-Dinitrotoluene	µg/kg	330	
Di-n-octyl phthalate	µg/kg	330	
Fluoranthene	µg/kg	330	
Fluorene	µg/kg	330	
Hexachlorobenzene	µg/kg	330	
Hexachlorobutadiene	µg/kg	330	
Hexachlorocyclopentadiene	µg/kg	330	
Hexachloroethane	µg/kg	330	
Indeno(1,2,3-cd)pyrene	µg/kg	330	
Isophorone	µg/kg	330	
2-Methyl-4,6-dinitrophenol	µg/kg	1330	
2-Methylnaphthalene	µg/kg	330	
2-Methylphenol	µg/kg	330	
4-Methylphenol	µg/kg	330	

Parameter	Units	Project Reporting Limit[a]	
Naphthalene	µg/kg	330	
2-Nitroaniline	µg/kg	1330	
3-Nitroaniline	µg/kg	1330	
4-Nitroaniline	µg/kg	1330	
Nitrobenzene	µg/kg	330	
2-Nitrophenol	µg/kg	330	
4-Nitrophenol	µg/kg	1330	
N-Nitrosodiphenylamine	µg/kg	330	
N-Nitroso-di-n-propylamine	µg/kg	330	
2,2'-Oxybis (1-chloropropane)	µg/kg	330	
Pentachlorophenol	µg/kg	1330	
Phenanthrene	µg/kg	330	
Phenol	µg/kg	330	
Pyrene	µg/kg	330	
1,2,4-Trichlorobenzene	µg/kg	330	
2,4,5-Trichlorophenol	µg/kg	1330	
2,4,6-Trichlorophenol	µg/kg	330	
Volatile Organics GC/MS (SW846 Method 5035/8260B)			
Acetone	µg/kg	250	
Benzene	µg/kg	125	
Bromodichloromethane	µg/kg	125	
Bromoform	µg/kg	125	
Bromomethane	µg/kg	125	
2-Butanone	µg/kg	250	
Carbon disulfide	µg/kg	125	
Carbon tetrachloride	µg/kg	125	
Chlorobenzene	µg/kg	125	
Chloroethane	µg/kg	125	
Chloroform	µg/kg	125	
Chloromethane	µg/kg	125	
Dibromochloromethane	µg/kg	125	
1,1-Dichloroethane	µg/kg	125	
1,2-Dichloroethane	µg/kg	125	
1,1-Dichloroethene	µg/kg	125	
1,2-Dichloroethene (total)	µg/kg	125	
1,2-Dichloropropane	µg/kg	125	
cis-1,3-Dichloropropene	µg/kg	125	
trans-1,3-Dichloropropene	µg/kg	125	
Ethylbenzene	µg/kg	125	
2-Hexanone	µg/kg	250	
4-Methyl-2-pentanone (MIBK)	µg/kg	250	
Methylene chloride	µg/kg	125	
Styrene	µg/kg	125	
1,1,2,2-Tetrachloroethane	µg/kg	125	
Tetrachloroethene	µg/kg	125	
Toluene	µg/kg	125	
1,1,1-Trichloroethane	µg/kg	125	
1,1,2-Trichloroethane	µg/kg	125	
Trichloroethene	µg/kg	125	
Vinyl chloride	µg/kg	125	
Xylenes (total)	µg/kg	125	

Parameter	Units	Project Reporting Limit[a]	
Metals - Cold Vapor Atomic Absorption (SW846 7471A)			
Mercury	mg/kg	0.1	
Metals - Inductively Coupled Plasma (SW3050A/6010B)			
Aluminum	mg/kg	20	
Antimony	mg/kg	2	
Arsenic (TRACE)	mg/kg	1	
Barium	mg/kg	1	
Beryllium	mg/kg	0.5	
Cadmium	mg/kg	1	
Calcium	mg/kg	50	
Chromium	mg/kg	2	
Cobalt	mg/kg	2	
Copper	mg/kg	2	
Iron	mg/kg	10	
Lead	mg/kg	0.5	
Magnesium	mg/kg	50	
Manganese	mg/kg	1	
Nickel	mg/kg	4	
Potassium	mg/kg	50	
Selenium	mg/kg	0.5	
Silver	mg/kg	1	
Sodium	mg/kg	50	
Thallium	mg/kg	1	
Vanadium	mg/kg	5	
Zinc	mg/kg	2	

(a) Project Reporting Limit is the Practical Quantitation Limit (PQL), i.e. the lowest point on the calibration curve normalized for mass of soil extracted.

NOTE: GC/MS = Gas chromatograph/mass spectrometry.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Metals by ICP: SW3010A/6010B in water; SW3050A/6010B in soil and sediment			
Holding time	6 months from sampling	Digestion /analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. Coefficient of variation for linear fit, r, ∃0.995	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Check	After each Initial Calibration	%R is 95%-105%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentration of any analyte of concern <RL	1. If the applicable criteria is not met, recalibrate the instrument. 2. Reanalyze all associated QC and field samples 3. Document actions taken.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 90%-110%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Interelement Check Sample (ICS)	Beginning and end of each analytical run	Concentration of analyte subject to potential spectral interference is within 20 percent of known value.	1. Recalibrate instrument and reanalyze interelement check sample. 2. Check interelement correction factors or background correction points, and update if necessary. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentration of any analyte of concern <RL	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. If preparation in error reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken in a Nonconformance Record, and in the analytical report

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, validate preparation of samples. If no errors or problems are discovered for sample preparation, data is apprpropriately flagged and reported with discussion in analytical narrative.
Serial Dilution	1+4 dilution for one samples per analytical batch	1+4 dilution for one sample per analytical batch; %D ≤ 10%. Criteria applies only to analytes where the original concentration is ∃ 50X RL.	1. If the dilution analysis for one or more analytes is not within 10%, no further action is required 2. A chemical or physical interference effect must be suspected, and the data for all affected analytes in the samples received associated with that serial dilution must be qualified.
Mercury by CVAA: SW7470A in water; SW7471A in soil and sediment			
Holding time	28 days	Digestion/analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. Initial calibration correlation coefficient, r ≥ 0.995.	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentration of any analyte of concern <RL	1. If the applicable criteria is not met, recalibrate the instrument. 2. Reanalyze all associated QC and field samples 3. Document actions taken.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 80%-120%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **MeC**[illegible]ethylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting lim[illegible]D, relative percent difference; **SD**, standard deviation; **SPCC**, system performance ch[illegible]pound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Method Blank	1 per analytical batch	Concentration of any analyte of concern <RL	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. If preparation in error reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken in a Nonconformance Record, and in the analytical report
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, validate preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.
Volatile Organic Compounds SW5030B/8260B in water; SW5035/8260B in soil and sediment			
Holding time	14 days from sampling	Analysis is performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration curve	Established initially at 5 concentration levels.	1. Initial calibration %RSD for all CCCs is #30 %; RF for SPCCs is ≥ method specified minimum. 2. Average %RSD is # 15%, or use linear regression with r ≥ 0.990 (r2 ≥ 0.980).	1. Recalibrate instrument. 2. Reanalyze samples since last criteria met. 3. Document actions taken.
Initial Calibration Verification (ICV)	Second source mid-level standard immediately following initial calibration	%D for all CCCs is # 20 %; RF for SPCCs is ≥ method specified minimum.	1. Verify standard preparation, if incorrect reprepare ICV 2. Verify preparation of calibration standards if incorrect reprepare standards, and recalibrate instrument. 3. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Continuing Calibration Verification (CCV)	Mid-level standard every 12 hours of analysis	%D for all CCCs is # 20 %; RF for SPCCs is ≥ method specified minimum.	1. Verify standard preparation and instrument operations, correct problem. 2. Repeat initial calibration. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentration is less than the project RL for all analytes except the common laboratory contaminates MeC12 and Acetone are less than five times the RL.	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. Reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken.
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
Surrogate spike	All field and QC samples	Surrogate recoveries must be within project specified control limits in Attachment B-6.	1. Examine all QC (including but not limited to LCS, MB). 2. If surrogate in LCS and/or MB is out-of-control, check quantitation. If quantitation is correct reanalyze. 3. If similar results are obtained from reanalysis, obtain fresh, verified surrogate solution, and reprepare and reanalyze the analytical batch. 4. If samples cannot be reprepared, qualify data. 5. If surrogate recoveries in LCS and MB are acceptable but outside the control limits for any sample, reanalyze sample to determine if matrix effect. If matrix effect confirmed, report both analyses. Document actions taken in the analytical narrative.
Internal Standard Responses and Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	1. Retention time for any internal standard must be within 30 seconds of the initial calibration, the retention times are compared to the 10 µg/L standard (water) or the 50 µg/L standard (soil and sediment) 2. The area counts for all internal standards in the CCVs must be within a factor of two (-50% to +100%) of the 10 µg/L standard (water) or the 50 µg/L standard (soil and sediment) of the most recent initial calibration.	1. Inspect the mass spectrometric system for malfunction and correct. 2. Reanalyze affected samples. If the areas meet criteria, report data from the compliant analysis. 3. If reanalysis of the sample does not solve the problem, submit data from both runs, and document all inspection and corrective actions taken in the analytical narrative.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **MeC**[illegible]**ethylene** chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting lim[illegible]**PD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance ch[illegible]**pound**.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, review preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.
Semivolatile Organics by GC/MS: SW3520C/8270C (water; SW3540C/8270C) (soil and sediment)			
Holding time	Water: extract within 7 days of sampling; analyze within 40 days of extraction. Solid: extract within 14 days of sampling; analyze within 40 days of extraction.	Extraction and analysis are performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration curve	Established initially at 5 concentration levels	1. Initial calibration %RSD for all CCCs is $\leq$ 30%; RF for SPCCs is $\geq$0.05. 2. Average %RSD is # 15%, or use linear regression with r $\geq$ 0.990 (r2 $\geq$ 0.980).	1. Reanalyze check standard. 2. If similar results are obtained recalibrate instrument. 3. Reanalyze samples since last criteria met. 4. Document actions taken.
Initial Calibration Verification (ICV)	Second source mid-level standard immediately following initial calibration	%D for all CCCs is # 20 %; RF for SPCCs is $\geq$ 0.05.	1. Verify standard preparation, if incorrect reprepare ICV 2. Verify preparation of calibration standards if incorrect reprepare standards, and recalibrate instrument. 3. Document actions taken.
Continuing Calibration Verification (CCV)	Mid-level standard every 12 hours of analysis	%D for all CCCs is # 20 %; RF for SPCCs is $\geq$ 0.05.	1. Verify standard preparation and instrument operations, correct problem. 2. Repeat initial calibration. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentrations are less than the project RL for all analytes except the common laboratory contaminate bis-2-ethylhexyl-phthalate is less than five times the RL.	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. Reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
Surrogate spike	All field and QC samples	Surrogate recoveries must be within project specified control limits in Attachment B-6.	1. Examine all QC (including but not limited to LCS, MB). 2. If surrogate in LCS and/or MB is out-of-control, check quantitation. If quantitation is correct reanalyze. 3. If similar results are obtained from reanalysis, obtain fresh, verified surrogate solution, and reprepare and reanalyze the analytical batch. 4. If samples cannot be reprepared, qualify data. 5. If surrogate recoveries in LCS and MB are acceptable, and a) if 2 base/neutral or 2 acid surrogates are outside of QC limits or b) the recovery for any one surrogate is <10% in any sample, reprepare and reanalyzed sample to determine if matrix effect. If matrix effect is confirmed, report both analyses. Document all actions in the analytical narrative.
Internal Standard Responses and Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	1. Retention time for any internal standard must be within 30 seconds of the initial calibration, the retention times are compared to the 50 µg/L standard. 2. The area counts for all internal standards in the CCVs must be within a factor of two (-50% to +100%) of the 50 µg/L in the most recent initial calibration.	1. Inspect the mass spectrometric system for malfunction and correct. 2. Reanalyze affected samples. If the areas meet criteria, report data from the compliant analysis. 3. If reanalysis of the sample does not solve the problem, submit data from both runs, and document all inspection and corrective actions taken in the analytical narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, review preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **MeCl**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Attachment A-2

Title Pages of Ceimic's SOPs for Various Project Analytical Methods

CEIMIC CORPORATION

Standard Operating Procedure

No. 8270C

TITLE:

SEMI-VOLATILE ANALYSIS BY SW846 METHOD 8270C

FINAL

Approved By:

Jane King
QA/QC Officer

Laboratory Manager

Jane King
Laboratory Supervisor

Previous Revision Date: 6/25/98

Date Revised: 2/29/00

DATE ISSUED

MAR 01 2000

Control No.: 1/1

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CEIMIC CORPORATION

Standard Operating Procedure

No. 8260B

TITLE:

GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS BY SW846 METHOD 8260B

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

DATE ISSUED

MAR 01 2000

Previous Revision Date: 2/11/99

Date Revised: 2/29/00

Control No.: M/4

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CEIMIC CORPORATION

Standard Operating Procedure

No. 6010B

TITLE:
INDUCTIVELY COUPLED PLASMA - ATOMIC EMISSION SPECTROSCOPY BY SW846 METHOD 6010B

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

Previous Revision Date: 1/17/97

DATE ISSUED

MAR 01 2000

Date Revised: 2/29/00

Control No.: N/A

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Jeff

CEIMIC CORPORATION

Standard Operating Procedure

No. 300A

TITLE:

DETERMINATION OF INORGANIC ANIONS BY EPA METHOD 300.0 ION CHROMATOGRAPHY (REV. 2.1)

Approved By:

Jane Hung
QA/QC Officer

Donald Tatarelli
Laboratory Manager

Jeffrey D. Mangmon
Laboratory Supervisor

DATE ISSUED
JAN 15 1999

Previous Revision Date: 12/4/96

Date Revised: 1/14/99

Control No.: 300A-02

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CEIMIC CORPORATION

Standard Operating Procedure

No. 3810

TITLE:

METHANE, ETHANE AND ETHENE GASES IN WATER SAMPLES BY GAS CHROMATOGRAPHY ANALYSIS OF SAMPLE HEADSPACE

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

FINAL

Previous Revision Date: 4/14/99

Date Revised: 3/27/00

Control No.: U/A

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CEIMIC CORPORATION

Standard Operating Procedure

No. Method 5035

TITLE:
Closed-System Purge-and-Trap and Extraction for
Volatile Organics in soil and waste samples

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

FINAL

Previous Revision Date: 05/04/00

Date Revised:

Control No.: 5035-01

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Attachment A-3

USACE's QA Sample Summary and Shipment Instructions

INSTRUCTIONS FOR SHIPMENT OF QUALITY ASSURANCE SAMPLES

Date: October 4, 1999 **(revised 11 May 2000)**

Name of Contractor: EA Engineering, Science, and Technology, Bedford, MA
James Schultz
Phone: (781-275-8846

Name of USACE Project: Former NIKE PR-58 and Adjacent Navy NCBC Davisville Site 03
Characterization of CVOC Contamination
Location of Project: North Kingstown, RI
Contract No.: DACA31-94-D-0025; task order 0181
QA Laboratory No: E0853
Name of Primary lab: CEIMIC Laboratory, Narragansett, RI

Quality Assurance (QA) samples for this project should be shipped to the following QA Laboratory:

Severn Trent Laboratories
55 South Park Drive
Colchester, VT 05446
Phone: (802)-655-1203
Fax: (802)-655-1248
Laboratory Point of Contact: Brian Blair

Instructions for EA Engineering, Science, and Technology, Inc.:

1. Fill out necessary documentation (i.e. Chain of Custody (COC) forms, etc), and ship samples in accordance with the procedure specified in the Work Plan/Quality Assurance Project Plan (QAPP) to the laboratory stated above. Include the project name and QA Laboratory project number on all documentation sent to the QA laboratory. Include specific method references on the COC forms for extraction and analysis of samples (in accordance with the method references stated in the approved QAPP).

2. Within 24 hours of shipment of samples to the QA Laboratory, fax copies of QA Chain of Custody forms to: Bill Saner, Fax number: (978)-318-8663

   Address: US Army Corps of Engineers, New England District, CENAE-EP-GE
   696 Virginia Road
   Concord, MA 01742-2751
   Phone: (978)-318-8734

3. Please direct questions regarding this procedure to Bill Saner (978)-318-8734 or Marie Wojtas at (978)-318-8175.

Project: NIKE PR-58 and Adjacent Navy NCBC Davisville Site 03, North Kingstown, RI; QA Lab No. E0853

date: 11 May 2000

QA SAMPLE SUMMARY

ANALYSIS	NUMBER OF SAMPLES	PREP METHOD	ANALYSIS METHOD	REPORTING LIMITS	COMMENTS
VOCs – Water Soil	10 + TBs 2 + TBs	5030B 5035	8260B 8260B	1-5 ppb 125-250 ppb	Soil samples will be preserved with methanol
SVOCs – Water Soil	1 1	3520C 3540C	8270C 8270C	10-15 ppb 330-1500 ppb	
TAL metals – Water Soil	2 1	3010A 3050A	6010B/7470A (Hg) 6010B/7471A (Hg)	standard	
Anions - Water (nitrate, sulfate, sulfide, chloride)	9	NA	300	standard	
Manganese - Water	9	3010A	6010B	standard	
Alkalinity - Water	9	NA	310.1	standard	

Note: Reporting limits should be lowest achievable for the referenced methods.
NA = Not Applicable.
Laboratory results turnaround time: standard (3-4 weeks from receipt of samples at the laboratory)

Send laboratory results report to the following address:

Bill Saner
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Cost code: L22102; funded work item number: see Peter Hugh (x78452)
Primary lab: CEIMIC Corporation, Narragansett, RI
QA Laboratory: Severn Trent Laboratory, Colchester, VT
Contractor: EA Engineering, Science, and Technology, Inc., Bedford, MA
Samples to be collected week of May 23 – August 15, 2000

Attachment A-4

Data Structure

ATTACHMENT A-4. (DATA STRUCTURE)

TABLE 1: SAMPLE LOCATION

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
LOCATION	C	15	The unique identifier for a specific sample location. (ie. well, boring,etc.) Examples: 01GW04 (site 01 groundwater well # 04), 01HP06 (site 01 hydropunch # 6), 01SED05 (site 01 sediment sample # 5), BGSED07 (background sediment sample # 7), 06SW05 (site 06 surface water sample/location # 5)
REF_ELEV	N	8.2	The elevation of this location.
TOT_DEPTH	N	6.2	Total depth below ground surface that this hole was drilled.
EASTING	N	10.2	The easting coordinate of this location.
NORTHING	N	10.2	The northing coordinate of this location.
TOP	N	5.1	The depth below ground surface to the top of the sampling point. For soil samples will be the Top of the split spoon depth. For groundwater, this will be the top of the screen.
BOTTOM	N	5.1	The depth below ground surface to the bottom of the sampling point. For soil samples will be the bottom of the split spoon depth. For groundwater, this will be the bottom of the screen.
TOP_CASING	N	8.2	The elevation of the top of the well casing.
SURVEYED	C	1	"Y" if the northing, easting, ref_elev, etc were surveyed. "N" if the coordinates "N" if the coordinates were digitized.
SURVEYOR	C	50	The name of the surveying company if the coordinates were surveyed.
SURV_DATE	I	8	The date the survey was conducted (i.e. 19970724 = 07/24/97)

TABLE 2: SAMPLE ATTRIBUTES

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
LOCATION	C	15	The unique identifier for a specific sample location. (ie. well, boring,etc.) Examples: 01GW04 (site 01 groundwater well # 04), 01HP06 (site 01 hydropunch # 6), 01SED05 (site 01 sediment sample # 5) BGSED07 (background sediment sample # 7), 06SW05 (site 06 surface water sample/location # 5)
SAMPLE_NO	C	30	The unique character string that identifies a specific sample specimen. If well names have been used instead of sample names, the sample date shall be appended to the sample name. For field duplicates, the sample number shall be identical to the original sample name plus "-D". Examples: 01GW07 07/24/97 - D (site 01 groundwater well # 7 collected July 24 1997 - Duplicate) duplicate.
MATRIX	C	7	The sample matrix. Examples: GW (groundwater), GWF (filtered groundwater), SOIL, SED, (sediment), PVMT (pavement) and TISS (tissue sample), TANKAQ (tank aqeuous), TANKSED (tank sediment).
TOP	N	5.1	The depth below ground surface to the top of the sampling point. For soil samples will be the Top of the split spoon depth. For groundwater, this will be the top of the screen.
BOTTOM	N	5.1	The depth below ground surface to the bottom of the sampling point. For soil samples will be the bottom of the split spoon depth. For groundwater, this will be the bottom of the screen.
TURB_NTU	N	5.2	Turbidity in well when sample was collected (measured in NTU's)
VALIDATED	C	1	This field will contain a "y" if the data has been validated and an "N" if the data has not been validated.
OUR_RESULT	C	15	A character string with the result and qual fields combined and separated by two spaces. The purpose of this field is for reporting and tag maps in the GIS.(ie. 16 J)
COMPOSITE	C	1	This field will contain a "Y" if this sample is a composite.
EXCAVATED	C	1	This field will contain a "Y" if this sample has been excavated.
SOURCE	C	80	This field describes the source document or file in which the information for this sample was taken. For historical data, the document title, author and date should be included. if the historical information was provided electronically, the title of the diskette and the name of the contractor who provided the diskette shall be included in this field.

C = Character string (everything shall be reported in capital letters)
I = Integer string
N = Numeric string (decimal places as indicated after period)

TABLE 3: LAB ANALYTIC RESULTS

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
SAMPLE_NO	C	30	Field sample ID as listed on the chain-of-custody. The sample number indicated in this field should never be truncated. The only exception for this field not matching the chain-of-custody is for reanalysis and matrix spike results in which a RE or MS suffix will be added to the sample number respectively
TRUNCATE	C	15	If the field sample ID listed on the Chain of Custody is truncated by the laboratory for use with the laboratory software, the truncated laboratory ID should appear in this field.
LAB_ID	C	15	Laboratory number for the given sample.
LABORATORY	C	25	Laboratory name.
BATCH_NO	I	10	Laboratory code for batch of samples in a given run.
ASSOC_BLNK	C	15	Laboratory name of the method blank associated with that particular batch of samples.
QC_TYPE	C	15	Normal, Duplicate, Matrix Spike, etc.
COLL_DATE	I	8	Date of sample collection as indicated on the Chain of Custody. Example: 19971107 = 11/07/97
REC_DATE	I	8	Date sample was recieved by the laboratory.
EXTR_DATE	I	8	Date sample was extracted or prepared by the laboratory.
ANAL_DATE	I	8	Date sample was analyzed by the Laboratory.
SDG	C	15	Sample delivery group identifier assigned by the laboratory.
PROJECT_NO	C	10	Identification of Project Number or CTO number.
PARAMETER	C	45	Chemical or analyte name as reported on Form 1.
CAS_NO	C	10	Chemical Abstract Service number for the parameter listed. This field should be left blank for those parameters not having CAS numbers(e.g. Total Organic Carbon)
FRACTION	C	5	Metals + 'M', Volatiles = 'OV', Semivolitiles/BNAs = 'OS', Pesticides = 'PEST', Polychlorinated Biphenyls = 'PCB', Radionuclide = 'RAD', Miscellaneous = 'MISC'.
METHOD	C	20	Analytical method used to quantitate parameter concentrations. SW846 method names should be used if applicable.
LAB_RESULT	N	15.4	Reported value in units specified in the UNITS field containing the proper number of significant digits. The % Recovery shall be placed in this field for matrix spike results.
UNITS	C	5	The units of measure as reported on the Form 1.
LAB_QUAL	C	2	The laboratory qualifier as reported on the Form 1. For example, a U qualifier should be used for all nondetected results.
IDL	N	10.4	Instrument detection limit in units specified in the UNITS field.
MDL	N	10.4	Method detection limit in units specified in the UNITS field and method specified in the METHOD field.
CRDL_CRQL	N	10.4	Contract Required Detection/Quantification Limit in the units specified in the UNITS field. RDL for non-CLP parameters.
DIL_FACTOR	I	5	Dilution factor.
PCT_MOIST	N	5	Percent moisture for soil samples; blank for water samples.
COMMENTS	C	20	Analytical result qualifier or comment other than that listed in the LAB-QUAL field. Example; "Reanalysis'

C = Character string (everything shall be reported in capital letters)
I = Integer string
N = Numeric string (decimal places as indicated after period)

SHERP

2. PERSONNEL

2.1 KEY PERSONNEL

Contract Task Order (CTO) Manager:	Jim Shultz,CPG	(781) 275-8846
Program Safety and Health Officer:	Barry Weissman	(732) 404-9370 Pager (888) 451-3578
Site/Task Manager*:	Jeff Norberg,	(781) 275-8846
Site Safety and Health Officer:	Jeff Norberg	
Field Personnel:	Jeff Norberg, Jim Shultz, Stella Kiras, Sam Whitin, Kevin Baum, Tom Biolsi, Jennifer Martin, Dan Bishuk, John Clark, Sue Chase, Mike Chase, Sandy Staigerwald, Steve Welzant, Stephanie D'jimas, James Gatherer, Bob Haras, Kim Shutty, Robert Wasserman	

* Certification of 8-Hour Supervisor's Training for Hazardous Waste Operations (HWO) is required for Site Manager.

2.2 RESPONSIBILITIES

The responsibilities for health and safety-related issues for program operations are as follows.

2.2.1 Project Manager

The responsibilities of the Project Manager include the following:

- Overseeing the preparation of the SSHSP
- Ensuring that the SSHSP is available onsite
- Assuring compliance with this SSHSP
- Coordinating with the designated USACE, Navy, and Rhode Island Economic Development Corporation (RIEDC) Technical Representatives
- Providing overall supervisory control for health and safety protocols in effect for the project
- Assigning the Site Manager and SHSO and assuring that the assigned onsite staff will enforce provisions of the approved SSHSP
- Assuring adequate resources are available for health and safety.

2.2.2 Program Health and Safety Officer

The Program Health and Safety Officer is responsible for the following:

- Providing senior review of this SSHSP
- Conducting audits of Delivery Orders for health and safety and stopping work if unacceptable health and safety risks exist
- Reviewing consultants' and subcontractors' health and safety programs, as they relate to work under the Delivery Order, to ensure consistency with EA's health and safety program.

Mr. Kris Hoiem, a Certified Industrial Hygienist, will be the substitute Program Health and Safety Officer in the event that Mr. Weissman is unavailable.

2.2.3 Site Health and Safety Officer

The SHSO will be onsite throughout the project and will be responsible for daily compliance with site health and safety requirements. The duties of the SHSO include the following:

- Stopping work, and directing shutdown of the work site if imminent safety or health risks exist or as outlined in this SSHSP
- Implementing usage of forms provided in attachments
- Implementing the SSHSP
- Providing an initial health and safety briefing to site workers and visitors
- Reviewing training and medical records (Table 2-1) prior to site work
- Evaluating reported hazardous conditions and recommending corrective action
- Conducting necessary monitoring
- Establishing and ensuring compliance with site control areas and procedures
- Ensuring decontamination of personnel, tools, and equipment
- Supervising the distribution, use, maintenance, and disposal of personal protective clothing and equipment
- Investigating and preparing incident reports as necessary.

2.2.4 Site Manager

The Site Manager (or the SHSO) during an emergency will be responsible for initiating and coordinating responses. The Site Manager will be responsible for the following:

- Work with the SHSO to identify and evaluate hazards
- Be responsible for initiating the evacuation of the work site when needed, or as directed by the SHSO, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders
- Determine if the abatement of hazardous conditions is sufficient prior to allowing resumption of work operations after an emergency.

2.2.5 Field Personnel and Subcontractors

Employees (including subcontractor and consultant employees) will be responsible for the following:

- Following this SSHSP and applicable health and safety rules, regulations, and procedures
- Using required controls and safety devices, including PPE
- Notifying his/her supervisor of suspected safety or health hazards
- Complying with training and medical requirements.

2.3 VISITORS

Visitors will be required to read and verify their understanding and willingness to comply with this SSHSP. Visitors will remain in an observation area and will not be allowed in the Exclusion Zone unless they have complied with the appropriate OSHA training and medical requirements (Table 2-1) and have the permission of the Project Manager or the SHSO.

10. MEDICAL MONITORING/ TRAINING REQUIREMENTS

Dates of employee training are documented in Table 2-1. Any person who does not meet these training requirements is prohibited from engaging in site operations. Once the SSHSP has been signed by the Project Manager, no other personnel may be added to the project field work without prior written approval by the Project Manager or SHSO, who must review the proposed employee's training and medical status. The following training must be completed prior to the start of work operations.

10.1 MEDICAL MONITORING

Hazardous waste site workers must have satisfactorily completed a comprehensive medical examination by a licensed physician within 12 months prior to the start of site operations. Non-hazardous waste site workers will be medically examined and undergo an annual respirator fit test to meet OSHA requirements specific to their job. The date of medical examination and respirator clearance for each EA site worker will be recorded on Table 2-1. Subcontractors will provide this information in writing to the Project Manager for their workers onsite prior to startup of field activities. Medical surveillance protocols shall comply with 29 CFR 1910.120.

10.2 TRAINING

All personnel must be active participants in a medical monitoring program that complies with 29 CFR 1910.120(f). Only individuals that will be in the field greater than 30 days will need to have completed an annual surveillance examination. Each individual must have completed an initial baseline examination within the last year prior to performing any site work covered by this SSHSP.

10.2.1 All Site Workers

- Prior to project start-up, 40-hour initial OHSA training, and 3 days of onsite training under the direct supervision of a more experienced site worker

- 8-hour annual OHSA refresher training (if >12 months have passed since 40-hour initial training or previous 8-hour refresher).

10.2.2 Site Manager

- Above requirements for site workers, plus one-time OHSA 8-Hour Supervisor's Hazardous Waste Operations Training.

10.2.3 Subcontractor Training

Prior to the start of work operations, the Project Manager will obtain a written list of subcontractor personnel to be present onsite, and written certification from the subcontractor management that these workers meet the training requirements summarized above in Section 10.2.

Non-hazardous waste site workers will have been trained to meet applicable OSHA requirements specific to their work. Training records and certification letters will be managed and maintained per the EA's Safety and Health Program Management Plan.

10.3 PRE-ENTRY BRIEFING

All site workers will read the SSHSP and indicate their understanding of the requirements by signing Attachment A, Site Health and Safety Review Record. The SHSO must check the training status of all onsite personnel and then brief workers on the potential hazards at the site and protective measures to be implemented, both prior to entry and daily during the work. An evacuation location to be used in the event of an emergency must be designated and known to all personnel. This location should be an upwind point from site activities, in an area not expected to be affected by emergency situations onsite. Authorized visitors are not permitted to enter areas where they may be exposed to hazardous substances if they do not meet the training requirements summarized above in Section 10.2.

10.4 FIRST AID/CPR

At least two employees currently trained in first aid/CPR will be on site while work is being performed. Directions to the Kent County Memorial Hospital are given in Table 11-1 and shown on the map in Attachment I.

TABLE 2-1 SITE WORKER TRAINING AND PHYSICAL EXAMINATION RECORD

SITE: NCBC Davisville Site 16

Name	HAZWOPER 40-Hour Initial	HAZWOPER Annual	Respirator Fit Test	First Aid[a]	CPR[a]	Supervisor[b]	Medical Exam
James Shultz	1984	3/00	---	12/91	11/93	2/93	4/99
Barry Weissman	1995	12/99	12/99	8/97	8/97	9/95	10/99*
Jeff Norberg	1994	3/00	3/00	10/99	10/99	2/99	4/99*
Kevin Baum	2000	1/00	1/00	5/00	5/00	---	3/00*
Stella Kiras	1997	3/00	3/00	11/97	10/98	---	1/99*
Sam Whitin	2000	2/00	3/00	2/00	2/00	---	2/00*
Tom Biolsi	1997	10/99	2/99	4/98	4/98	---	10/99*
Jennifer Martin	1999	3/00	---	5/99**	5/99**	---	5/00
Dan Bishuk	1991	3/91	---	5/99**	5/99**	3/97	11/98**
John Clark	1998	3/00	---	5/99**	5/99**	---	2/00
Sue Chase	1993	4/00	---	3/99	3/99	4/93	6/99
Mike Chase	1996	4/00	---	3/99	3/99	---	5/00
Sandy Staigerwald	1989	7/99	5/00	1/99	1/99	12/90	***
Steve Welzant	1997	10/99	5/00	1/99	3/00	7/98	10/98**
Stephanie D'jimas	1998	2/00	---	8/99	8/99	---	8/99
James Gatherer	1999	2/00	---	8/99	8/99	---	12/99
Bob Haras	1989	2/00	---	8/99	8/99	12/94	3/00
Kim Shutty	1989	2/00	---	8/99	8/99	12/94	4/00
Robert Wasserman	2000	4/00	---	8/99	8/99	---	4/00

(a) At least two persons onsite must have current certification in first aid/CPR for all tasks.
(b) At a minimum, the Site Manager must have had supervisor's training.
* respirator clearance was issued at time of medical exam
** planned to be taken 6/00
*** planned to be taken 7/00
NOTE: No employees other than those listed above are permitted to work onsite without prior written approval by the Project Manager or SHSO.

TABLE 7-1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

Equipment	Level D	Level C
Hard hat	X[a]	X
Safety glass/splash shield	X/O	X/O
Work clothes	X	O
Boots, safety with steel toe/steel shank	X	NR
Boots, chemical resistant with steel toe and shank, or boot covers to go over safety boots	NR	X
Gloves, inner and outer, chemical resistant (nitrile)	O	X
Air-purifying full-face or half-face respirator	NR	X[b]
Chemical-resistant clothing	NR	X
Disposable boot protectors	NR	O
Hearing protection	O	O
Two-way radio communication	NR	X*

(a) Hard hat will be required while within the Exclusion Zone of the drilling rig, due to overhead hazards.

(b) Must comply with OSHA respirator cartridge provisions.

NOTE: X = Required.
O = Optional.
NR = Not required.
X* = If permitted.

WORK PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03 NORTH KINGSTOWN, RI

CONTRACT NUMBER DACA31-94-D-0025
DELIVERY ORDER NO. 0181

Prepared for:

U.S. Army Corps of Engineers, New England District
696 Virginia Road
Concord, MA 01742-2751

Prepared by:

EA Engineering, Science, and Technology, Inc.
175 Middlesex Turnpike, Wyman Building
Bedford, Massachusetts 01730
(781) 275-8846

FINAL
60957.56.0001
April 2000

WORK PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03 NORTH KINGSTOWN, RI

CONTRACT NUMBER DACA31-94-D-0025
DELIVERY ORDER NO. 0181

James A. Shultz, CPG
Project Manager

19 April 2000
Date

Brenda Herman
Program Manager

4/18/00
Date

FINAL
60957.56.0001
April 2000

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APPENDIX A QUALITY ASSURANCE PROJECT PLAN (QAPP)
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1. INTRODUCTION

This Work Plan has been prepared for the U. S. Army Corps of Engineers – New England District (USACE) to present the investigative plan and field procedures for the joint USACE-Navy chlorinated volatile organic compound (CVOC) investigation ("Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy Property") under Contract No. DACA31-94-D-0025, Delivery Order No. 0181. As agreed upon by USACE and the Navy, for efficiency and because of the concurrent nature of the joint investigation activities, both the USACE and Navy portions of the joint investigation are included in this Work Plan prepared for USACE with input for the Navy portions. The investigation of the former Nike PR-58 Site will be preformed under the Defense Environmental Restoration Program-Formally Used Defense Sites (DERP-FUDS) Program. The Navy portion of the joint investigation is being performed under the Base Realignment and Closure Act (BRAC) Contract No. N62472-92-D-1296, Contract Task Order (CTO) 0096. The Quality Assurance Project Plan (QAPP) is provided as Appendix A and describes the laboratory testing program which will be utilized for the collection of analytical data in support of the joint USACE-Navy investigation. The related Site-Specific Health and Safety Plan (SSHSP) is included as Appendix B and all field work will be performed in accordance with the SSHSP.

The Navy's investigations at the adjacent Naval Construction and Battalion Center (NCBC) identified dissolved CVOC in the deep ground-water. Based upon the findings presented in the Navy's 'Nike Source Area and Offsite Investigation' Final Interim Report dated October 1998, the main source area for the CVOC plume detected in deep zone ground-water samples was in the vicinity of monitoring well MW03-14D located just east of the former Nike PR-58 Site and west, up-gradient of Navy property. Three other secondary source areas are suspected and are located on the Navy's property. Based upon these findings and the comments from the U.S. Environmental Protection Agency - Region 1 (EPA) and the Rhode Island Department of Environmental Management (RIDEM), additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the bedrock.

The main contamination of concern is a dissolved CVOC plume in the deep soil and bedrock ground-water zones. The plume in the water-table overburden zone at the former Nike PR-58 site has considerable characterization from previous investigations, but some additional study is needed, particularly in the deep overburden zone. The CVOC plume has been detected in the bedrock ground-water zone, but further work is needed to assess the extent of CVOC contamination in the deeper bedrock zone. The U.S. EPA is the lead regulatory agency overseeing activities within the Navy property (BRAC funded). The RIDEM is the lead regulatory agency overseeing the activities within the Nike area (DERP-FUDS funded).

The former Nike PR-58 missile launch site (deactivated in 1962) is located in North Kingstown, Rhode Island. A description and history of the site is summarized in the following sections.

1.1 SITE LOCATION

The former Nike PR-58 Site and the Site 03 portion of NCBC Davisville are located adjacent to one another in the town of North Kingstown, Rhode Island, approximately 18 miles south of Providence (Figure 1).

1.2 OBJECTIVES AND SCOPE OF WORK PLAN

The objectives of the additional characterization within the Nike and the northern residential area **(the USACE portion)** are to:

- Further assess the nature and extent (lateral and vertical) of the potential primary CVOC source area in the competent bedrock in the vicinity of MW03-14.
- Assess the nature and extent (lateral and vertical) of the potential second CVOC source area in the sand and gravel / weathered rock and competent bedrock zones at the end of a 20-25 ft dirt road just east of the former bermed area where monitoring well EA-114 is planned to be located (Figure 2). This area was alleged by recent information from RIDEM to have been an area of historical disposal of solvents and acids.
- Assess the nature and extent of the CVOC plume with specific focus on the northeast edge that extends off the former Nike Site and Navy properties, north of Perimeter Road (impacting the GA aquifer).
- Further assess natural attenuation (develop isopleth plots).
- Assess remedial alternatives in a focused manner.

The objectives of the additional characterization within the Navy property **(the Navy portion – BRAC)** are to:

- Document the direction of ground-water flow and assess the nature and extent in the competent bedrock of the CVOC plume that has extended east beneath the Navy property from the former Nike PR-58 Site area.
- Further assess natural attenuation within the Navy property.

To accomplish these objectives, the following work will be performed:

For the USACE:

- Installation, development, and testing of 15 monitoring wells. Two (2) of the wells will be screened in the deep overburden ('D')ground-water zone, 8 of the wells will be completed in the shallow competent bedrock ('R') ground-water zone, and 5 of the wells will be completed in the deeper competent bedrock ('R2') ground-water zone. Additionally, up to 7 optional wells may be installed.

- During drilling, collect and analyze two (2) soil samples from each of the following monitoring well locations [i.e., EA-114D, EA-115D (an 'optional well'), EA-116D, and EA-117D (an 'optional well')].
- Sampling and analyzing of ground water from the 15 new wells, up to 7 optional wells, plus 19 existing deep ('D') and rock ('R') wells at the site.
- Performance of data validation of the soil and ground-water analytical results.
- Preparation of a report documenting the USACE and Navy field investigation results, conclusions, and recommendations.
- Assess, identify, and recommend remedial action alternatives. An elaborate detailed level of effort is not the intent of this assessment.

For the Navy:

- Installation, development, and testing of 5 monitoring wells completed in shallow competent bedrock ground-water zone.
- Sampling and analyzing of ground water from the 5 new wells, plus 31 existing deep ('D') and rock ('R') wells in the NCBC Site 03 vicinity.
- Performance of data validation of the ground-water analytical results.
- Preparation and incorporation of the related Navy field investigation results, conclusions, and recommendations in the USACE report of the joint Navy / USACE investigations.

1.3 PROJECT ORGANIZATION

The Project Organization is shown on Figure 3.

1.4 WORK PLAN ORGANIZATION

This Work Plan is organized as follows:

- Chapter 1 presents the objectives of the investigation, the purpose and scope of the sampling plan, and project organization.
- Chapter 2 presents the description and history of the site.
- Chapter 3 presents the field program and rationale.
- Chapter 4 presents the field procedures that will be used to implement the field program.

- Attachment 1 presents the Seismic Refraction Field Procedures from Geophysical Applications, Inc.
- Attachment 2 presents the Soil Gas Study Field Procedures.
- Attachment 3 presents the borehole geophysical procedures (to be obtained after selection and contracting of the related geophysical service firm).
- Attachment 4 presents examples of forms which will be completed during field activities.
- Appendix A presents the QAPP.
- Appendix B presents the SSHSP.

2. BACKGROUND INFORMATION

2.1 SITE DESCRIPTION and HISTORY

The following has been excerpted from the Revised Draft Final, Study Areas 01 and 04 and Installation Restoration Program (IRP) Sites 02 and 03, Phase III Comprehensive Remedial Investigation Report, NCBC Davisville, Rhode Island, prepared by EA for the Navy and dated December 1998 (EA 1998)

2.1.1 Former PR-58 Site

The former Nike Site is currently owned by the Rhode Island Economic Development Corporation (RIEDC) and has been the subject of environmental investigations by USACE under the DERP-FUDS Program. The area bounded by Perimeter Road, Seabee Avenue, and Babcock Road (Figure 2) which was formerly part of Camp Thomas, was not used after World War II until 1955-1956 when the Army constructed a Nike missile battery. The area between the Nike Site and Seabee Avenue has apparently not been used since World War II as evidenced by the forest cover which this area now supports. Aerial photographs from 1951 to 1976 show the area as vegetated and undeveloped. The former Nike site included three underground missile silos (Buildings 347, 348 and 349), a refueling area located to the south of Building 347, a missile assembly and test building (Building 344) with an underground storage tank (UST), a generator building with a 4,000 gal UST (Building 345), and personnel quarters. The facility was constructed during the mid-1950s and was equipped with short-range, conventionally-armed Nike Ajax missiles. The facility was deactivated in 1962. In 1995, the Army drilled holes in the bottom of each silo, backfilled the missile silos with clean sand, and demolished the concrete pads surrounding the silos.

Construction drawings of the Nike Site show a leaching field for sanitary wastes 250 ft east of Building 343 which was the Ready (personnel) Building. The building was later used by the Navy as a training classroom. Each missile silo was equipped with a sump pit to collect liquids which had accumulated in the bottom of each silo. The contents of the pit were pumped via pipe and discharged directly into a ditch which ran along the eastern edge of the silos. The concrete pad which surrounded the silos also drained into this ditch. An acid neutralization pit and drainage sump were reportedly located at the missile refueling area which was just south of the three former missile silos.

There is no site specific documentation regarding the use, storage or disposal of hazardous material at this former Nike PR-58 Site. However, for Nike sites in general, a variety of chlorinated organic solvents such as carbon tetrachloride, tetrachloroethene (PCE), trichloroethane (TCA) and trichloroethene (TCE) were reportedly used for parts cleaning, cleaning of grease spills, and overall cleaning in preparation of painting. Typical quantities used ranged from 30 to 120 liters per month of TCE and 190 to 380 liters per month of other solvents.

The Navy reportedly used the area west of the missile silos as the Disaster Recovery Training Area between 1964 and 1974. The training consisted of classroom instruction and hands-on training. Reportedly, tear gas grenades, smoke pots and biological agent simulants were used for training purposes. Detonation cord, blasting caps and plastic explosives were also used in small quantities. All materials were considered to be consumed in use, and thus, no wastes were considered to have been generated. Although Decontaminating Agent - Non-Corrosive (DANC), a mixture of 1,1,2,2-tetrachloroethane (PCA) and 1,3-dichloro-5,5-dimethylhydantion, was reportedly stored at the Disaster Recovery Training Area, the available information does not indicate that there was training with DANC. Monitoring well EA-105D was installed in this area.

There are currently 30, 6-in diameter pipes which rise about 4 ft above grade that are located east of the missile silos. This area is referred to as the "pipe structure area". On 7 June 1996, the Navy investigated this structure. During the investigation, two of the southern pipes in the pipe structure were pulled from the ground to assess their extent. Based upon the field observations and the two removed steel pipes, the pipes are arranged in six rows of five pipes each. Each pipe was approximately 6-in in diameter, 4.5 ft in length, extended into the ground approximately 12 in., and was partially filled with sand. No odor or staining of the soil was observed where the two pipes were removed from the ground. Monitoring well EA-103D was installed adjacent to the east perimeter of the pipe structure.

In 1974, the land west of Seabee Avenue was transferred to the General Services Administration (GSA). In 1978, the GSA transferred ownership to Rhode Island Port Authority (RIPA), now RIEDC. RIPA leased 2.2 acres of land to Peabody Clean Industries (PCI) between 1980 and 1982 for use as a hazardous waste tank farm. At any one time, an estimated maximum of 50,000 gallons of oil/water waste; 10,000 gallons of waste solvents, waste oil, and sludge; and 20 drums of various hazardous materials were onsite. In 1983, the RIDEM directed PCI in a cleanup of soil impacted by the PCI activities at the site. RIPA removed the 4,000-gal UST at Building 345 and demolished many structures, including Building 345, as part of the cleanup/closure activities. Currently, RIEDC leases Building 344 to Marine Education Inc., which operates a marine repair training center.

2.1.2 NCBC Davisville Site 03

Site 03 is an unmarked, previously paved lot located west of Sayers Street, north of Parade Road and south of Battalion Boulevard (Figure 2).

From 1955 to the late 1970s, paint thinners and unidentified solvents were disposed on the ground, west of Sayers Street and Building 224. Neither the exact manner of solvent disposal nor the precise limits of the disposal area are known; however, the solvent disposal activity is thought to have occurred in an area, which borders Sayers Street. An Initial Assessment Study (IAS) performed by Fred C. Hart Associates, Inc. (Hart 1984) estimated that approximately 3,000 gallons of solvents were disposed at a rate of about 10 gallons per month. Part of Site 03 was also used to store heavy equipment (TRC 1991).

The area immediately west of Site 03, and extending north and west to Perimeter Road was formerly Camp Thomas. During World War II, military personnel were temporarily housed here. The camp included 800 huts scattered over 130 acres. At that time, Building 224 served as a recreation hall, drill hall, bowling alley, and pool (Ecology and Environment 1994). Camp Thomas was demolished after World War II. Building 224 was converted into a truck/heavy equipment maintenance facility in the early 1950's, and was used in that capacity until base closure in 1994.

Aerial photographs from 1951, 1957, 1963 and 1970 show that the area between Battalion Boulevard, Seabee Avenue, and Parade Road was paved and used for vehicle and equipment storage. Vehicles awaiting maintenance were also temporarily stored in this area. The area north of Battalion Boulevard and extending north to Perimeter Road was also used as a storage area; but, as early as 1970, the area was used as an equipment operator training area. There are no records of vehicle maintenance occurring in these areas. Building 378 which is located south east of the corner of the intersection of Battalion Boulevard and Seabee Avenue was built in 1968 for equipment operator training. All vehicle maintenance reportedly occurred in Building 224. Stained or darken surfaces suggesting disposal of waste oils on the ground were not observed on aerial photographs (dated 1951, 1957, 1963 and 1970) of the area to the west of Building 224, or during site inspections or field activities by the Navy in 1993, 1994, and 1995.

2.2 SITE AREA GEOLOGY

The site area from the former Nike PR-58 Site east to the Marine Road area of NCBC Davisville is characterized by Quaternary glacial deposits mantling the quartzitic and phyllitic bedrock (weathered and competent zones) of the Rhode Island Formation. In general, based upon logs of borings, the unconsolidated sedimentary (glacial) deposits consist of the following units presented in order from the ground surface downward (EA 1998):

(1) Glacio-fluvial deposits of sand with varying amounts of silt and/or gravel;
(2) Glacio-lacustrine deposits of silt to very fine sand and silt; and
(3) Sandy silty gravel to sandy gravelly silt (possibly till).

2.3 SITE AREA HYDROGEOLOGY

The identified geological units have been divided into three hydrogeological zones (beginning with the uppermost zone) (EA 1998):

(1) Shallow ground-water zone (typically the glacio-fluvial sand unit);
(2) Deep ground-water zone (the sandy silty gravel to sandy gravelly silt [possibly till] unit and the weathered bedrock zone); and
(3) Competent bedrock ground-water zone (the upper approximately 25 ft of competent bedrock).

The sandy gravel / gravelly sand and weathered bedrock units are considered as a single ground-water zone (the deep zone) because:

(1) No apparently continuous layer of lower permeability material (e.g. a clay layer) was encountered through this zone that could subdivide this zone;
(2) The weathered bedrock where quartzite (hard) and phyllite (soft) are interbedded, forms a zone that is hydrogeologically similar because of the apparent horizontal and vertical variation observed which would allow for horizontal and vertical flow (hydraulic communication) through it; and
(3) The two units are in direct hydraulic communication.

All three of these ground-water zones are in direct hydraulic communication beneath the former Nike Site where the main subsurface CVOC source has been detected. Further east (down gradient) beneath the adjacent Navy property, the shallow and deep ground-water zones are separated by a layer of silt to sandy silt. Based on the ground-water surface data, the deep zone ground water is interpreted to flow southeast from the former Nike site and the residential area located north of the Nike Site, and then, east southeast across Site 03 to an area where a slight ground-water mound is present northeast of the intersection of Marine Road and Davisville Road. This mound may be related to infiltration of rain during Winter 1998 that collected in the vicinity of the former gravel pit ('Snake Pit'). Because of this slight mound as interpreted from the February 1998 data, the ground-water flow east from the Nike Site appears to diverge in the vicinity of Building 224 to the northeast and southeast. Because of the northeast migration of a portion of the CVOC plume offsite, the water level data obtained from the new monitoring wells to be installed will be used to confirm the interpreted direction of ground-water flow, particularly in the areas beneath the Nike Site and residential area north of the Nike Site. There is also a small portion of the study area, west of the former Nike missile silos, where deep ground water is interpreted to flow toward the west.

Based upon the February 1998 water level data, ground-water flow in the bedrock is interpreted to be approximately toward the southeast from the former Nike PR-58 Site and the residential area located north of the former Nike Site. Because of the northeast migration of a portion of the CVOC plume offsite, the water level data obtained from the new monitoring wells to be installed will be used to confirm the interpreted direction of ground-water flow, particularly in the areas beneath the Nike Site and residential area north of the Nike Site.

3. FIELD SAMPLING PLAN

3.1 INTRODUCTION

The Field Sampling Plan states the field program and rationale. The field procedures are presented in Chapter 4.

3.2 FIELD PROGRAM

The field program is comprised of the following 5 key elements:

1. **Seismic Refraction profiling**. Previous site investigations have shown that the configuration of the surface of competent bedrock appears to have influenced the migration of the CVOC plume. In general, seismic refraction interpretive data is available for the areas of additional characterization except for the area of the northeast plume beyond EA-112D/R. Therefore, this task shall include up to 4,000 linear ft of seismic refraction survey to aid in locating: (1) the northeast trending valley in the competent bedrock surface, and (2) the location of the two planned monitoring well clusters (EA-116 and EA-117) in that area.

   Geophysical Applications, Inc. completed the seismic refraction profiling, as planned, in October 1999. A copy of the field procedures is provided as Attachment 1. The profiling lines were oriented as referenced in Figure 2.

2. **Soil Gas Study**. This task will include performance of a soil gas survey (up to 10 points) in the area east of the former 'bermed area' and west of Seabee Avenue. The purpose is to gather possible source area information to help select the location for the new monitoring well clusters EA-114D,R, and R2. Refer to Figure 2 for the planned location of this well cluster.

   EA completed the soil gas study as planned on 7 October 1999. A copy of the field procedures is provided as Attachment 2. Nine (9) soil gas samples were collected from six (6) locations at intervals ranging between four to eight feet below grade (bg). Soil gas samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX); 1,1,2,2-PCA; PCE; TCE; 1,1,2-TCA; and 1,2-DCE onsite by means of a Varian gas chromatograph (GC) interfaced with a Varian DS 654 data station. Analytical results indicated that the analytes were not detected above the method detection limit.

3. **Drilling/Installation of Monitoring Wells**. This task includes the installation of 15 new monitoring wells for the USACE and 5 for the Navy, plus the option of up to 7 additional wells for the USACE as listed on Tables 1a, 1b, and 1c. The approximate locations of these planned wells are shown on Figure 2. Based upon the available subsurface data, the planned depths and zones to be screened are also provided in the Tables. The rationale for each location and zone is also stated in Tables 1a, 1b, and 1c. The wells will be installed in accordance with the field procedures presented in Chapter 4. After completion of well

development, a dedicated bladder pump will be installed in each well for use during ground-water sampling. The pumps shall be compatible with the pumps in the existing monitoring wells (TIMCO Manufacturing, Inc.). All rock wells will require the performance of packer tests in cored holes or geophysical borehole logging in downhole air hammer drilled holes. The general method to be used for the respective wells is noted in Tables 1a, 1b, and 1c.

Monitoring well clusters EA–114, and EA-116 and MW03-14R2 are planned to be drilled first, so the need for optional wells EA-115, EA-117, and MW03-13R2, respectively, can be assessed and planned with the BCT early in the field program.

4. **Geophysical Borehole Logging**. Geophysical logging of the open rock portions of selected boreholes, as noted on Tables 1a, 1b, and 1c will be performed by a subcontractor after completion of the drilling activity. The selected borings will be logged to aid in the assessment of bedrock fractures and areas of ground-water flow. The planned geophysical methods are caliper, single-point resistivity, fluid temperature, heat-pulse, and acoustic televiewer logging. The related field procedures will be obtained from the related firm after selection and contracting has been completed. A copy of these field procedures will be provided at that time to be incorporated into the Work Plan as Attachment 3.

5. **Sampling and Analysis**. At four (4) monitoring well locations [i.e., EA-114D, EA-115D (an 'optional well'), EA-116D, and EA-117D (an 'optional well')], two soil samples will be collected and analyzed for the Target Compound List (TCL) VOC. The soil samples collected from EA-114D will also be analyzed for semi-volatile organic compounds (SVOC) and the Target Analyte List (TAL) inorganics (Tables 3-1 and 3-2). The soil samples will be selected base upon the criteria described in Section 4.4.1.1.

   For USACE, sampling and analysis of the 15 planned new and 19 existing deep ('D') and rock ('R') wells (Table 3-1) at the NCBC Site 03 vicinity to aid in assessment of the nature and extent of the CVOC plume in shallow competent bedrock. Additionally for USACE, are the 7 optional monitoring wells which may be installed as stated in Item Number 3, above. For the Navy, sampling and analysis of the 5 new and 31 existing deep ('D') and rock ('R') wells (Table 3-1) at the NCBC Site 03 vicinity to aid in assessment of the nature and extent of the CVOC plume in shallow competent bedrock.

   Ground-water samples will be collected using the low-flow sampling technique as has been used during previous Navy investigations at this site and in accordance with Section 4.7. Prior to sampling, depth to water will be measured in these wells for use in interpreting ground-water flow direction(s). To provide data that is consistent with the large existing database, the samples will be analyzed in accordance with Test Methods for Evaluating Solid Waste, SW-846, for the parameters shown on Tables 3-2 through 3-4.

   In general, ground-water samples to be collected from the monitoring wells will be analyzed by Ceimic Corporation for TCL VOC, methane, and selected general chemistry parameters (i.e., alkalinity, chloride, nitrate, sulfate, and sulfide). Ground-water samples to be collected from the EA-114 well cluster will also be analyzed for TCL SVOC and TAL

inorganics, in addition to TCL VOC, methane, and selected general chemistry parameters. Ground-water samples to be collected from EA-104D/R/R2, EA-106D/R, EA112D/R/R2, and EA-113D/R will also be analyzed for TAL inorganics, in addition to TCL VOC, methane, and selected general chemistry parameters.

A TAL inorganics aliquot of ground water will also be collected from EA-116D/R/R2 and EA-117D/R/R2 (an 'optional well' cluster), submitted to CEIMIC Corp, but held for up to 6 months (analysis will be required only if exceedance of related RIDEM ground-water standards is detected in the samples collected from EA-112D/R/R2 and EA-113D/R).

EPA plans to collect split samples of the ground water to be collected from EA-116D/R/R2.

4. FIELD PROCEDURES

Procedures for seismic refraction profiling; soil gas study; drilling activities and monitoring well installation, development, and testing; sampling; IDW management; and decontamination of reused field equipment are presented in this chapter.

The seismic refraction profiling, soil gas sampling, and drilling activity will be performed using the following guidelines:

- Obtain USACE, NCBC Davisville, and RIEDC approval for profiling and boring locations.
- Obtain all USACE (978-318-8452), NCBC Davisville (401-294-6108), RIEDC (401-277-3134), and Digsafe (888-344-7233) clearances for profiling and boring locations.
- Mitigate potential contamination of the aquifer by the drilling equipment.

All field work described here in will also be performed in accordance with the QAPP (Appendix A) and the SSHSP (Appendix B).

4.1 SUBSURFACE UTILITY CLEARANCE

NCBC Davisville, RIEDC, and Digsafe clearance will be obtained prior to conducting any subsurface drilling activities. Location and marking of all underground utilities in the vicinity of each site will be done prior to any drilling. The drilling subcontractor will obtain required drilling permits necessary for completion of the field work. This clearance will be coordinated by the EA Project Manager.

4.2 SEISMIC REFRACTION PROFILING

The seismic refraction profiling was performed by Geophysical Applications, Inc of Foxboro, MA, in October 1999, in accordance with their standard operating procedures, a copy of which is provided as Attachment 1.

4.3 SOIL GAS STUDY

The soil gas sampling was conducted by EA, on 7 October 1999, in accordance with the field procedures provided as Attachment 2.

4.4 DRILLING AND SUBSURFACE SOIL SAMPLING

Borings will be drilled for the installation of "deep" ('D') zone (overburden and weathered bedrock) monitoring wells, "shallow competent bedrock" ('R') zone monitoring wells, and "deeper competent bedrock" ('R2') zone monitoring wells listed on Tables 1a, 1b, and 1c and shown on Figure 2.

Drilling will be performed using the hollow stem auger (HSA) or air rotary/downhole hammer method with 4- to 5-in diameter steel casing which has been steam cleaned (in accordance with the Decontamination Procedure in Section 4.11) prior to use at each boring. The following presents the various methods for the monitoring wells listed on Tables 1a, 1b, and 1c:

Hollow Stem Auger (HSA) for Overburden and Weathered Bedrock ('D') Screened Monitoring Well – 6.25 in. inner diameter (ID) HSA to the top of competent bedrock, tri-cone drill 3-ft into rock to confirm rock, then obtain a 5-ft length of HQ-core of the rock. The overburden will be sampled using a 2.5-in to 3-in inner diameter (ID) split-barrel sampler that is 18 in. or 24 in. in length. Split-barrel samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be continuous to the top of bedrock or refusal.

For EA-114D and EA-116D that will be drilled by this method, the following special field testing will be performed during the drilling of each of these borings/wells: the 3-ft interval just above competent bedrock will be slug tested, the 3-ft interval just below the top of competent bedrock will be slug tested, and the 5-ft cored interval will be packer tested.

Place a bentonite seal within the core hole to top of competent rock unit [following the special hydraulic conductivity tests in EA-114D and EA-116D (i.e., slug and packer tests)]; and then, construct a 2-in ID PVC well with 10-ft length of screen (6-to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space as the HSA is removed. The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Hollow Stem Auger (HSA) and Coring for Shallow Competent Bedrock ('R') Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' companion well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. There will be no sampling of the overburden. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the HSA is removed (allow grout to setup for 24-hours before beginning coring). HX-core (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. Perform packer testing of each of the 5 cored intervals of rock.
[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]

The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Hollow Stem Auger (HSA) and Coring for Deeper Competent Bedrock ('R2') Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' and 'R' companion wells, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5 in. ID drill casing. There will be no sampling of the overburden. Continue with wash drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed (allow grout to setup for 24-hours before beginning coring). HX-core (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. Perform packer testing of each of the 5 cored intervals of rock.

[If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC). The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]

The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

Air Rotary/Downhole Hammer for Shallow Competent Bedrock ('R') Monitoring Well – Because of concerns due to potential air emissions during drilling, this method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. There will be no sampling of the overburden. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the HSA is removed (allow grout to setup for 24-hours before continuing drilling). Air/downhole hammer drill 25 ft of the bedrock beyond the bottom of the 4-in steel casing.

The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Air Rotary for Deeper Competent Bedrock ('R2') Monitoring Well – This method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep and shallow bedrock wells, 6.25-in ID HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5-in ID drill casing. There will be no sampling of the overburden. Continue with air drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout 4-in ID steel casing centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed (allow

grout to setup for 24-hours before continuing drilling). Air/downhole hammer drill 25 ft of the rock below the bottom of the 4-in ID steel casing.

The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Additional drilling, soil sampling, and monitoring well construction procedure details are described in the following sections.

4.4.1 Soil Boring and Sampling

Drill cuttings will be containerized and handled in accordance with the Investigative Derived Waste (IDW) procedures (Section 4.12). The area above the borehole will be monitored with a photoionization detector (PID) equipped with an 11.7 electron volt (eV) probe. The PID will be calibrated each work day before work begins, after lunch, and as required in the field. The PID calibration will be checked with the appropriate span gas at the end of the work day to ensure that the last measurements taken are acceptable. The procedures for the calibration of the PID are included in Attachment F of the SSHSP (see Appendix B of the Work Plan).

Drilling and sampling equipment including drill pipe, sampling tools, and drill casing will be freed of potentially contaminating materials by steam cleaning prior to use at each boring as stated in Section 4.11. The drill rig will be steam cleaned prior to use at the former Nike PR-58 Site and NCBC Davisville Site 03 areas and as required by the EA Geologist or Engineer. The rig will be free of leaks which could potentially contaminate the borings. No petroleum-based lubricant will be used on drill pipe joints.

Samples will be obtained in soil by driving a 2-in to 3-in ID split-barrel sampler that is 18 in. or 24 in. in length. The sampler will be driven into undisturbed soil by a 140-lb drop hammer free-falling 30 in. The number of "blows" (hammer drops) required to effect each successive 6 in. of penetration are recorded on the log. The sampler is advanced until one of the following occurs.

a. A total of 50 blows have been applied during any one of the first, second, or third 6-in increment;

b. A cumulative total of 100 blows have been applied;

c. There is no observed advance of the sampler during the application of 10 successive blows of the hammer; or

d. A 24-in sampler is advanced a total of 24 in. or, an 18 in. long sampler is advanced a total of 18 in. without the limiting blow counts, as described above, occurring.

Using the split-barrel sampler, soil samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be

continuous (i.e., back-to-back split-barrel sample collection) to the top of bedrock or refusal for each of the 'deep' ('D') zone. Soil sampling will not be preformed during the drilling of the adjacent shallow rock and deeper rock wells of a well pair or cluster.

4.4.1.1 Collection of Soil for Analysis

An aliquot (10 grams) of each soil sample collected by split-barrel sampler from EA-114D, EA-115D (an 'optional well'), EA-116D, and EA-117D (an 'optional well') will be quickly placed in the appropriate containers with a pre-measured amount (10 mL) of methanol preservative supplied by Ceimic Corp and placed on ice in a cooler for potential TCL VOC analysis. At the completion of each one of these, the PID headspace measurements will be reviewed and the 2 highest elevated (at least 3 times above background) measurements will be submitted to the laboratory for TCL VOC analysis. If there are no elevated PID headspace measurements for the soil samples from the boring, then 2 stained or discolored samples will be submitted to the laboratory for TCL VOC analysis. If there are no elevated PID headspace measurements or stained, discolored soil samples from a boring, then the samples collected from the apparent water table interval and from the interval just above competent bedrock will be submitted to the laboratory for TCL VOC analysis.

In addition, an aliquot of each soil sample collected from EA-114D will be composited in a stainless steel bowl, placed in the appropriate containers supplied by Ceimic Corp, and placed on ice in a cooler for potential TCL SVOC and TAL inorganics analyses. The two (2) soil sample intervals selected for TCL VOC analysis from EA-114D will also be analyzed for TCL SVOC and TAL inorganics.

Handling, labeling, and shipping of samples is presented in Section 4.10.

4.4.2 Water Source

Water for drilling, steam cleaning, and other necessary field activities will be arranged by the drilling contractor from the potable water system/hydrant at NCBC Davisville as coordinated with the RIEDC. The drilling contractor will be responsible for obtaining and transporting all water to the drilling areas for required uses. EA will sample the water at each source and analyze it for the same parameters specified for ground-water samples. This information and documentation of the source of the water (i.e., fire hydrant location, etc.) will be is used to evaluate the potential effect the water source may have on the analytical results for samples collected from the borings.

4.4.3 Borehole Logging

The drilling activities will be observed by an EA Geologist or Geotechnical Engineer. The Geologist or Engineer will log the subsurface conditions encountered in the boring and record the information on a soil boring log and rock core log as follows:

4.4.3.1 Soil Borehole Logging Requirements

Soil samples will be visually classified in the field using a modified Unified Soil Classification System (USCS). An example of a soil boring log is provided in Attachment 4. Soil borehole logging requirements are:

1. Logs will be prepared in the field, as borings are drilled, by an EA Geologist or Geotechnical Engineer. Each log will include the name of the preparer and the date of the logging activity, and Quality Control (QC) checked in the office by a Senior Geologist.

2. Borehole depth information will be direct measurements from land surface accurate to 0.1 ft.

3. Logs will be prepared on a Soil Boring Log Form. A copy of which is supplied in Attachment 4.

4. Relevant information in the log heading will be completed. Location sketches referenced by measured distances or prominent surface features (where present), will be shown on, or attached to the log.

5. Log scale will be as shown on the Soil Boring Log Form (Attachment 4).

6. Material type encountered will be described on the log form. Unconsolidated materials will be described as follows:

   - Descriptive modified USCS classification modified from American Society of Testing and Materials (ASTM) *Practice for Description and Identification of Soils (Visual-Manual Procedure)* ASTM D 2488-84
   - Consistency of cohesive materials or apparent density of non-cohesive materials
   - Moisture content assessment, (e.g., dry, moist, wet)
   - Color
   - Other descriptive features (e.g., bedding characteristics, organic materials, macrostructure of fine-grained soils, e.g., root holes and fractures)
   - Fill material will be described including organic and inorganic material and content (e.g., wood, plastic, glass, paper, metal)

   The number of hammer blows required to advance a split-barrel sampler shall be recorded for each 6 in. advance for each sampling attempt. The number of blows and the number of inches penetrated for an incompleted 6 in. interval shall be recorded (e.g., 75/3 in.). "WOR" or "WHO" will indicate that the sampler was advanced by the weight of the drill rods (WOR) or the weight of the drill rods and hammer without driving (WHO). For the Standard Penetration Test (and only for the Standard Penetration Test), when less than 18 in. (but greater than 12 in.) are penetrated by a total (maximum allowable) of 100 blows, the number of blows for the 6in. to 18 in. of

penetration (N) shall also be recorded (e.g., N = 63).

7. For each soil sampling attempt the type and diameter of sampler shall be indicated at the appropriate depth.

8. Depth of casing during sampling.

9. Borehole refusal—The maximum depth to which 4-in diameter casing can be advanced.

10. Borehole and sample diameters and depths at which drilling or sampling methods or equipment change.

11. Total depth of penetration and sampling. The bottom of the hole will be clearly identified on the log with the notation "Bottom of Boring."

12. Document the use of drilling fluids, including source water and additives by brand and product name.

13. Document discernable drilling fluid losses, including the estimated volume, to the geological formation or discernable gains including depths at which they occur, and estimated volume lost or gained.

14. Depth and type of temporary casing used, if any.

15. Visual/olfactory observations of contamination in samples, cuttings, or drilling fluids (e.g., staining, odors).

16. PID measurements.

4.4.3.2 Bedrock Borehole Logging Requirements

Bedrock borehole logging requirements are:

1. Logs will be prepared on a Log of Core Boring.

2. The core bit size shall be indicated on the first sheet of each Core Log Form. A copy of which is supplied in Attachment 4.

3. Information will be recorded on the log in reference to the depth scale of the log.

4. The Geologist or Geotechnical Engineer will record drilling activities in chronological sequence and with respect to the depth scale in the "Drilling Log". Equipment changes will be documented with notation of time (24 hour clock), date of occurrence and depth of the boring at the time of occurrence.

5. Start and stop time (24 hour clock) for each core run will be recorded. Interruptions in coring shall be documented by time of occurrence and description of the problem and its resolution. Coring rates and depths of significant changes in coring rate shall be recorded.

6. The intervals of nonrecovered core will be estimated and an evaluation of the reason for loss recorded.

7. Casing depth, changes in core bit size, and 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. Air/water pressure and downhole bit pressure will be recorded at approximately 15-minute intervals.

8. A description of special problems and their resolutions will be recorded on the boring log, (e.g., hole caving, recurring problems at a particular depth, plugging of the core barrel, unrecovered tools).

9. A summary description of the completion of the monitoring well will be summarized on the boring log.

10. Core runs will be numbered consecutively down the hole as performed and indicated on the log with horizontal lines at the appropriate depth and the core run number recorded in the lower left quadrant of the Core Log Form for the indicated core run.

11. Total core recovery will be measured to within 0.1 ft and recorded on the log.

12. Total core recovery as a percent of the length of the core run will be determined for each core run and recorded on the log.

13. The Rock Quality Designation (RQD) as a percent of the length of the core run will be calculated for each core run and recorded on the log. The RQD method of 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 which 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 fresh broken pieces will be fitted together and counted as one piece.

14. The angle of bedding and schistosity will be recorded as the dip angle as measured from the perpendicular to the core axis.

15. The angle of fracture, joint, fault, or seam surfaces shall be measured from the perpendicular to the core axis and graphically illustrated.

16. The dominant type of coatings or fillings present in fractures or seams will be recorded. Slickensides shall be identified as apparent dip-slip or strike-slip.

17. Standard rock symbols will be used in the graphic log to show major variations in lithology. Minor changes will be documented in the written lithologic log.

18. Rock cores will be visually described for the following parameters:

- Lithology
- Grain Size and Texture
- Color
- Bedding/Foliation/Banding
- Hardness
- Weathering
- Solution or Void Conditions
- Permeability

4.4.3.3 Handling and Storage of Rock Core

Rock cores will be placed in wooden core boxes with the top and bottom of each run clearly labeled. Core will be placed with the top at upper left and bottom at lower right of the core box. For the standard hinged core box, the hinged side is designated the upper side of the box. Any breaks that are made to fit the core into the boxes will be marked.

Wooden spacers showing the footage at the beginning of each run will be placed in the boxes. In addition, core boxes will be clearly marked on the inside and outside of top cover and each outside end to identify the job, the boring number, the numerical sequence of the box (e.g., 2 of 7), and the footage interval within the box.

When it is necessary to split cores for detailed examination, the cores will be handled carefully and put back into the box in the same position they were prior to splitting.

4.4.4 BOREHOLE BACKFILLING

If a borehole must be abandoned, bentonite chips will be placed in the borehole as the backfilling material from the bottom of the boring up to ground surface as the HSA or temporary casing is removed. Depth to the top of the bentonite backfill will be measured/monitored with a weighted tape.

4.5 MONITORING WELLS

This section presents procedures for monitoring well installation, well material specifications, well development, and permeability testing. Monitoring wells will be constructed in only the 'deep' (overburden) zone and in the bedrock borings, drilled by coring only if the bedrock is of

poor quality and the borehole is unstable (i.e., not those drilled using the downhole air hammer method).

4.5.1 Installation

4.5.1.1 Screened Interval

Refer to Section 4.4 and Tables 1a, 1b, and 1c for the screened zones of the wells to be installed. For monitoring wells to be screened in the 'deep' zone, screens for such wells will be set so the base of the screen is set at the top of competent bedrock. For monitoring wells to be screened in cored bedrock borings, only where the bedrock is of poor quality and the borehole is unstable (collapsing), the well screen will be installed so it is adjacent to the most water conducting interval, based upon the field results of the packer testing. These screened intervals will allow the collection of ground-water samples, from which the analytical results will aid in the evaluation of the ground-water quality in the deep and bedrock zones. The wells will also be used to assess ground-water flow and ground-water levels. Well construction materials are specified in Section 4.5.2.

4.5.1.2 Construction

The screen and riser pipe, as specified in Section 4.5.2.1, will be installed through the driven casing with the screen positioned as described in Tables 1a, 1b, and 1c and Section 4.4. For the deep ('D') borings/wells, the 5-ft cored rock portion of the hole will be backfilled with bentonite chips or pellets prior to placement of approximately 6 inches of filter sand, and then, the PVC well screen.

Following placement of the well screen, sand for the filter pack (specified in Section 4.5.2.2) will then be poured through the annular space between the well pipe and sides of the driven casing. If drilling mud is used to maintain borehole stability during drilling and soil sampling, the mud will be thinned to approximately water viscosity prior to placement of the filter sand. The casing will be withdrawn incrementally as the sand is placed into the annular space. The sand will be placed to approximately one to two ft above the top of the screen. A steel-weighted surveyor's tape, or similar, will be used to sound the top of the filter pack during emplacement of the sand pack.

Following placement of the sand, a bentonite seal (specified in Section 4.5.2.3) will be placed through the casing in a manner similar to the filter pack. The bentonite seal will be placed above the filter pack to prevent intrusion of the grout into the filter sand. The minimum thickness of the bentonite seal will be two ft. The bentonite seal will be allowed to hydrate a minimum of one hour before grouting begins. The quantities of sand and bentonite introduced to the well will be measured and compared to a calculated estimate of the materials required based on well/borehole dimensions.

Following placement of the bentonite seal, the casing will be withdrawn as the remainder of the annular space is sealed with a cement-bentonite grout (specified in Section 4.5.2.4). The grout will be placed in the annular space between the well casing and the boring (or steel casing) from the top of the bentonite seal to the ground surface. Grout will be placed by pumping through a

tremie pipe with the lower end of the pipe approximately three ft above the top of the bentonite seal. Pumping will continue until undiluted grout flows from the annular space at the ground surface. Should the top of the bentonite seal occur within five ft of the ground surface, the grout will be poured into the borehole annular space from the ground surface.

Following completion of the grouting operation, each well will be completed by venting the side of the riser pipe approximately 6-in from the top with a small drilled hole. A locking expandable cap and a surficial protective steel casing or box will be used to secure the well (Section 4.5.1.3).

4.5.1.3 Protection and Completion of Wells

Throughout the progress of the work, precautions will be taken to mitigate tampering with the well or entrance of foreign material into it. If rain occurs during construction of a well such that sheet flow across ground surface is probable, runoff will be prevented from entering the well during the construction by placing a temporary earthen berm around the well. The well will be further secured by placing a suitable cover over the well at the end of the day until the well construction activity resumes.

The riser pipe of each well will be completed above grade and will be surrounded by a 4-in to 6-in ID protective steel casing rising approximately 2-3 ft above ground level and set an approximately equal distance below the ground surface into the cement-bentonite grout. The casing will be installed in a manner that does not hinder access to the monitoring well for purposes of obtaining samples or water level measurements.

A minimum 2-ft by 2-ft by 4-in thick concrete pad, sloped away from the well, will be constructed around each well casing with the top outer edge at ground surface.

4.5.2 Well Construction Materials

4.5.2.1 Well Riser and Screen

Well riser pipe will consist of new 2-in ID threaded, flush-joint, Schedule 40 PVC. The pipe will bear markings that will identify the material. No organic solvents or glue will be used in joining the pipe. The use of a Teflon tape on threaded joints is acceptable on an as-needed basis, and will be noted on the well construction log.

Well screens for the shallow and deep wells will consist of new, commercially fabricated, threaded, 10-ft, flush-joint, machine slotted 6- to 10-slot, 2-in ID PVC. The 6- to 10- slot screens will be used to mitigate turbidity of the future water samples to be collected from these wells. A threaded PVC cap or plug will be placed on the bottom of the well.

Well screens and riser will be steam-cleaned prior to installation unless they arrive and are maintained on site in the factory provided packaging.

4.5.2.2 Filter Pack

The annular space around the well screen will be backfilled with a clean, washed, silica sand to perform as a filter between the formation material and the well screen in accordance with RIDEM Ground-Water Regulations. It is anticipated that grade 00 sand is an appropriate size for the 6- to 10-slot well screens. The grade/type of the filter pack which is used will be included on the well construction diagram.

4.5.2.3 Bentonite Seal

The well seal will be comprised of commercially manufactured bentonite pellets or granules, not exceeding ½ -in diameter.

4.5.2.4 Grout Mixture

The cement-bentonite grout will consist of Type I or II Portland cement (ASTM-C150) and water added in the proportion of no more than seven gal per 94-lb bag of cement. Additionally, three percent by weight of granular bentonite will be added to the mixture to help reduce shrinkage.

4.5.3 Well Numbering and Labeling

Monitoring wells will be numbered sequentially for each well or well cluster location. The following suffixes will also be included: 'D' for wells completed in the deep overburden/weather rock zone, 'R' for wells completed in the shallow competent bedrock zone, 'R2' for wells completed in the deeper competent bedrock zone (e.g. EA-114D, EA-107R, and MW03-14R2). A permanent monitoring well designation will be stenciled on each well with oil-based paint.

4.6 MONITORING WELL DEVELOPMENT and BLADDER PUMP INSTALLATION

The monitoring wells will be developed no sooner than 48 hours after grouting is completed. Development protocol will be as follows:

a. Measure static water level. Water levels will be measured using a properly decontaminated water level indicator capable of measuring liquid depth to an accuracy of 0.01 ft.

b. Measure total well depth.

c. Develop the well by alternately surging (via a clean surge block, bailer or small diameter submersible pump) and pumping to remove "fines" from the well screen and filter sand. When pumping results in discharged water that appears to be relatively clear of turbidity, the well will be surged. Continue this procedure until little or no sediment enters the well but for no less than 2 hours. The well will be pumped using a decontaminated electric submersible pump (or centrifugal pump may be used, if the depth

to water is less than 15-20 ft below grade). Temperature, pH, specific conductivity, dissolved oxygen (DO), and turbidity of the ground water will be monitored during pumping. Pumping will continue until these parameters have stabilized (less than $\pm$ 0.2 pH units variation and less than a 10 percent change for other parameters between four consecutive readings) and the water is clear and free of "fines". If the parameters have not stabilized after 3 hours of development, the EA Project Manager will be informed who will in turn notify the USACE or Navy Project Manager.

If well yield is too low to permit continuous pumping or bailing, the well will be bailed or pumped dry three times. The well will be allowed to recharge for up to 0.5 hr between each bailing or pumping session.

If water was "lost" to the geological formation during drilling operations, at a minimum, a volume equivalent to the estimated amount "lost" will be removed during development.

d. Development water investigative derived waste (IDW) management will be performed in accordance with the IDW procedures (Section 4.12).
e. Install a dedicated adjustable rate bladder pump in each well. For monitoring wells constructed with PVC pipe and slotted screen, the pump intake will be set at the approximate center of the screened interval. For monitoring wells completed as open boreholes in bedrock, the pump intake will be set adjacent to the most water conducting interval, based upon the results of the borehole geophysics.

4.6.1 Well Development Records

A Well Development Form will be prepared and completed for each monitoring well installed. A copy of this Well Development Form is provided in Attachment 4. The form will be prepared by the EA representative present during the well development operations. Information provided on the Well Development Form will include the following:

- Client, name of project and site, project number, well identification number, and date(s).
- Date, time, and elevation of the static water level and bottom of well before development.
- Determination of the gallons of water per well volume.
- Method used for development, to include: equipment; size, type, make of bailer and/or pump used during development; and decontamination procedures.
- Time spent developing the well by each method, to include the typical

pumping rate, as possible, if a pump was used in development.

- Estimated volume and physical character of water removed, to include changes in clarity, color, particulates, and odor during development.
- Volume and source of water added to the well.
- Readings of pH, DO, PID screening, specific conductance, temperature, and turbidity taken before, during and at the end of development.
- Name(s) of individual(s) developing well.
- Location of the temporary storage area for the water removed during development.

4.7 GROUND-WATER SAMPLING

The following ground-water monitoring well sampling procedures include water level measurements, well purging, field measurements, and sample collection at each well. Ground-water samples will be collected from the monitoring wells and analyzed for organic and inorganic constituents. The field sampling log, a copy of which is in Attachment 4 is used to record well purging and sampling measurements. The objective of the ground-water sampling protocol is to obtain samples that are representative of the aquifer in the well vicinity so the analytical results reflect the composition of the ground water as accurately as possible.

Wells will be allowed to stabilize at least five days after development prior to collecting samples for analysis. Rapid and significant changes can occur in ground-water samples upon exposure to sunlight, temperature, and pressure changes at ground surface. Therefore, ground-water sampling will be conducted in a manner which will minimize interaction of the sample and the surface environment. The equipment and protocol for collecting ground-water samples is as follows.

4.7.1 Purging and Sampling Equipment

Well purging will be performed and ground-water samples will be collected from monitoring wells using a dedicated adjustable rate bladder pump and where not already present, new, dedicated lengths of Teflon-lined polyethylene tubing for each well sampled, i.e. EA-112R where no bladder pump has been installed because the well is only 1½ -in diameter.
Equipment

- Dedicated adjustable rate bladder pumps
- Tubing:
  - Teflon-lined polyethylene dedicated and in each well.

- Teflon-lined polyethylene between the well cap and the flow-through-cell.
- Teflon insert fittings (where required)

- Electronic water level measurement unit with accuracy of 0.01 ft.
- Flow measurement device (containers graduated in milliliters) and stop watch.
- Water Quality meter (Grant YSI 3800 or similar) with flow-through-cell (flushed with distilled water before use at each well) for field measurement of pH, specific conductance, temperature, Eh, and DO.
- Turbidity meter.
- HACH field kits for ferrous iron detection. A copy of the SOP from the HACH DR2000 (wavelength of 510 nM will be used) is included in Attachment 5. The same SOP can be used for the HACH DR700 (wavelength of 510 nM is preset for this unit)
- PID instrument (HNU or similar) to monitor vapor concentrations during purging and sampling as required by the SSHSP.

4.7.2 Field Analytical Equipment

Field equipment to be used at the site will include a Grant YSI 3800 water quality meter, or similar, with a flow-through-cell (which includes probes for measurement of pH, Eh, dissolved oxygen (DO), temperature, and conductivity). Additional equipment will include an organic vapor analyzer with a PID, turbidity meter, and field analytical kits to measure dissolved ferrous iron concentrations. Each piece of equipment will be checked by EA to be in proper working order before its use and calibrated as required by the manufacturer. Prior to each use, field analytical equipment probe(s) will be decontaminated in accordance with Section 4.11. After each use, the instrument will be checked and stored in an area shielded from weather conditions.

Instruments will be calibrated before sampling each day, before afternoon work, and on an as-needed basis in accordance with the manufacturer's instructions. The instrument calibration will be checked at the end of the work day to make sure that the readings are within an acceptable range.

4.7.3 Ground-Water Sampling

The low flow sampling protocol will be as follows:

a. <u>Measure Water Level</u>

Using a properly cleaned (Section 4.11) electronic water level indicator and/or oil/water interface probe, measure and record the depth to ground water from the top of the monitoring well casing.

b. Purge Well

- Purge each well with a adjustable rate bladder pump dedicated to the well (and dedicated length of Teflon-lined polyethylene tubing also to be left in each well) until the pH, specific conductance, DO, Eh (if DO is not detected), turbidity [5 nephelometric turbidity units (NTU) goal] and temperature have stabilized [less than ± 0.1 pH units and within 10% for turbidity (above 1 NTU values) and DO, 3% for specific conductance and temperature, and ± 10 millivolts for Eh between three consecutive readings at 5 minute intervals].

- Dedicated, inplace Teflon-lined polyethylene tubing with attached bladder pump will already have been installed so that the pump intake is at the approximate middle of the screened interval of the well or within 5 feet of the well bottom, if this zone is screened. For well screens which breach the water table, the pump intake will be placed at the approximate middle of the water column in the well. To minimize sediment/silt mobilization (turbidity) from the bottom of the well, the pump intake should be kept a minimum of 2-3 feet above the bottom of the well.
- Using the Teflon insert fitting in the well cap, connect the Teflon-lined polyethylene tubing (in the well) with a new short length of Teflon-lined polyethylene tubing. Connect the other end of this short length of tubing to the cleaned flow-through-cell of the water quality meter (Grant / YSI 3800 or equivalent). A "T" fitting will be installed in the tubing prior to the flow-through cell to allow for turbidity sample collection.

- Care will be taken to keep the Teflon-lined polyethylene tubing full of water in that portion of the tubing above the top of the well during purging and sampling (i.e., to mitigate the presence of air pockets).

- Using the variable speed bladder pump, purge the monitoring well. Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Once water reaches the well cap / flow-through-cell, decrease the flow rate and check the water level. Adjust pump speed until water level drawdown stabilizes (ideally less then 0.3 feet). Continue purging until indicator field parameters stabilize. For wells with low recharge rates with screened intervals that are totally below the water table (or potentiometric surface), do not draw the water level in the well down below the top of the screened interval. Stop the pump when the water level is just above the top of the screened interval, allow time for recharge, and then resume pumping. Repeat this as necessary until the water quality parameters have stabilized as stated above. For very low yield wells, if the recharge rate of a well is lower than the extraction rate capability of the bladder pump and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples. Then notify the

EA Project Manager and record the information on the Field Sampling Form. A copy of the Field Sampling Form is provided in Attachment 4.

- Every five (5) minutes, measure and record the depth to water (below the top of the well casing), the pumping rate (in milliliters/minute), pH, turbidity, specific conductance, temperature, Eh, and DO.

- Stabilization of the water level in the well should be achieved. This is defined as no more than 0.02 ft drawdown between the 5-minute measuring intervals and/or 0.3 ft drawdown overall during the purging event. The pumping rate should be adjusted (decreased) to mitigate drawdown of the water level to within the specified target range. (Ideally at the pumping rate of 100 ml/min, there would be no drawdown of the water level). If no more than 0.3 ft of drawdown occurs, the drawdown is considered negligible and sampling can begin after achieving stabilization of the field measured water quality parameters.

- If more than 0.3 ft of drawdown occurs during the purging process, then at a minimum, the volume of water discharged to that point must again be removed from the well, e.g., if 0.5 gals of water was purged from the well prior to stabilization of the water level, then an additional 0.5 gals must be purged whether or not the field measured water quality parameters have stabilized. The final purge volume must be greater than the stabilized drawdown volume plus pump/tubing volume.

- If the stabilization of the water level or water quality parameters or the recharge rate requires more than 2 hours of purging time for the well, call the EA Project Manager for discussion and decision as to how to proceed. Purged water will be containerized in drums and labeled in accordance with Section 4.12.

c. Collect Sample

- Ground-water sampling will continue directly after completion of purging using the same pump and Teflon-lined polyethylene tubing. The short length of tubing connecting the well cap with the flow-through-cell will be disconnected from the cell and ground-water samples will then be taken. VOC samples will be collected first directly into the pre-cleaned, pre-preserved sample containers provided and designated by the laboratory. A test VOC sample container will be checked with pH paper to confirm adequate preservation (i.e. pH<2). Additional HCl will be added to the VOA vials if necessary. VOA vials will be completely filled without headspace above the liquid portion (to minimize volatilization). A check to see that the Teflon-lined silicone septum is correctly placed in the cap will be undertaken prior to tightly securing the cap. After the cap is sealed, the vials will be inverted, lightly tapped and checked for air bubbles. If air bubbles are present, they will be eliminated by adding additional sample water before the vial is resealed. The water sample aliquots for the additional analytical parameters, as listed in Table 9.1 of the QAPP (Appendix A) will then be collected in the proper containers, labeled and sent to the laboratory for analysis. Methods and QC criteria are stated in Chapter 8 of the QAPP. As each

sample is obtained, observations made will be recorded on the Field Sampling Form and the field notebook.

- Ground water will be analyzed for **ferrous iron** in the field using HACH field kits following procedures as outlined in the field kits (copy provided as Attachment 5 for the HACH DR2000 at wavelength of 510 nM or the HACH DR700 with a preset wavelength of 510 nM). **Duplicate field analysis** will be performed on 10% of the samples

- The sequence for the collection of the sample aliquots will be as follows:

  —TCL VOC;
  —TCL SVOC;
  —TAL inorganics;
  —General Chemistry Parameters (nitrate, sulfate, sulfide, manganese, chloride, alkalinity, and methane), and
  —**Ferrous iron (duplicates** of 10% of the samples will also be field analyzed).

One **trip blank** will be included per shipping cooler containing water samples to be analyzed for TCL VOC. A **temperature blank** (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp. **Field duplicate** of each ground-water sample type will be collected at the rate of 1 per every 10 samples. The field duplicate samples will be analyzed for the same parameters as the duplicated samples.

Sample container handling, chain-of-custody and shipping to Ceimic Corp will be performed in accordance with Section 4.10. Investigative derived waste management will be performed in accordance with Section 4.12

4.8 *IN-SITU* HYDRAULIC CONDUCTIVITY TESTING/LOGGING

4.8.1 Slug Testing

An *In Situ* permeability test will be performed on each of the newly installed PVC wells after development and return of the water level to static conditions. The permeability tests will be "slug out" or "rising head" tests. A known volume (slug) of water will be removed from each well using a decontaminated pre-made solid slug which should instantaneously and temporarily lower the water level in the well. Immediately, recording of the water level rise (recovery) will begin and continue using an *In Situ* ™pressure transducer and data logger, or similar equipment, until at least 90 percent (as possible) of the recovery to the static water level is achieved. Data logging will be performed in accordance with the instructions stated in the equipment operator's manual. The recorded data will be evaluated using the Bower & Rice Method (or similar) to estimate the local hydraulic conductivity (K) adjacent to the tested well screen.

4.8.2 Packer Testing

Packer tests are *in situ* tests used to estimate effective permeability of a specific zone in a bedrock borehole for each borehole in which a PVC well will be constructed.

Packer tests will be performed after the borehole development is completed and before PVC well installation. Each section of the borehole will be sealed off with pneumatic packers for testing. Water will then be pumped through each borehole section between the packers at a known pressure. The rate of flow into the formation will be measured and recorded. The permeability of the tested zone is then calculated using the data obtained from the test. The data will be recorded on the Packer Test Form, provided in Attachment 4, and in the field notebook.

4.8.2.1 Methodology

The following packer test preparation will be performed:

1. Maintain the test pressures at the pump below the Maximum Water Pressure (Pmax). This should avoid hydrofracturing and loosening of the rock mass. Pmax is determined by the following formula:

   $$Pmax = (H_1)\ (1\ psi/ft)$$

   Note: (In highly fractured rock this should not exceed 0.75 psi/ft.)

   where,

   H_1 = depth in feet from ground surface to the bottom of the upper packer
   During test operations the water pressures are observed at the gauge. The Maximum Gauge Pressure (GPmax) is calculated by the following formula:

   $$GPmax = (H_1 + H_3)\ (1\ psi/ft) - (H_1 - H_2)\ (0.43\ psi/ft)$$

   where,

   H_1 = depth in feet from ground surface to the bottom of the upper packer.

   H_2 = depth in feet from ground surface to the static water level.

   H_3 = height in feet of pressure gauge above ground surface.

2. Ensure that the packer system is not leaking.

3. Determine the Packer Inflation Pressure (PIP), by performing the following steps:

Step 1 - Establish Minimum Inflation Pressure (MIP) (i.e., the pressure required to inflate the packers in the casing so that they can no longer be pushed or pulled through the casing).

Step 2 - Establish the Static Head Pressure (Ps) in psi at the test depth by the following calculation:

$$Ps = (H_1 - H_2)\ (0.43\ psi/ft)$$

where,

H_1 and H_2 are defined as stated above in Number 1.

Step 3 - Make sure the PIP equals the MIP plus the Ps plus the GPmax of the test zone between the packers:

$$PIP = MIP + Ps + GPmax$$

If the PIP exceeds the maximum pressure rating of the packers, then the PIP will be set at the recommended maximum pressure rating given by the manufacturer.

The following methodology will be used to conduct each packer test.

1. Measure and record the depth to the static water level in the borehole prior to the installation of the packer to set a baseline against which potential water level rise indicating a leak around the packer can be observed. If such occurs, the packers will be reset and the test restarted.
2. Flush the borehole with clean water to remove and check for collapsed borehole debris.
3. Assemble and install the pneumatic packer equipment in the borehole.
4. Before starting the test, review the Packer Test Data Sheets and record the following:

   - Hole location and site
   - Date
   - Driller and inspector conducting test
   - Type, manufacturer, and model of packer system, water meter, water gauge, and surge chamber
   - Test number
   - Length of test section
   - Borehole diameter
   - Height of pressure gauge above ground surface (H_3)
   - Depths below grade to rock surface, ground water, bottom of boring, bottom of upper packer, to top of lower packer, rock type, recovered percentage, and RQD of core interval to be tested.

4a. Calculate Gpmax, MIP, PIP, Ps, Pmax.

5. Before performing the first test, bleed air out of the lines by forcing water through the packer system assembly before the packers are inflated. Inflate both packers to the required packer pressure (PIP).

6. Conduct the bedrock packer test in three steps. During the testing activity, periodically measure and record the depth to water in the tested borehole. A sudden rise in the water level or the presence of bubbles indicates leakage around the packers. This should be resolved by resetting the packers and restarting the test.

   Step 1 - ½ GPmax

   Pump water into the system and record observations of gauge pressure and water meter reading at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 2 - Full GPmax

   Pump water into system and record observations of gauge pressure and water meter reading at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 3 - Full GPmax plus 20 psi increase on the PIP. If no water is lost to formation during Step 2, Step 3 should include 2X Gpmax at the same PIP.

   Increase PIP by 20 psi. Pump water into the system and record observations of gauge pressure and water meter at 30-second intervals for at least three to five minutes after a constant rate of flow is reached. The results of Steps 2 and 3 should be similar. If they are not, Step 3 should be repeated, increasing the PIP by an additional 20 psi. This is done to check for leakage past the packers.

7. If leakage of water from the packed section into the surrounding rock is so great that the GPmax cannot be achieved, operate the pump at its full capacity with the bypass valve closed. Record the volume of water pumped into the test section and the associated pressure readings at timed intervals. This data will give a minimum value of the rock permeability.

8. Upon completion of the test, deflate the packers and move them to the next test interval.

9. Complete data sheets.

4.8.2.2 Computed Rock Mass Permeability

Compute the rock mass permeability. Data required for each calculation are as follows:

- Depth of hole at time of each test
- Depth to bottom of top packer
- Depth to top of bottom packer
- Depth to water level in borehole at frequent intervals
- Elevation of potentiometric level
- Length of test section
- Radius of hole
- Length of packer
- Height of pressure gauge above ground surface
- Height of water swivel above ground surface
- Description of material tested

The formulas used to compute the permeability from pressure test data are:

When L > 10r (length is greater then ten times the radius)

$$\mathbf{K} = (Q/2\pi LH) \quad \ln(L/r)$$

and,

When 10r > L > r (length is greater than the radius but less than ten times the radius)

$$\mathbf{K} = (Q/2\pi LH) \quad \sinh^{-1}(L/2r)$$

where,

K = permeability
Q = constant rate of flow into the hole
L = length of the test section
H = differential head on the test section
r = radius of the borehole

It should be noted that when the test is conducted above the water table, H is the distance from the water pressure gauge to the middle of the test section. When the test is conducted below the water table, H is the distance from the gauge to the static water level.

4.8.3 Geophysical Logging of Boreholes

Geophysical logging of the open rock portions of selected boreholes, as noted on Tables 1a, 1b, and 1c will be performed by a subcontractor after completion of the drilling activity. The selected borings will be logged to aid in the assessment of bedrock fractures and areas of ground-water flow. The planned geophysical methods are caliper, single-point resistivity, fluid temperature, heat-pulse, and acoustic televiewer logging. The related field procedures will be obtained from the related firm after selection and contracting has been completed. A copy of these field procedures will be provided at that time to be incorporated into the Work Plan as Attachment 4.

4.9 PROFESSIONAL LAND SURVEYING

Following the completion of the drilling and monitoring well installation program, the horizontal coordinates (with in 1.0 ft) and vertical elevations (within 0.1 ft Mean Sea Level [MSL]) for ground surface and 0.01 ft for top of well casing) will be surveyed for each new monitoring well and soil gas sample location by a Rhode Island registered surveyor

All vertical measurements will be surveyed in 1988 USGS National Geodetic Vertical Datum, and all horizontal measurements will be in Rhode Island State Plane Coordinates, using the 1983 North American Datum.

4.10 SAMPLE DESIGNATION, LABELING, HANDLING, CUSTODY, SHIPPING, AND DOCUMENTATION

4.10.1 Sample Designation and Labeling

Once the soil/sediment or ground-water sample has been collected, label the appropriate sample bottle with the appropriate sample tag and provide the following data for the chain-of-custody (COC): sample identification number, project number and name, date, time, sampler's signature, number of containers per analyte, analysis requested, and preservative(s) added.

EA will employ the following sample designation system:

I. Soil Gas Samples

Example: SG-03-4.0
>SG-03-4.0 - Soil Gas Sample from location SG-03
>First dashed number from left to right indicated the sampling interval in feet (4.0).

II. Soil Samples

Example: EA-114D-1.0-3.0
>EA-114D - Soil Sample from boring/well EA-114D
>First dash number from left to right indicated the top of the sampling interval in feet below grade (1.0).
>Second dash number from left to right indicates the bottom of the sampling interval in feet below grade (3.0).

III. Ground-Water Samples

Example: EA-114D or MW03-14D = the ground-water sample from a specific monitoring well

III. Water Source Sample

Example: WS01 = the first source water sample

IV. QC Samples

Example 1: EA-114D-1.0-3.0RB
>EA-114D - Soil Sample from boring/well EA-114D
>Second dash number from left to right indicated the top of the sampling interval in feet below grade (1.0).
>Third dash number from left to right indicates the bottom of the sampling interval in feet below grade (3.0).
>RB = equipment rinsate blank from this sample location

Example 2: GW-DUP1 or Soil DUP1
>GW or Soil – ground-water or soil sample
> DUP 1 - First duplicate. The actual boring/well number and depth interval from which the sample is collected will be recorded in the field notebook and Field Sampling Form

Example 3: PR-58 TB1 or Site 03 TB1 = the first trip blank for VOC analysis only from the former Nike PR-58 site portion or NCBC Site 03 portion of this investigation.

4.10.2 Handling, Custody, and Shipping

Seal the sample containers with custody tape (for VOC vials, seal the vials in a quart plastic bag and attach the custody seal around the bag). Complete COC document (provided by the Ceimic Corp) entries and record the sampling event in the bound field notebook.

The properly labeled and sealed containers will be placed in a plastic ziplock-type bag and sealed. The samples will be packed with wet ice which has been double bagged with heavy duty polyethylene bags or similar, prior to placement into the cooler. Samples will be packed so as to maintain a temperature of 4° C.

The COC Form will be sealed in a ziploc-type bag and taped to the inside of the cooler lid. The lid of the cooler will be sealed with a custody seal. Clear adhesive tape will be placed over the custody seal to ensure that the seal is not accidentally broken during shipment. The laboratory will be notified by phone of the sample shipment at least 24 hours before arrival and 48 hours before arrival if the arrival is to occur on a Saturday. The laboratory will be notified one week prior to the beginning of sampling. The sample containers for each matrix are listed in Tables 9-1 and 9-2 of the QAPP. Samples are to be shipped overnight to Ceimic Corp in Narragansett, RI for chemical analyses in accordance with the QAPP.

4.10.3 Sample Documentation

The documentation necessary for this investigation includes the following:

- Field Notebook

- Field Sampling Form
- Chain-Of-Custody Form

4.10.3.1 Field Notebook

The EA Project Manager will control all field notebooks. Field notebooks will be issued to the Field Team Leader. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 ½ in. x 7 in. in size. Field notebooks will be maintained by the Field Team Leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include at a minimum the following information:

- Name of author, date and time of entry, and physical/environmental conditions during field activity
- Names and titles of field crew
- Names and titles of any site visitors
- Type of sampling activity
- Location of sampling activity
- Description of sampling point(s)
- Date and time of sample collection
- Sample media (e.g., soil, sediment, ground water)
- Number and volume of sample(s) collected
- Analyses to be performed
- Field observations
- Calibration/Maintenance requirements of field equipment

Original data recorded in either the field notebooks on sample labels, or in the COC records will be written with indelible ink. None of these accountable documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information, initialing and dating the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

4.10.3.2 Chain-of-Custody Forms

A completed COC Form will accompany the samples shipped to the laboratory and will contain the following information:

- Project name and EA project number
- Name of person collecting samples
- Date and time samples were collected

- Type of sampling conducted (e.g., composite, grab)
- Sample matrix (e.g., soil, ground water)
- Parameters and method for analysis
- Location of sampling station
- Field filtration and/or preservation methods
- Number and type of containers used
- Signature of EA field personnel relinquishing sample
- Date and time of custody transfer to overnight courier
- Sample shipper (e.g., UPS, Federal Express)

The COC forms will provided by Ceimic Corp with the sample containers/coolers and will be completed by the sampling team and included with the samples.

4.10.3.3 Field Sampling Form

This document is used by the person sampling to record the physical measurements of the sample information, and also, as a reference. A copy of the form is provided in Attachment 4.

4.11 DECONTAMINATION PROCEDURES

The primary objective of the decontamination process is to prevent the accidental introduction of potential contaminants to non-contaminated areas and/or samples. This section describes the methods associated with decontamination of field equipment. The SSHSP (Appendix B) addresses personnel decontamination.

4.11.1 Decontamination Area

Decontamination will be performed in the vicinity of each boring/well and the area will contain a wash solution collection system. The collected material will be contained in U.S. Department of Transportation (DOT) approved, 17H, 55-gal drums that are suitable for storage of liquid hazardous materials. Drums will be labeled and moved to a designated staging area in the vicinity of Building 224.

Wash tubs used in the field to clean split-barrel soil samplers will be emptied into a DOT approved, 17H, 55-gal drum and labeled.

4.11.2 Decontamination Procedures

4.11.2.1 Drill Rig and Downhole Drill

Equipment (drilling tools/pipe, bits, temporary steel casing) that will be used during drilling activities will be steam cleaned prior to use and before starting each boring. Equipment will be kept off the ground on clean sawhorses, racks, or pallets. If blowing dust is a problem, equipment shall be covered with plastic sheeting during storage. Upon completion of the work, the portions of the drilling rig which came in contact with subsurface soil/drilling fluids will be steam cleaned.

4.11.2.2 Sampling Equipment

Reusable ground-water and soil sampling equipment will be cleaned prior to use in the field. Wherever possible, sampling equipment will be dedicated to a single location to minimize potential for cross-contamination. All other non-dedicated sampling equipment will be decontaminated as described below.

Stainless Steel or Teflon

This includes all split-barrel soil samplers, spoons, spatulas, trowels and bowls, and other stainless-steel or Teflon equipment that may reused for field activities:

1. Wash thoroughly (at each boring/well location) using a brush and Liquinox, or similar non-phosphate detergent, plus clean water from the designated source.

2. Rinse equipment thoroughly with distilled water.

3. Rinse with isopropyl alcohol by spray bottle and allow to air dry.

4. Flush with distilled water to remove isopropyl alcohol.

5. Air dry and store on plastic poly sheeting, or if not being used shortly, in plastic garbage bags to prevent contamination during storage and/or transport to the field.

4.12 INVESTIGATIVE DERIVED WASTE MANAGEMENT

This section addresses the procedures for handling, collection, and storage of investigative derived wastes (IDW) generated during field activities. IDW will be managed in accordance with the RIDEM *Guidelines for the Management of Investigation Derived Waste* (Policy Memo 95-01). Drill cuttings, drill mud, purging/sampling water, decontamination fluid, and other decontamination-related wastes will be containerized in DOT-approved 55-gal steel drums (17H for liquid waste, and 17E for solid wastes) or secured (locked) roll-off containers. Large volumes of well development or purge water will be temporarily stored in 200-1,000 gal polyethylene tanks adjacent to the well from which it was generated, except for wells located in residential property yards. Refer to Section 4.12.5 for an explanation of the Waste Collection Staging Area.

Because no previous analytical data exists for the proposed EA-114 well cluster, soil and ground-water samples collected from this area will be analyzed for TCL VOC and SVOC, and TAL inorganics. The results of these analyses will be used to determine the proper disposal of the drill cuttings and fluids generated from this well cluster.

4.12.1 Drill Cuttings

Refer to Section 4.12.5 for management of IDW related to residential property yards. Drill

cuttings will be containerized in DOT-approved, 17E, 55-gal drums or in secured (locked) roll-off containers, marked as IDW, labeled with the contents (drill cuttings), the soil boring designation number, and the date of collection. Cuttings from the EA-114 well cluster and from the 'deep' and 'bedrock' zones of MW03-14R2 will each be retained in containers separate from those which contain cuttings from the other monitoring wells. The drums or roll-off containers will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending soil analytical results to aid in determining the proper method of disposal.

Non-hazardous soil cuttings generated from drilling activities are planned to be transported to and disposed of at the Resource Conservation and Recovery Act (RCRA) Subtitle D facility at the Central Landfill, in Johnston, Rhode Island. Soil IDW determined to be above regulatory levels for disposal at the Central Landfill will be disposed of appropriately in accordance with state and federal regulations.

4.12.2 Development/Sampling/Purge Water

Development and sampling/purge water will be vented to the atmosphere to reduce the PID reading. Upon obtaining a headspace PID measurement less than or equal to 10 PPM the water will be spread on the ground in the immediate vicinity of the monitoring well where generated, except for water from wells located in residential property yards and water from the EA-114 well cluster. See Section 4.12.5 for handling of IDW related to residential property yards. Water obtained from the EA-114 well cluster will be retained until the soil and ground-water analytical results analyzed for TCL VOC and SVOC, and TAL inorganics are obtained from the laboratory.

Water IDW that exhibits a headspace PID measurement of greater than 10 PPM will be containerized in DOT-approved, 17H, 55-gal drums at the time of generation. The drums will be labeled with the description of the drum contents; site name; boring/well number; and date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending ground-water analytical results to aid in determining the proper method of disposal.

Ground-water IDW determined to be above regulatory levels will be disposed of appropriately in accordance with state and federal regulations.

4.12.3 Decontamination Fluids

Liquid generated as a result of decontamination activities will be collected and containerized initially in DOT-approved, 17H, 55-gal drums at the time of generation. The drums will be labeled with the description of drum contents, related boring/well numbers, and the date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending analytical results to aid in determining the proper method of disposal.

4.12.4 Other Decontamination Waste

Other wastes generated during decontamination activities, including discarded personal

protective equipment, aluminum foil, and other debris, will be collected and containerized in DOT-approved, 17E, 55-gal drums labeled with the description of drum contents, related boring/well numbers, and the date the drum was filled. The drums will be marked as IDW and transferred by the drilling contractor to the staging area described in Section 4.12.5 pending subsequent testing and disposal.

4.12.5 Waste Collection Staging Area

Drill cuttings, drill mud, purging/sampling water, decontamination fluid, and other decontamination-related wastes will be containerized in DOT-approved 55-gal steel drums (17H for liquid waste, and 17E for solid wastes) and/or secured (locked) roll-off containers in accordance with the RIDEM IDW policy and as described in Sections 4.12.2 through 4.12.4. The drums and/or secured (locked) roll-off containers, properly designated as IDW, will be transferred and staged by the drilling contractor for temporary storage in a secured area (i.e., series of locked gates) near the EA Field Office trailer located northeast of Building 224 and east of Sanford Road for coordination with and disposal by a licensed disposal firm.

All IDW generated off-site in the residential property yards will be containerized and transferred to the on-site staging area, regardless of detected concentrations.

Table 1a
New Wells within the Former Nike PR-58 Site and Residential (North of Perimeter Road) Area

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	MW03-14R2	37	85	48	Deep Rock	OS		R2_HSA_C		Determine vertical extent @ Former Peabody Drum Transfer Area (potential source), supplements existing shallow rock data.
2	MW03-11R	29	60	31	Shallow Rock	OS	X		R_HSA_A	Determine extent in bedrock @ southern edge (dissolved plume).
3	EA-108R	30	60	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ southwestern edge (dissolved plume). Down gradient from potential source area.
4	EA-107R	40	70	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ lower western edge (dissolved plume). Down gradient from potential source area.
5	EA-105R	30	60	30	Shallow Rock	OS	X		R_ HSA_A	Determine extent in bedrock @ upper western edge (dissolved plume). Down gradient from potential source area.
6	EA-114D	32	40	8	Overburden & Weathered Rock	OS		OB-WR_HSA		Determine extent in overburden @ alleged dumping point (potential source).
7	EA-114R	32	65	33	Shallow Rock	OS		R_HSA_C		Determine extent in shallow rock @ alleged dumping point (potential source).
8	EA-114R2	32	95	63	Deep Rock	OS		R2_HSA_C		Determine extent in deep rock @ alleged dumping point (potential source). **Perform EA-114R first; if no indication of contamination, make decision (USACE, EPA, RIDEM) to possibly delete this deep well.**
9	EA-104R	67	95	28	Shallow Rock	OS	X		R_ HSA_A	Determine extent in shallow rock @ northern edge (dissolved plume) within NIKE PR-58 property.
10	EA-104R2	67	125	58	Deep Rock	OS	X		R2_ HSA_A	Determine extent in deep rock @ northern edge (dissolved plume) within NIKE PR-58 property. **Perform EA-104R first; if no indication of contamination, make decision (USACE, EPA, RIDEM) to possibly delete this deep well.**
11	EA-113R	50	80	30	Shallow Rock	OS	X		R_ HSA_A	Sentinel well in residential area. Ensure the deep CVOC plume is not migrating towards drinking water wells (bedrock aquifer).
12	EA-112R2	97	155	58	Deep Rock	OP	X		R2_ HSA_A	Determine the extent in the deeper rock (dissolved plume) in residential area. The existing shallow rock results exceeded RIDEM stds.

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
13	EA-116D	97	105	8	Overburden & Weathered Rock	OP		OB-WR_HSA		Determine edge of the dissolved plume within the overburden (as it heads towards the residential developments).
14	EA-116R	97	125	28	Shallow Rock	OP	X		R_HSA_A	Determine edge of the dissolved plume within the shallow rock (as it heads towards the residential developments).
15	EA-116R2	97	155	58	Deep Rock	OP	X		R2_HSA_A	Determine edge of the dissolved plume within the deep rock (as it heads towards the residential developments).

Table 1b
"Optional" Wells within the Former Nike PR-58 Site and Residential (North of Perimeter Rd) Areas

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	EA-115D	24	30	6	Overburden & Weathered Rock	OS		OB-WR_HSA		Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
2	EA-115R	24	55	31	Shallow Rock	OS	X		R_HSA_A	Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
3	EA-115R2	24	85	61	Deep Rock	OS	X		R2_HSA_A	Decision to install this MW to be based on results from the monitoring wells EA114D/R/R2.
4	MW03-13R2	43	100	57	Deep Rock	OS	X		R2_HSA_A	Decision to install this MW to be based on results from the monitoring well MW03-14R2.
5	EA-117D	97	105	8	Overburden & Weathered Rock	OP		OB-WR_HSA		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.
6	EA-117R	97	125	28	Shallow Rock	OP		R_HSA_C		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.
7	EA-117R2	97	155	58	Deep Rock	OP		R2_HSA_C		Decision to install this MW to be based on results from the monitoring wells EA116D/R/R2.

Table 1c
New Wells within the Navy Study Area

No	Well Designation	Approx. Depth Top of Bedrock (ft bgs)	Total Depth Drilled (ft bgs)	Rock to be Drilled (ft)	Zone to be Screened	Location Onsite (OS) or Off Property (OP)	Geophysical Logging Open Rock Portion of Hole	HSA and Core Drill / Well Completion Methods	HSA and Air Rotary/ Downhole Hammer Drill/Well Completion Methods	Purpose
1	MW01-10R	82	110	28	Shallow Rock	OS	X		R_HSA_A	Determine extent in shallow rock @ the central/eastern edge of the main dissolved plume. Obtain insight to why the plume separates into two lobes.
2	MW01-15R	51	80	29	Shallow Rock	OS	X		R_HSA_A	Determine extent of the dissolved plume in shallow rock @ the northeastern edge of the southern lobe.
3	MW02-03R	42	70	28	Shallow Rock	OS	X		R_ HSA_A	Determine extent of the dissolved plume in shallow rock @ the southeastern edge of the southern lobe.
4	MW03-03R	59	90	31	Shallow Rock	OS	X		R_ HSA_A	Determine extent of the dissolved plume in shallow rock @ a location in the center of the deep CVOC plume.
5	MW01-13R	75	105	30	Shallow Rock	OS	X		R_ HSA_A	Sentinel well in shallow rock.

NOTES:

SUMMARY OF THE DRILLING / MONITORING WELL COMPLETION METHODS TO BE USED

OB-WR_HSA = **Hollow Stem Auger (HSA) for Overburden and Weathered Bedrock ('D') Screened Monitoring Well** – 6.25 in. inner diameter (ID) HSA to the top of competent bedrock, tri-cone drill 3-ft into rock to confirm rock, then obtain a 5-ft length of HQ-core of the rock. The overburden will be sampled using a 2.5-in to 3-in inner diameter (ID) split-barrel sampler that is 18 in. or 24 in. in length. Split-barrel samples will be collected at 5-ft intervals until approximately 10 ft above the estimated depth to competent bedrock, at which point sampling will be continuous to the top of bedrock or refusal.

For EA-114D and EA-116D that will be drilled by this method, **the following special field testing will be performed during the drilling** of each of these borings/wells: the 3-ft interval just above competent bedrock will be **slug tested**, the 3-ft interval just below the top of competent bedrock will be **slug tested**, and the 5-ft cored interval will be **packer tested**.

Place a bentonite seal within the core hole to top of competent rock unit [following the special hydraulic conductivity tests in EA-114D and EA-116D (i.e., slug and packer tests)]; and then, construct a 2-in ID PVC well with 10-ft length of screen (6-to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space as the HSA is removed. The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R_HSA_C = Hollow Stem Auger (HSA) and Coring for Shallow Competent Bedrock ('R') Screened Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' companion well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. **There will be no sampling of the overburden.** Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the HSA is removed **(allow grout to setup for 24-hours before beginning coring). HX-core** (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. **Perform packer testing of each** of the 5 cored intervals of rock.
[**If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC).** The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]
The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R2_HSA_C = Hollow Stem Auger (HSA) and Coring for Deeper Competent Bedrock ('R2') Screened Monitoring Well – This method will be used in the vicinity of the CVOC source area and in the residential area. Based upon the depth to bedrock encountered in the adjacent 'D' and 'R' companion wells, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5 in. ID drill casing. **There will be no sampling of the overburden.** Continue with wash drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed **(allow grout to setup for 24-hours before beginning coring). HX-core** (4-in diameter) five 5-ft intervals of the rock below the bottom of the 4-in ID steel casing. **Perform packer testing of each** of the 5 cored intervals of rock.
[**If bedrock is of poor quality and the borehole is unstable, construct a 2-in ID PVC well (Schedule 40 PVC).** The screened interval will be selected by the EA Field Manager and Project Manager to be the 10-ft interval with the highest water loss during performance of the packer testing. Such a monitoring well will be constructed with a 10-ft length of screen (6- to 10-slot), appropriate filter sand for the screen's slot size, bentonite seal, and cement-bentonite grout the annular space.]
The monitoring well will be completed approximately 2-3 ft above ground with 4-in ID steel protective casing and locking cap and centered within a 2-ft by 2-ft cement pad at ground surface.

R_HSA_A = **Air Rotary/Downhole Hammer for Shallow Competent Bedrock ('R') Monitoring Well** – Because of concerns due to potential air emissions during drilling, this method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep well, 6.25 in. inner diameter (ID) HSA to within approximately 2 ft of the known top of competent bedrock. Then drill a 3-ft deep socket into rock with 5.875 in. tri-cone. **There will be no sampling of the overburden.** Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the HSA is removed **(allow grout to setup for 24-hours before continuing drilling).** Air/downhole hammer drill 25 ft of the bedrock beyond the bottom of the 4-in steel casing.
The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, **i.e. no PVC well will be constructed**.

R2_HSA_A = **Air Rotary for Deeper Competent Bedrock ('R2') Monitoring Well** – This method will only be used in onsite areas away from the vicinity of the CVOC source area and in non-residential offsite areas. Based upon the depth to bedrock encountered in the adjacent existing deep and shallow bedrock wells, 6.25-in ID HSA to within approximately 2 ft of the known top of competent bedrock. Then spin/drill to 3-ft into competent rock with 5-in ID drill casing. **There will be no sampling of the overburden.** Continue with air drill of 4.875-in diameter hole in rock for 25 ft below the bottom of the 5-in ID drill casing. Place and grout **4-in ID steel casing** centered and to the bottom of the hole as the 5-in ID drill casing and HSA are removed **(allow grout to setup for 24-hours before continuing drilling)**. Air/downhole hammer drill 25 ft of the rock below the bottom of the 4-in ID steel casing.
The monitoring well 4-in ID steel casing will be completed approximately 2-3 ft above ground with a locking cap and centered within a 2-ft by 2-ft cement pad at ground surface. The bedrock portion below the 4-in ID casing will remain as an open borehole, i.e. no PVC well will be constructed.

Table 3-1
Existing Monitoring Wells To Be Sampled By USACE And The Navy

Existing Monitoring Wells to be Sampled by USACE	Existing Monitoring Wells to be Sampled by the Navy
MW03-12D	MW01-08D
MW03-12R	MW01-09D
MW03-13D	MW01-10D
MW03-13R	MW01-11D
MW03-14D	MW01-12D
MW03-14R	MW01-13D
EA-101	MW01-14D
EA-102	MW01-15D
EA-103	MW02-03D
EA-104	MW02-08D
EA-105	MW02-10D
EA-106	MW02-11D
EA-106R	MW03-02D
EA-107	MW03-03D
EA-108	MW03-05D
EA-109	MW03-06D
EA-112D	MW03-07D
EA-112R	MW03-08D
EA-113	MW03-08R
	MW03-09D
	MW03-10D
	EA-110D
	EA-110R
	EA-111D
	EA-111R
	MW-Z3-01
	MW-Z3-02
	MW-Z3-03D
	MW-Z4-01
	MW-Z4-02

Table 3-2 Sampling and Analytical Program for the USACE Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (15 new wells + 19 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	34	4		8 & 2/2	50
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	34	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	34	4		-- & 2/2	42
In addition to all of the above parameters ground-water samples from EA-104D/R/R2, EA-106D/R, EA-112D/R/R2, and EA-113D/R will also be analyzed for the following:	TAL Inorganics – (Cold Vapor Atomic Absorption (detection limit, < 0.08 ug/L) SW846 7470A (Mercury Only)	10	1		-- & 1/1	13
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3010A/6010B	10	1		-- & 1/1	13

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
In addition to all of the above parameters ground-water samples from EA-114D/R/R2 will also be analyzed for the following:	TCL Semi-Volatile Organics –GC/MS (detection limit, see QAPP) SW-3520C/8270C	3	1		-- & 1/1	6
Soil Samples (EA-114D and EA-116D)	TCL Volatile Organics – (GC/MS (detection limit, ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12
In addition the above parameters soil samples from EA-114D will also be analyzed for the following:	TCL Semi-Volatile Organics –(GC/MS (detection limit, see QAPP) SW-3540C/8270C	2	1	1	-- & 1/1	6
	TAL Inorganics –(Cold Vapor Atomic Absorption (detection limit, < 0.08 mg/kg) SW846 7471A (Mercury Only)	2	1	1	-- & 1/1	6
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3050A/6010B	2	1	1	-- & 1/1	6

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the **QA analysis** (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 3-3 Sampling and Analytical Program for the USACE Optional Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (up to 7 new wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	7	1		2 & 1/1	12
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	7	1 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	7	1		-- & 1/1	10
Soil Samples (EA-115D and EA-117D)	TCL Volatile Organics – (GC/MS detection limit ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the QA analysis (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 3-4 Sampling and Analytical Program for the Navy Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (5 new wells + 30 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	35	4		9 & 2/2	51
	Field Measured Parameters • Dissolved Oxygen • Turbidity • pH • Eh • Conductivity • Temperature • Ferrous Iron	35	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	35	4		-- & 2/2	43

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

For the Navy portion of this investigation, there will be no samples collected and shipped for QA lab analysis.

ATTACHMENT 5

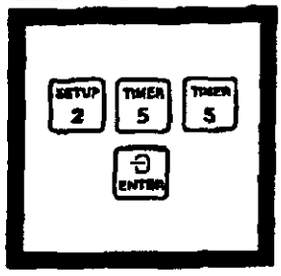
FIELD PROCEDURES FOR FERROUS IRON MEASUREMENT

IRON, FERROUS (0 to 3.00 mg/L)

For water, wastewater, and seawater

1,10 Phenanthroline Method* (Powder Pillows or AccuVac Ampuls)

USING POWDER PILLOWS



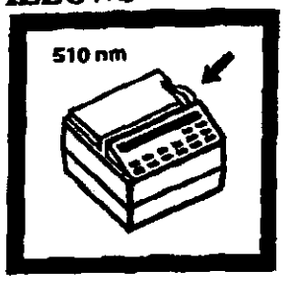
1. Enter the stored program number for ferrous iron, (Fe^{2+})-powder pillows.

Press: **2 5 5 ENTER**

The display will show:

Dial nm to 510

Note: The Pour-Thru Cell can be used with this procedure.



2. Rotate the wavelength dial until the small display shows:

510 nm

When the correct wavelength is dialed in, the display will quickly show:

Zero Sample

then: **mg/L Fe^{2+}**

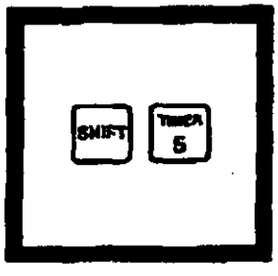
3. Fill a sample cell with 25 mL of sample.

Note: Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric, which is not determined.

4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Swirl to mix.

Note: An orange color will form if ferrous iron is present.

Note: Undissolved powder does not affect accuracy.



5. Press:

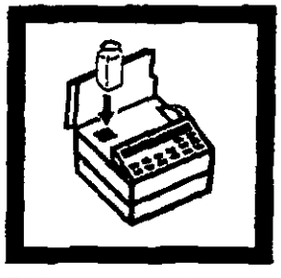
SHIFT TIMER

A three-minute reaction period will begin.

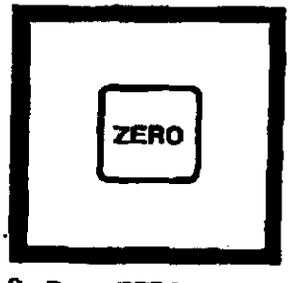
6. When the timer beeps, the display will show:

mg/L Fe^{2+}

Fill a second sample cell with 25 mL of sample (the blank).



7. Place the blank into the cell holder. Close the light shield.



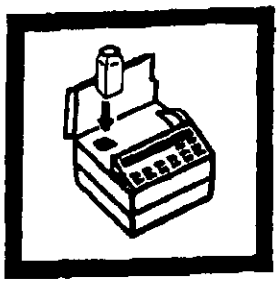
8. Press: **ZERO**

The display will show

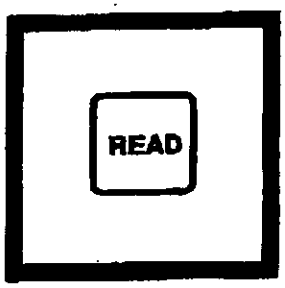
Zeroing...

then: **0.00 mg/L Fe^{2+}**

* Adapted from *Standard Methods for the Examination of Water and Wastewater.*



9. Place the prepared sample into the cell holder. Close the light shield.



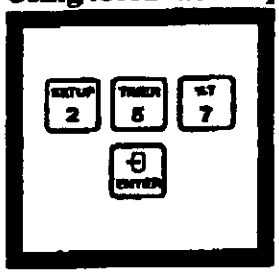
10. Press: **READ**

The display will show:

Reading. . .

then the result in mg/L Fe^{2+} will be displayed.

Using Accuvac Ampuls



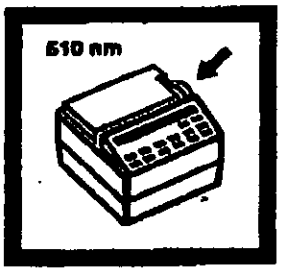
1. Enter the stored program number for ferrous iron (Fe^{2+})-AccuVac ampuls.

Press: **2 5 7 ENTER**

The display will show:

Dial nm to 510

Note: Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric, which is not determined.



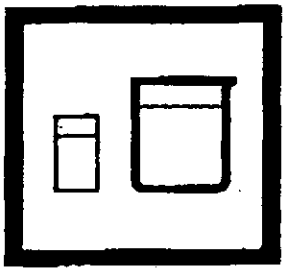
2. Rotate the wavelength dial until the small display shows:

510 nm

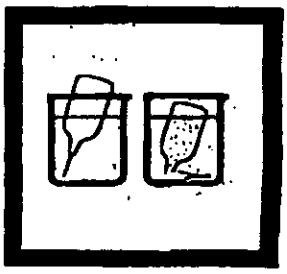
When the correct wavelength is dialed in, the display will quickly show:

Zero Sample

then: **mg/L Fe^{2+} AV**

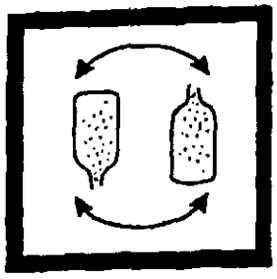


3. Fill a zeroing vial with at least 10 mL of sample (the blank). Collect at least 40 mL of sample in a 50-mL beaker.



4. Fill a Ferrous Iron AccuVac Ampul with sample.

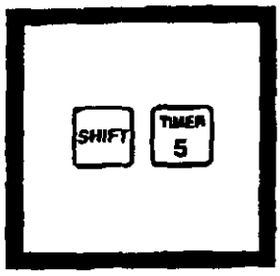
Note: Keep the tip immersed while the ampul fills completely.



5. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: An orange color will form if ferrous iron is present.

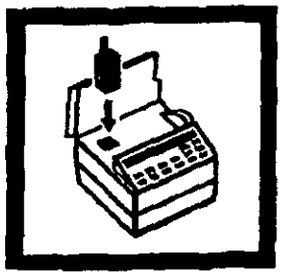
Note: Undissolved powder does not affect accuracy.



6. Press:

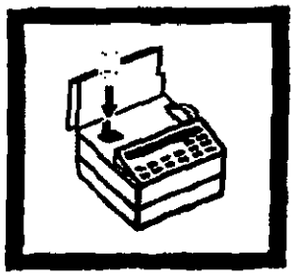
SHIFT TIMER

A three-minute reaction period will begin.



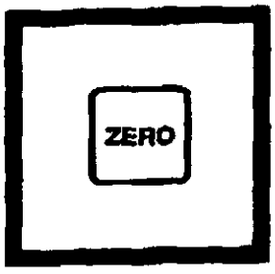
7. Place the AccuVac Vial Adapter into the cell holder.

Note: Place the grip tab at the rear of the cell holder.



8. When the timer beeps, the display will show: **mg/L Fe^{2+} AV**

Place the blank into the cell holder. Close the light shield.

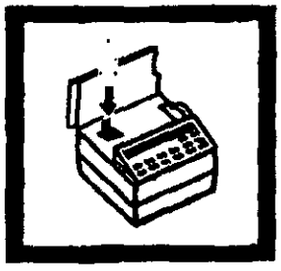


9. Press: **ZERO**

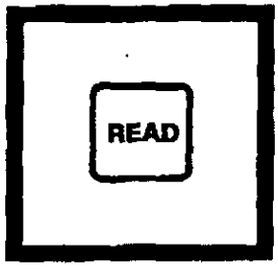
The display will show:

Zeroing. . .

then: **0.00 mg/L Fe^{2+} AV**



10. Place the AccuVac ampul into the cell holder. Close the light shield.



11. Press: **READ**

The display will show:

Reading. . .

then the result in mg/L Fe^{2+} will be displayed.

Accuracy Check

Standard Solution Method

Prepare a ferrous iron stock solution (100 mg/L Fe^{2+}) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate, in deionized water. Dilute to 1 liter. Prepare immediately before use. Dilute 1.00 mL of this solution to 100 mL with deionized water to make a 1.00 mg/L standard solution. Prepare immediately before use.

Run the test using the 1.00 mg/L Fe^{2+} Standard Solution by following either the powder pillow or AccuVac procedure. Results should be between 0.90 mg/L and 1.10 mg/L Fe^{2+}.

Precision

In a single laboratory using an iron standard solution of 1.000 mg/L Fe^{2+} and two representative lots of powder pillow reagents with the DR/2010, a single operator obtained a standard deviation of ±0.006 mg/L Fe^{2+}.
In a single laboratory using a standard solution of 1.000 mg/L Fe^{2+} and two representative lots of AccuVac ampuls with the DR/2010, a single operator obtained a standard deviation of ±0.009 mg/L Fe^{2+}.

Summary of Method

The 1,10-phenanthroline indicator in Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

REQUIRED REAGENTS (USING POWDER PILLOWS)

Description	Quantity Required Per Test	Units	Cat. No.
Ferrous Iron Reagent Powder Pillows	1 pillow	100/pkg	1037-69

REQUIRED REAGENTS (USING ACCUVAC AMPULS)

Ferrous Iron Reagent AccuVac Ampuls	1 ampul	25/pkg	25140-25

REQUIRED APPARATUS (USING POWDER PILLOWS)

Sample Cell, 25 mL, matched pair		pair	20950-00

REQUIRED APPARATUS (USING ACCUVAC AMPULS)

Adapter, AccuVac Vial	1	each	43784-00
Beaker, 50 mL	1	each	500-41
Vial, Zeroing		each	21228-00

OPTIONAL REAGENTS

Ferrous Ammonium Sulfate, hexahydrate, ACS		113g	11256-14
Water, deionized		4 L	272-56

OPTIONAL APPARATUS

AccuVac Snapper Kit		each	24052-00
Flask, volumetric, 100 mL, Class B		each	547-42
Flask, volumetric, 1000 mL, Class B		each	547-53
Pipet, volumetric, Class A, 1.00 mL		each	14515-35
Pipet Filler, safety bulb		each	14651-00
Pour-Thru Cell Assembly Kit		each	45215-00

For technical support and ordering information, see Section V.

In the U.S.A. call 800-227-4224 to place an order. Outside the U.S.A.—Contact the Hach office or distributor serving you.
Outside the U.S.A.—Contact the Hach office or distributor serving you.

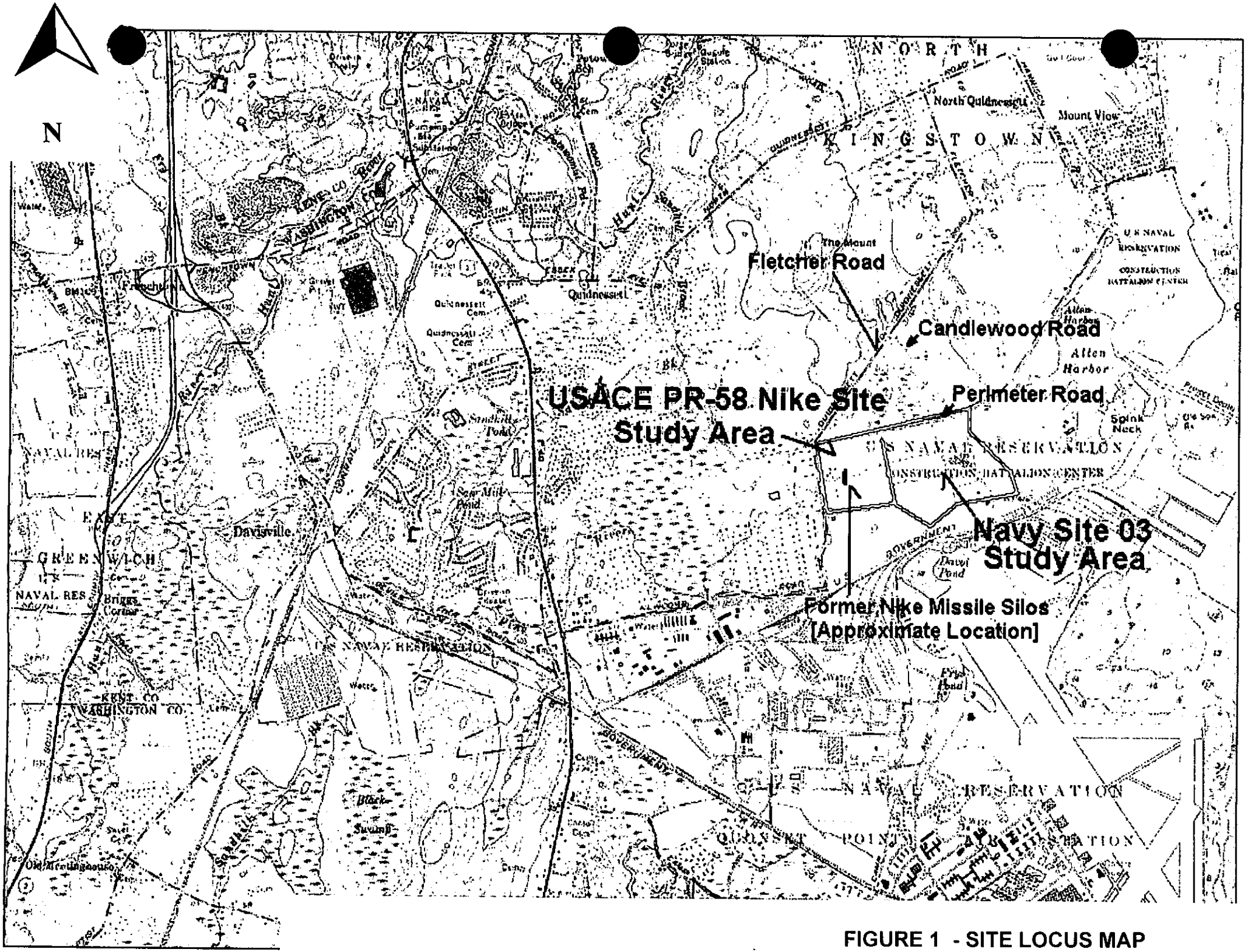
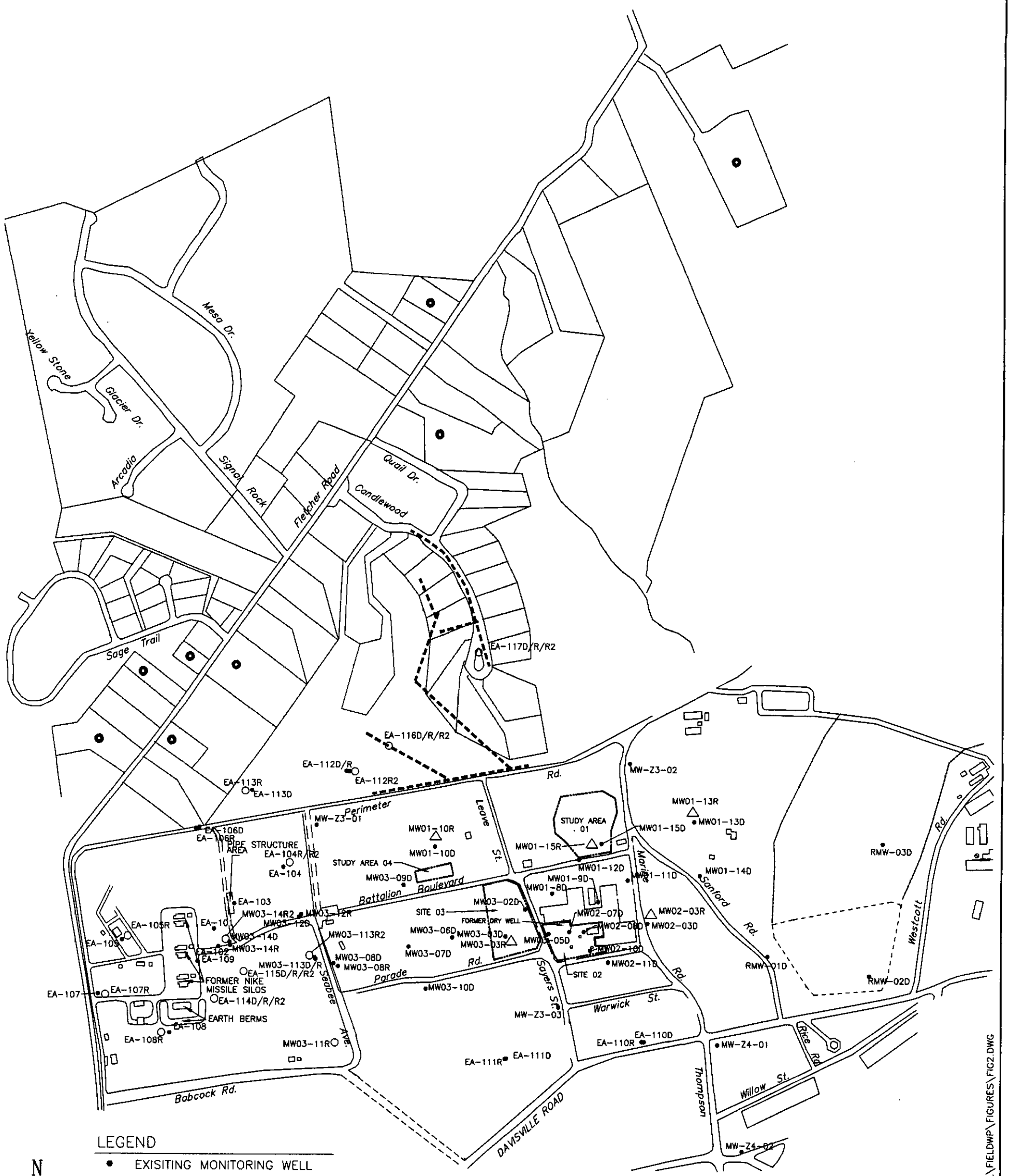


FIGURE 1 - SITE LOCUS MAP
USACE FORMER NIKE PR-58 SITE/ NCBC DAVISVILLE SITE 03 STUDY AREAS



LEGEND

- EXISITING MONITORING WELL
- LOCATION OF PROPERTY WITH PRIVATE USE WELLS
- PROPOSED MONITORING WELL FOR USACE
  - D – DEEP ZONE
  - R – SHALLOW COMPETENT BEDROCK ZONE
  - R2 – DEEPER COMPETENT BEDROCK ZONE
- PROPOSED MONITORING WELL FOR THE NAVY
- SEISMIC REFRACTION SURVEY LINE

N

500 250 0 500 1000

GRAPHIC SCALE IN FEET

NOTES:

MONITORING WELL LOCATIONS ARE APPROXIMATE

BASE MAP (SOUTH OF PERIMETER RD) DIGITIZED FROM: NCBC CENTER DAVISVILLE RI STATION MAP, SEPT 1992, ADDITIONAL ROADS ADDED FROM AERIAL PHOTO DATED 4/95

OFFSITE AREA (NORTH OF PERIMETER RD) DIGITIZED FROM A DRAWING PROVIDED BY THE TOWN OF NORTH KINGSTOWN, RI.

G:\PROJECTS\60957.56\0001.WPS\FINAL\FIELDWP\FIGURES\FIG2.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

U.S. ARMY CORPS OF ENGINEERS
FORMER PR-58 NIKE SITE CHARACTERIZATION
NORTH KINGSTOWN, RHODE ISLAND

SITE MAP

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
JAS	JAS	JBN	JAS	04-19-00	AS SHOWN	60957.56	FIG.2	–	2

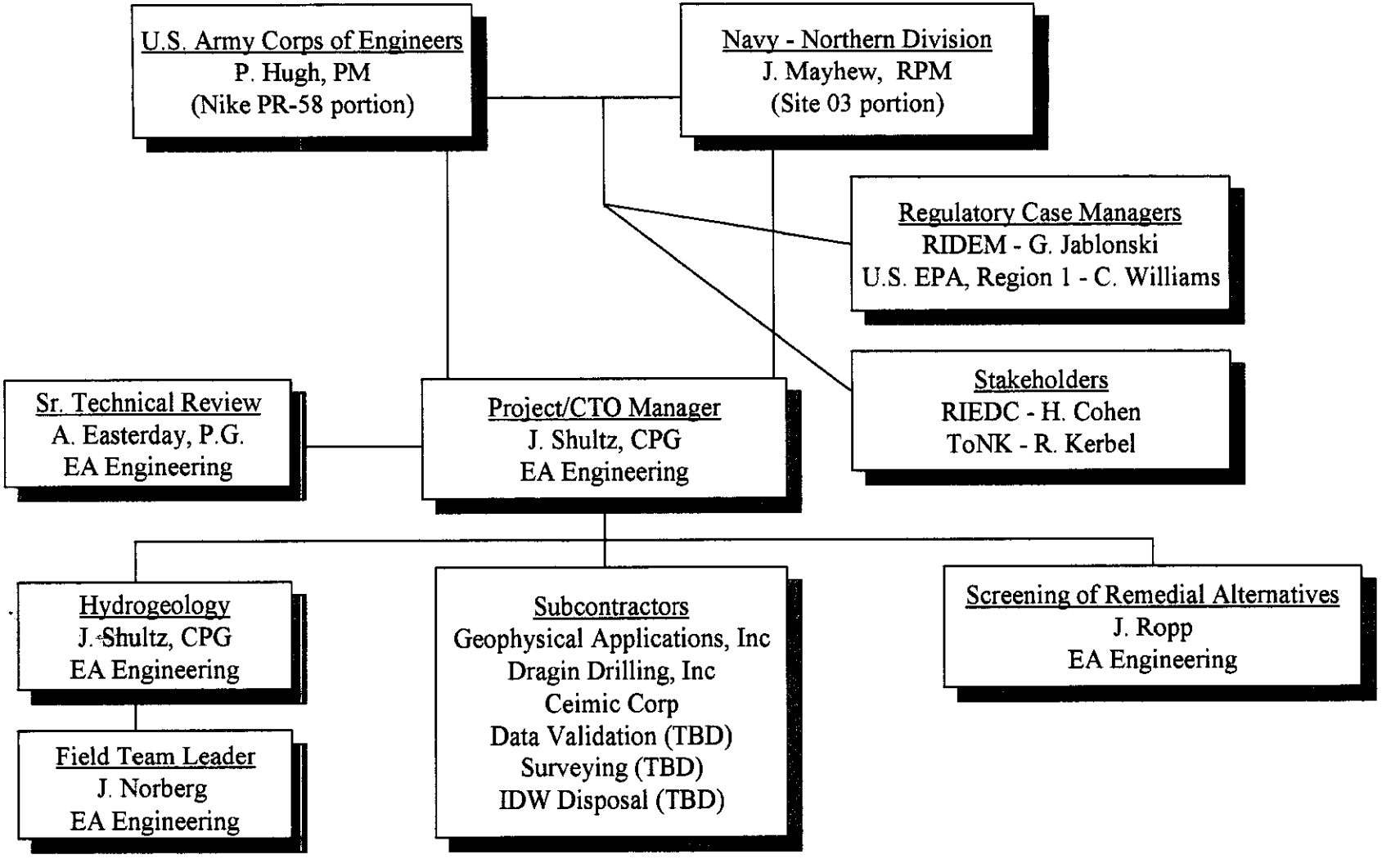


Figure 3: Project Organization

Nike PR-58/ Site 03 Additional Site Characterization

North Kingstown, RI

ATTACHMENT 1

SEISMIC REFRACTION FIELD PROCEDURES

(From Geophysical Applications, Inc.)

Standard Operating Procedures for Seismic Refraction Surveys

Geophysical Applications, Inc.
August 1999

EA ENGINEERING, SCIENCE & TECHNOLOGY
AUG 16 1999
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Purpose

This document provides guidelines for planning and conducting seismic refraction surveys. Seismic refraction surveys are often utilized during environmental or geotechnical investigations to measure depths to ground water, glacial till, or bedrock. Refraction depth calculations are based on the assumption that seismic velocity values increase with deeper geologic strata. Only features that exhibit contrasting seismic velocity values are identifiable with this method (e.g. saturated overburden versus bedrock, or fractured bedrock versus unfractured bedrock).

Pre-Survey Planning

Data requirements will be reviewed with the client to determine the survey objectives. Possible objectives include measuring depths to geologic strata, or locating bedrock fractures to be sampled with monitoring wells.

Background information should be requested from the client that may assist design of an effective survey. Such information may include:

- visible bedrock outcrops near the survey area
- previous seismic survey results or boring logs from the site vicinity
- available descriptions of regional geology.

The degree of accuracy required in the survey deliverables shall be discussed with the client. In general, higher-resolution surveys may require closer geophone spacings, more shot points, or more detailed ground surface elevation control than reconnaissance surveys.

If the approximate thickness and seismic velocity values of expected geologic strata are available, then forward travel-time models shall be prepared to confirm that enough seismic arrival times will be obtained to measure depths to each expected layer. In general, if fewer than two seismic arrivals are expected from a critical layer, then the geophysicist shall consider modifying geophone spacings or shot positions such that more arrival times will be detected.

Equipment Preparation

An equipment checklist (example attached) will be prepared before loading equipment into the field vehicle. Project-specific requirements (such as type of seismic energy

source, or materials needed for equipment decontamination) will be indicated on the equipment checklist.

Instrumentation will be functionally-checked before mobilization. The field geophysicist will initial and date the checklist when all equipment is loaded, and a copy of the completed checklist will be placed in the project files.

Site Preparation

Proposed refraction traverses will be positioned by taped or paced distance measurements, and transit or compass bearings referenced to roads, buildings, or other noteworthy features. Brushcutting, if needed, shall be performed before laying out seismic cables to avoid cutting the cables with sharp tools.

If explosive energy sources are to be used, Dig-Safe or similar utility notification and a blasting permit shall be obtained by the subcontracted blaster as required by State law.

Data Acquisition

A field book shall be maintained during each survey to record geophone and shot positions, ground surface elevations, distance measurements between seismic spreads and noteworthy features, or other field observations. Each field book shall be labelled with the client's name, site name, job number, and dates of work.

Seismic cables shall be placed along the intended alignment, as straight as permitted by site conditions. Bends in the traverse shall be noted in the field book, preferably by noting compass bearings and lengths of each line segment. Twenty-four channel geophone arrays with 10 or 20-foot geophone spacings are generally used. Distances along each spread shall preferably increase from west to east, or south to north, and any exceptions shall be noted. Traverse orientations shall be recorded in the field book and on a plan map (if available).

Geophones shall be placed at each takeout along the seismic cables. Spiked geophones will be used in soft ground, and tripod-based geophones will be used on hard surfaces. If spike-based geophones are used, loose soil or forest litter shall be removed from the geophone positions with a shovel or by scraping with a boot heel to facilitate coupling with firm soil. If tripod-based geophones are used, then a small sandbag or similar weight shall firmly couple the geophone to the ground surface.

Geophones that must be located more than one foot from their intended positions due to site conditions will be noted in the field book.

Six shot points are typically located along each traverse, and all shotpoints shall be marked with flagging or stakes. Shot points will be located at each end of the geophone array, and usually between the 8th and 9th geophones and between the 16th and 17th geophones. Additional shots shall be offset outside the array endpoints, if permitted by site conditions. Offset shots will be located sufficiently far from the array end points to produce refracted bedrock arrivals at all geophones, if permitted by site conditions. All shot stations shall be identified in the field notebook.

If explosive energy sources are used, then shotholes will be driven at least two feet deep with a steel bullpoint and a sledge hammer. If a Betsy firing rod is used as an energy source, then shotholes will be driven at least one foot deep. Actual shot hole depths, and the energy source used, shall be noted in the field book.

The ABEM Terraloc Mark 6 seismograph shall be set up using a twelve-volt battery as a power source. Seismic cables and shot lines shall be connected to the seismograph, paying careful attention to correctly identify geophone channels 1 through 12 and 13 through 24. The seismograph shall be set up to sample the seismic waveforms at 0.25-millisecond intervals or less. Seismic recording duration shall be at least 25% longer than the latest expected arrival times. If necessary, record duration will be modified during the field program (for example, if bedrock depth increases and later arrival times are observed). In general, a low-cut filter (typically 10 to 30 hertz) should be used to minimize ambient vibration or wind interference. A 60-hertz notch filter shall be used only if interference from nearby electrical cables is detected.

The field geophysicist will use the ABEM's software menus to assign distance stations to each geophone and shot point. Distances shall be in feet. Each recorded seismogram will be identified by the shot station and a three to six-digit record number. The record number, shot station, type and amount of energy source, and shot depth shall be recorded in the field book.

The field geophysicist will evaluate each seismogram to determine whether arrival times can be measured at each geophone. Records will be re-shot, or stacked with successive shots, if needed to obtain more distinct first arrivals. Each seismogram will be stored on the seismograph's hard drive, and transferred to floppy diskette at the conclusion of each geophone spread.

Observed distances between an end shot and the first refracted arrivals from the bedrock surface shall determine the minimum offset shot distance (i.e., for shots outside the geophone array endpoints). If the survey objective entails bedrock depth profiling, at least one seismogram from each geophone array shall be checked using the seismograph's software to confirm the velocity of seismic arrivals judged to represent bedrock. If the measured velocity value is lower than values that typically represent

bedrock (e.g. less than 10,000 feet per second) then longer offset shots or longer geophone spacings will be used to assure that adequate depth penetration is achieved.

Elevation differences between geophones shall be noted using a hand-held level, or by visual estimation. Elevation differences between shot points will be measured using an electronic theodolite and a surveyor's elevation rod. All elevation observations shall be noted in the field book.

Adjacent geophone spreads shall be overlapped by at least one geophone position to permit modeling via delay-time or generalized reciprocal method (GRM) techniques.

Data Analysis

First arrival times will be measured using the seismograph or a separate software package. Arrival times will be recorded on floppy diskette, and formatted for input into SIPT2, ViewSeis, or SeisOpt2D modeling software. If arrival times are picked by a person other than the project's senior geophysicist, then the senior geophysicist shall spot-check the arrival time picks before modeling.

The software package to be used for data analysis will depend upon the survey objectives. In general, depth modeling using SIPT2 delay-time software will be performed to produce cross sections showing seismically-detected strata. GRM or other modeling may also be employed for projects where an intended objective is to identify discrete low-velocity zones that might represent fractured bedrock. ViewSeis GRM and SeisOpt2D software can import a SIPT2 data file, preserving layer assignments and shot parameters (location, depth, etc.).

Arrival times and shot parameters shall be entered into the interpretive software, and each arrival time shall be assigned to a layer (except for SeisOpt2D). Layer numbers increase from top to bottom of a geologic cross section (i.e., unsaturated overburden is layer no. 1, saturated overburden is layer no. 2, and bedrock is layer no. 3). Layer assignments and calculated layer depths shall be checked by the senior geophysicist, and compared to existing boring logs or geologic cross sections. The geophysicist shall endeavor to obtain calculated layer depths that agree to within $\pm$ 5% or better with nearby borings or intersecting seismic traverses. If such agreement cannot be obtained, then the geophysicist shall endeavor to determine the cause of the discrepancy.

Calculated layer depths and velocity values shall be transferred to presentation graphics software to prepare final cross sections. These cross sections shall show the seismically-inferred strata, calculated compressional seismic velocity values, and nearby borings, outcrops, or other relevant features. Cross sections will be plotted using horizontal and vertical scales of one inch equals fifty feet, unless alternative depth scales are required to present especially shallow or deep strata.

ATTACHMENT 2

SOIL GAS STUDY FIELD PROCEDURES

SOIL GAS STUDY FIELD PROCEDURES

This fieldwork activity will include performance of a soil gas study (up to 10 points) [also referred to as a Soil Vapor Contaminant Assessment (SVCA)] in the area east of the former 'bermed area' and west of Seabee Avenue. The purpose of this work is to gather possible source area information from the vadose zone (unsaturated soil located above the ground-water table) to help select the location for the new monitoring well clusters EA-114D, R, and R2. Refer to Figure 2 of the Work Plan. This is an area where acids and solvents were alleged by the RIDEM to have been spilled.

1. Data Quality Objectives

SVCA data quality objectives will include the following:

> Evaluate the presence or absence of selected vapor-phase VOC (BTEX; 1,1,2,2-PCA; PCE; TCE; 1,1,2-TCA, and 1,2-DCE) in the vadose zone. This data may aid in the selection of the location for the new monitoring well cluster EA-114. The five chlorinated VOC (CVOC) are the key CVOC previously detected in deep ground-water samples collected from monitoring wells in the area.
>
> Estimate the areal extent of the selected organic vapors in the vadose zone. This data may assist in the assessment of the alleged historical source area.
>
> Identify variations in selected VOC concentrations within the vadose zone of the alleged source area.

2. Data Types

Unsaturated zone soil-vapor samples will be collected and analyzed onsite to characterize the selected VOC concentrations within the vadose zone in the vicinity of planned monitoring well cluster EA-114.

3. Data Uses

SVCA screening data will be used to identify VOC vapors in the subsurface. The data will be used to assist in selecting the location for monitoring well cluster EA-114 and to assist in the assessment of the alleged historical source area. Vacuum readings generated during the SVCA will also help in the assessment of subsurface air permeabilities.

SVCA screening data alone cannot be used with confidence to assess the impact of the alleged source area on ground-water quality, because correlation is based on many site-specific assumptions, such as subsurface homogeneity, uniform velocity gradients, and ideal vapor transport conditions. It is, however, a cost- and time-effective first step in evaluating the existence and degree of the selected subsurface VOC occurrence, and it is useful for locating more definitive source characterization techniques (e.g., borings/wells).

4. Quality Control

Gaseous analytic standards will be used during the one-point calibration of the gas chromatograph (GC) each day prior to the analysis of any samples. Standards will also be analyzed at the end of the day after soil-vapor samples have been analyzed to determine instrument drift, if present. A method blank will be analyzed each day to check for potential cross contamination. In addition, a syringe blanks will also be analyzed throughout the day to check for potential cross contamination. If the onsite environmental chemist deems it necessary, additional blanks will be analyzed to demonstrate sampling system cleanliness. A duplicate sampling event analysis will be performed after every tenth soil-vapor sample analysis. One soil-vapor sample per 20 samples will be spiked with the analytical standards to ensure that analytes in the soil-vapor samples are properly identified and that any shifts in retention times are taken into account.

5. Quality Assurance

The soil-vapor field data will be reduced by the onsite environmental chemist. A second environmental chemist will check the data generated to ensure that it is mathematically correct. A senior environmental chemist will provide a final review of the data.

6. General Methodology

The SVCA will be conducted at up to 10 locations. Based upon historical measurements in four nearby monitoring wells (NMW-1, NMW-4, EA-108, and EA-109), the depth to ground water has varied between approximately 4 ft and 11 ft below grade (bg). Therefore, the depth of the SVCA samples is estimated to be 3-10 ft bg. This depth range will be adequate to locate shallow subsurface VOC vapors, resulting from vertical migration from the alleged source area; this range is also anticipated to be effective in detecting VOC, if volatilizing from the shallow ground water. The SVCA will begin with a location at the alleged spill area (just east of the end of the asphalt-paved path) as identified by RIDEM personnel during the 2 June 1999 site visit by the Base (NCBC Davisville) Closure Team. At this location, soil gas samples will be collected from three depths (approximately 3, 6, and 9 ft bg) to assess potential vertical profile variation in the detected soil gas parameter concentrations, and to select the depth for collection of soil gas samples from the remaining locations. If none of the soil gas parameters is detected, then the second sampling location will be positioned just west of the aforementioned asphalt-paved path. Again at this second location, soil gas samples will be collected from three depths (approximately 3, 6, and 9 ft bg) to assess potential vertical profile variation in the detected soil gas parameter concentrations, and to select the depth for collection of soil gas samples from the remaining locations. The next four sample locations will be positioned approximately 25 ft north, east, south, and west of the initial sample locations and from the selected depth. The positions for remaining four samples will be determined in the field based upon the results of the previous samples to provide additional data at locations where one or more of the soil gas parameters are detected.

The ½ -in diameter, stainless steel probes will be advanced into the ground to a depth of 3-10 ft bg. Special care will be taken to ensure that the sampler is seated such that aspiration of ambient air is precluded. After the sampler is firmly seated, a vacuum source will be applied to the distal

end of the probe, and the system will be pumped until a near steady-state is attained. A steady-state, in soil-vapor sampling, means that analyte concentrations in soil vapor entering the sampling probe approximate analyte concentrations in soil vapor in the subsurface surrounding the sampling probe. This generally requires 2-4 minutes of applied vacuum.

If the vacuum gauge shows essentially no reduction in pressure after the vacuum pump is activated, vapors are being readily obtained and the system need only be purged for about 1 minute. This will purge a surplus (approximately 100) of probe and sampler volumes. If a significant reduction of pressure is observed (e.g., 15 in. mercury (Hg) vacuum), but the pressure returns to atmospheric fairly quickly after closing the sampling valve, a longer pumping time of 3-4 minutes will be adequate to purge the probe and sampler.

The analysis of soil-vapor samples will be in accordance with the EPA Level II Field Techniques, as defined in EPA's *Data Quality Objectives for Remedial Response Activities – Example Scenario: RI/FS Activities At A Site With Contaminated Soils and Ground Water* (EPA 1987). Vapor samples will be analyzed for BTEX; 1,1,2,2-PCA; PCE; TCE; 1,1,2-TCA; and 1,2-DCE onsite by means of a Varian GC interfaced with a Varian DS 654 data station. The Varian is a programmable GC equipped with a flame ionization detector (FID), an electron capture detector (ECD), and dual-column capability. The FID, which is used to detect hydrocarbons, responds specifically to compounds that yield a carbon skeleton that can be oxidized when introduced into an air/hydrogen flame. Therefore, it is sensitive to all organic compounds except formaldehyde and formic acid.

The Varian system is calibrated by injecting a known amount of vapor standard into each column in the GC. One set of standards contains a mixture of hydrocarbons (benzene; toluene; ethylbenzene; and ortho-, meta-, and para-xylene) that is used to calibrate the FID, while the other set contains a mixture of methylene chloride, cis- and trans-1,2-dichloroethene, 1,1,1-trichloroethane, carbon tetrachloride, TCE, and PCE, which is used to calibrate the ECD.

Typically, 10-15 soil gas samples can be analyzed per day. This includes collection, analysis, and data reduction.

ATTACHMENT 3

BOREHOLE GEOPHYSICAL LOGGING FIELD PROCEDURES

(These field procedures will be obtained from the related firm after selection and subcontracting has been completed)

ATTACHMENT 4

EXAMPLE FIELD FORMS

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL BORING

Coordinates: N: E:
Surface Elevation: FT MSL
Well Riser Elevation: FT MSL

Job. No.	Client:	Location:
60957.56.0003	USACE - NED	Nike PR-58 Site North Kingstown, RI
Drilling Method:		Boring No.
Sampling Method:		Sheet 1 of
Drilling Water Level		Start / Drilling Times / Finish
Date		
Time		
Surface Conditions:	woodland	

Sample Type	Inches Driven/In. Recvrd	Dpth Csg.	Samp # / depth (ft)	PID (ppm) Above bk.	Blows per 6"	Ft gs	USCS Log	SOIL DESCRIPTION
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						#		
						#		
						#		
						#		
						#		
						#		
						#		
						#		
						#		
						#		

Logged by: _____ Date: _____

Drilling Contractor: _____ Driller: _____

WELL SPECIFICATIONS:

Diam. of Riser: _____ Screen Interval: _____ Sandpack: _____ Grout: _____

Bottom of Hole: _____ Riser Interval: _____ Bentonite: _____ Cover: _____

EA Engineering, Science, and Technology, Inc.

LOG OF CORE BORING

Coordinates:
Surface Elevation:
Well Riser Elevation:

Job. No.	Client:	Location:
60957.56.0003	USACE	Nike PR-58 Site, North Kingstown, RI

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:

PACKER TEST FORM

Project Name: CVOC Characterization Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03	Hole No.
Project Number: 60957.56.0003	Test No. 1
Client: U.S. Army Corps of Engineers – New England District	Location: NIKE PR-58 Site
Contractor: Dragin Drilling	Date:
	Driller:
	Inspector:
	Hole Size:
	Length of Section:

	Packer System	Water Meter	Water Gauge	Surge Chamber
Type				
Mfg.				
Model No.				

GPmax = (0.566 to 1.0) × H1 _____ Rock Type _____

Computed Max Gauge Pressure: (GPmax) _____ Recovery _____

Computed Internal Friction _____ RQD (%) _____

Depths: (all distances measured from ground surface in feet)

To Top of Rock _____ To Top Lower Packer _____

To Bottom of Boring _____ To Bottom Upper Packer (H1) _____

To Water (H2) _____

Height of Water Pressure Gauge Above Ground Surface (H3) _____

GPmax = [(H1 + H3) (1 psi/ft)] - Ps _____

Minimum Inflation Pressure (MIP) _____

Static Pressure Head (Ps) = (H1 - H2) × 0.43 psi/ft _____

Packer Inflation Pressure (PIP) = (MIP + Ps + GPmax) _____

Maximum Water Pressure (Pmax) _____

Time	Elapsed Time (min)	Packer Pressure (psi)	Gauge Pressure (psi)	Meter Reading (gal)	Volume of Flow (gal/min)	Remarks

Field Sampling Form

Project Name: CVOC Characterization Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03

Project No.: 60957.96 Task: 0003 Date: _____

Well ID: _____ Personnel: _____ Start Time: _____ Finish Time: ____

Air Monitoring Equipment Used (Make/Model/Serial No.): _____

Calibration Information: _____

Ambient Air Reading: ____ ppm Well Headspace Reading: _____ ppm

Well Data/Integrity

Well Locked __ Yes __ No
Protective Casing Secure __ Yes __ No
Concrete Collar Intact __ Yes __ No
Other: _____
Protective Casing Stick-Up (ft): _____
Casing/Well Difference (ft): _____

Well Material: __ PVC / __ SS / Other _____
Well Diameter: __ 2-in. / __ 4-in. / __ 6-in. / Other _____
Water Level Equip. Used: __ Elect. Cond. Probe
__ Interface Probe
__ Press. Transducer
__ _____

Water Level Data Measured from: Top of Riser

Depth to Bottom of Well _____ (ft)
Depth to Top of Water _____ (ft)

Depth to center of screened interval: _____ (ft)

Depth of screened interval: _____ (ft)

Analytical Parameter	X if Field Filtered	Volume Required/ Sample Container	Sample ID	Preservation Method

Equipment Decon Identify equipment used (i.e., pumps, bailers, tubing, filters, etc.)

P = Purge S = Sample		Equipment Used (serial number)	Decon Method
P	S	Water Level Indicator	
P	S	Water Quality Meter w/ Flow-Through Cell	
P	S		
P	S		
P	S		
P	S		

NOTES: _____

Field Sampling Form

Page__ of_

Project Name: CVOC Characterization Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03

Project No.: 60957.96 Task: 0003 Date: _____

Well ID: _____ Personnel: _____ Start Time: _____ Finish Time: ____

Parameter (units)	Initial	Volume	Volume	Volume	Volume	Volume	Volume
Liters							
Time							
Temperature (°C)							
pH							
Conductivity (m_/cm)							
DO (mg/L)							
Turbidity (NTUs)							
Eh (mV)							
Water Level (ft from TOR)							
Flow Rate (mL/min.)							

Parameter (units)	Volume	Volume	Volume	Volume	Volume	Volume	Volume
Liters							
Time							
Temperature (°C/°F)							
pH							
Conductivity (m_/cm)							
DO ( )							
Turbidity (NTUs)							
Salinity (%)							
Eh (mV)							
Water Level (ft from TOR)							
Flow Rate (mL/min.)							

Parameter (units)	Volume	Volume	Volume	Volume	Volume	Volume	Volume
Liters							
Time							
Temperature (°C/°F)							
pH							
Conductivity (m_/cm)							
DO ( )							
Turbidity (NTUs)							
Salinity (%)							
Eh (mV)							
Water Level (ft from TOR)							
Flow Rate (mL/min.)							

NOTES: _____

WELL DEVELOPMENT LOG

Client:	
Project Title:	
Project No.:	
Staff:	

Well No.:

1. Total Riser and Screen Length (ft)	
2. Screen Internal Diameter (in.)	
3. Water Level Below Measuring Point (ft)	
4. Volume of Water in Well (gal) V = (1-3)*(5)	

Screen ID	5. Volume/Ft (gal/ft)
1 in.	0.04
2 in.	0.16
4 in.	0.65
6 in.	1.47
8 in.	2.61

Parameters

Date									
Total Gallons									
Time									
Temperature (°C)									
Conductivity (mS/cm)									
pH									
Turbidity (NTU)									
Dissolved Oxygen (mg/L)									
Salinity (%)									
Eh (mV)									

NOTES:

QUALITY ASSURANCE PROJECT PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03

NORTH KINGSTOWN, RI

CONTRACT NUMBER DACA31-94-D-0025
DELIVERY ORDER NO. 0181

Prepared for:

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FINAL
April 2000
EA Project No. 60957.56.0001

QUALITY ASSURANCE PROJECT PLAN

CHARACTERIZATION OF CVOC CONTAMINATION AT THE FORMER NIKE PR-58 SITE AND ADJACENT NAVY NCBC DAVISVILLE SITE 03

NORTH KINGSTOWN, RI

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INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared for the U. S. Army Corps of Engineers – New England District (USACE) to present the investigative plan and field procedures for the joint USACE-Navy chlorinated volatile organic compound (CVOC) investigation ("Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy Property") under Contract No. DACA31-94-D-0025, Delivery Order No. 0181. As agreed upon by USACE and the Navy, for efficiency and because of the concurrent nature of the joint investigation activities, both the USACE and Navy portions of the joint investigation are included in this Work Plan prepared for USACE with input for the Navy portions. The investigation of the former Nike PR-58 Site will be preformed under the Defense Environmental Restoration Program-Formally Used Defense Sites (DERP-FUDS) Program. The Navy portion of the joint investigation is being performed under the Base Realignment and Closure Act (BRAC) Contract No. N62472-92-D-1296, Contract Task Order (CTO) 0096.

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency overseeing activities within the Navy property (BRAC funded). The Rhode Island Department of Environmental Management (RIDEM) is the lead regulatory agency overseeing the activities within the Nike area (DERP-FUDS funded).

The former Nike PR-58 missile launch site (deactivated in 1962) is located in the Town of North Kingstown, Rhode Island (Figures 1 and 2). A description and history of the site is summarized in Chapter 2 of the Work Plan. The Navy's investigations at the former Naval Construction Battalion Center (NCBC) Davisville, Rhode Island (Figures 1 and 2) identified dissolved Chlorinated Volatile Organic Compounds (CVOC) in the deep ground water. Based upon the findings presented in the Navy's "Nike Source Area and Offsite Investigation" Final Interim Report dated October 1998, the main source area for the CVOC plume detected in deep zone ground-water samples was in the vicinity of monitoring well MW03-14D located just east of the former PR-58 Nike Site and west, up-gradient of Navy property. Based upon these findings and the comments from the EPA-Region 1 and RIDEM, additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the deep and bedrock ground-water zones, particularly the northeast extension of the plume offsite (north of Perimeter Road) beneath a residential area.

The Work Plan (of which the QAPP is Appendix A) describes the field and laboratory activities that will be used. The QAPP has been prepared for use by EA to ensure that data collected are scientifically valid and legally defensible, and to establish the field and analytical protocols and documentation requirements that will ensure the data collected meet the quality objectives of the site investigation.

This QAPP presents the policies, organizations, functions, and quality assurance/quality control (QA/QC) requirements designed to achieve the data quality goals established in the Work Plan. It further presents the criteria and procedures that will be followed during implementation of all activities specified in the Work Plan.

The following provides a brief summary of the work to be performed for USACE and the Navy.

For the USACE:

- Installation, development, and testing of 15 monitoring wells. Two of the wells will be screened in the deep overburden ground-water zone, 8 of the wells will be screened in the shallow competent bedrock ground-water zone, and 5 of the wells will be screened in the deeper competent bedrock ground-water zone.
- Sampling and analyzing of ground water from the 15 new wells, plus 19 existing deep ('D') and rock ('R') wells at the site.
- Performance of data validation of the ground-water analytical results.
- Performance of data management and provide electronic and Geographic Information Systems (GIS) deliverables.
- Preparation of a report documenting the USACE and Navy field investigation results, conclusions, and recommendations.
- Assess, identify, and recommend remedial action alternatives. An elaborate detailed level of effort is not the intent of this assessment. If required at a future date, a Phase III level Feasibility Study (Detailed Assessment of Remedial Alternatives) will be incorporated as a modification to this task order.

For the Navy:

- Installation, development, and testing of 5 monitoring wells screened in shallow competent bedrock ground-water zone.
- Sampling and analyzing of ground water from the 5 new wells, plus 31 existing deep ('D') and rock ('R') wells in the NCBC Site 03 vicinity.
- Performance of data validation of the ground-water analytical results.
- Performance of data management and provide electronic and GIS deliverables.
- Preparation and incorporation of the related Navy field investigation results, conclusions, and recommendations in the USACE report of the joint Navy/USACE investigations.

3. DISTRIBUTION LIST

The following is the list of organization and agency representatives to whom the Work Plan, including this QAPP, will be distributed. The QAPP is a dynamic document and should be revised or updated to reflect changes in organization and procedures needed to meet the Quality Objectives identified in the Work Plan. Whenever revisions are made or addenda added to the QAPP, those listed below will receive the revisions/addenda. This distribution system does not preclude making and using copies of the QAPP. However, those listed below are responsible for distributing the Work Plan and QAPP, and any additional material to update any copies within their organizations.

EA Engineering, Science, and Technology (EA)
James Shultz, EA Project Manager
USACE, New England District
Peter Hugh, USACE Remedial Project Manager
Navy-Northern Division
John Mayhew, Navy Remedial Project Manager
U.S. Environmental Protection Agency, Region I (EPA)
Christine Williams
Rhode Island Department of Environmental Management (RIDEM)
Gary Jablonski
U.S. Fish & Wildlife (USF&W)
TBD
Town of North Kingstown (ToNK)
Richard Kerbel
Rhode Island Economic Development Corporation (RIEDC)
Howard Cohen
Dynamac Corporation
Eileen Curry

4. PROJECT ORGANIZATION

4.1 Project Organization Chart

The project organization is shown on Figure 3.

4.2 Communications Pathways

All official communication shall be through the EA Project Manager, the USACE Remedial Project Manager, and the Navy Remedial Project Manager. All other communication shall be considered shadow communication and shall be non-binding and not official.

4.3 Project Roles and Responsibilities

The individuals directly involved with this joint USACE and Navy project and their specific responsibilities are outlined below.

Peter Hugh, USACE Remedial Project Manager: Overall coordination and decision-maker for the USACE portion of the project. Coordinates all activities within the USACE New England District for the PR-58 Nike Site and the off-site residential (i.e., north of Perimeter Road) portions of the investigation. Coordinates and resolves issues with regulatory case managers.

John Mayhew, Navy Remedial Project Manager: Coordination and decision-maker for the Navy portion of the project. Coordinates all activities within the Navy Northern Division for the NCBC Davisville site 03 portion of the investigation. Coordinates and resolves issues with regulatory case managers. Navy member of the Base Closure Team (BCT).

Christine Williams, EPA Region 1, Remedial Project Manager: EPA Region I decision-maker and oversight of Navy investigation and remediation. Coordinates all activities within EPA for this site. EPA member of the BCT.

Gary Jablonski, RIDEM, Remedial Project Manager: RIDEM decision-maker and oversight of USACE investigation and remediation. Coordinates all activities within RIDEM for this site. RIDEM member of the BCT.

James Shultz, EA Project Manager: Overall coordination and preparation of the site investigation. Includes coordination and scheduling of lab analysis, data review, and validation, and overall coordination of field work. Delivers investigation report to the USACE and regulatory case managers.

USF&W (TBD): Reviews the site investigation in relation to specific trustee responsibilities.

Howard Cohen (RIEDC) and Richard Kerbel (ToNK). Reviews the site investigation in consideration of future use of the site.

4.3.1 Ceimic Corporation

The objective of the QAPP is to provide analytical data that are technically valid and legally defensible, and that meet the user's needs. Accordingly, the management of the selected EPA Certified Laboratory Program (CLP) laboratory, Ceimic Corporation, encourages excellence in analytical testing and provides the necessary resources and environment. A copy of Ceimic's Laboratory Quality Assurance Plan is included as Attachment 1 of this QAPP and identifies the policies, organization, objectives, functional activities, and specific activities designed to achieve the desired quality goals set forth by the laboratory for this project.

All analytical support will be provided by Ceimic Corporation, which is located at 10 Dean Knauss Drive, Narragansett, RI 02882. Neil Pothier is the CEIMIC point of contact with the EA Project Manager. In the event that any analyses must be subcontracted for any reason, it will be done only with the approval of the EA Project Manager.

4.4 Special Training Requirements/Certification

No special training requirements or certifications are required for this project except for the 40-hour HAZWOPER class and annual refreshers.

5. PROJECT PLANNING AND PROJECT DEFINITION

5.1 Project Planning Meetings

Project planning meetings began upon submittal of the draft Work Plan and QAPP. Project meetings will be as requested by either the EA Project Manager, USACE Remedial Project Manager, or Navy Remedial Project Manager .

5.2 Site History, Background, and Problem Definition

The former Nike PR-58 missile launch site (deactivated in 1962) is located in the Town of North Kingstown, Rhode Island (Figures 1 and 2). A description and history of the site is summarized in Chapter 2 of the Work Plan.

The Navy's investigations at the former Naval Construction Battalion Center (NCBC) Davisville, Rhode Island (Figures 1 and 2) identified dissolved CVOC, the contaminants of concern, in the deep ground water. Based upon the findings presented in the Navy's "Nike Source Area and Offsite Investigation" Final Interim Report dated October 1998, the main source area for the CVOC plume detected in deep zone ground-water samples was in the vicinity of monitoring well MW03-14D located just east of the former PR-58 Nike Site and west, up-gradient of Navy property. Based upon these findings and the comments from the EPA-Region 1 and RIDEM, additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the deep and bedrock ground-water zones, particularly the northeast extension of the plume offsite (north of Perimeter Road) beneath a residential area.

The project action levels for ground water are the RIDEM Class GA standards (north of Perimeter Road) and GB standards (south of Perimeter Road) for further assessment of the CVOC plume that has migrated offsite north of Perimeter Road where ground water can and has been used for residential water supply. These standards (project action limits) have been included in Section 12 along with the laboratory's analytical methods and reporting limits. The analytical results of the few soil samples are for comparison to the results of ground-water samples from the related borings/wells and to add to the understanding of nature and extent of the analytes. This project does not include a risk assessment and so project action levels for soil have not been established.

6. PROJECT DESCRIPTION AND SCHEDULE

6.1 Project Overview

The data will be used to address the following:

General objectives of the additional characterization within the NIKE and northern residential areas for USACE are to:

- Further assess the nature and extent (lateral and vertical) of the potential primary CVOC source area in the competent bedrock in the vicinity of MW03-14.
- Assess the nature and extent (lateral and vertical) of the potential second CVOC source area in the sand and gravel/weather rock and competent bedrock zones at the end of a 20-25 ft dirt road just east of former Building (silo) 349 where monitoring well cluster EA-114 is planned to be located (Figure 2). This area was alleged by recent information from RIDEM to have been an area of historical disposal of solvents and acids.
- Assess the nature and extent of the CVOC plume with specific focus on the northeast edge that extends off the former Nike Site and Navy properties (impacting the GA-classified aquifer).
- Further assess natural attenuation (develop isopleth plots).
- Assess remedial alternatives in a focused manner.

General objectives of the additional characterization within the Navy property for the Navy are to:

- Document the direction of ground-water flow.
- Assess the nature and extent in the competent bedrock of the CVOC plume that has extended east beneath the Navy property from the former PR-58 NIKE Site area.
- Further assess natural attenuation within the Navy property.

6.2 Project Schedule

Assuming concurrence of the BCT with the Work Plan, the following schedule is planned:

• Begin Field Work	31 May 2000
• Complete Field Work	24 August 2000
• Lab Results due to EA	21 September 2000
• Data Validation Completed	19 October 2000
• Draft Investigation Report Due to BCT	30 November 2000
• Draft Report Comments Due from BCT	15 January 2000
• Final Investigation Report Submittal	12 February 2000

7. PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA

7.1 Project Quality Objectives

The project data quality objective is to provide valid data of known and documented quality. The data quality indicators to be measured are described below.

Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control sample (LCS) is used to determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference between the duplicate sample results.

Precision is to be expressed as relative percent difference and calculated using the equations in Table 7-1. Project-specific precision criteria are included in Table 7-2

Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy is to be expressed as percent recovery and calculated using the equation in Table 7-1. Project-specific accuracy criteria are included in Table 7-2.

Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations.

The Chapter 4 of the Work Plan contains the sampling and field handling protocols (e.g., storage, handling and shipping) designed to ensure that the collected samples are representative of the media. Proper field documentation is to be used to show that the designated protocols have been followed, and that sample identification and integrity have been maintained during the sampling event.

Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

With regard to field and laboratory analyses and measurements, similar methods with similar reporting limits will be used to the extent possible to ensure comparability of data collected during the planned field work and the future work at the Site. Acceptance criteria will be provided for QC samples such as field duplicates, LCS, and Matrix Spike/Matrix Spike Duplicates in the final Work Plan.

Completeness

Completeness is calculated using the equation in Table 7-1 for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified as unusable. The goal for completeness is 100 percent. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

7.2 Measurement Performance Criteria

The lateral and vertical extent of the ground-water contamination shall be defined as those locations that exceed RIDEM Remediation Regulations (August 1996) for the USACE portion and CERCLA for the Navy portion.

The vertical extent of this investigation shall be from ground surface down to the deep (R2) bedrock ground-water zone.

Analytical results will be needed from at least 50% of the analyzed soil samples collected from EA-114D. Ground-water sample analytical results will be needed from at least 80% of the total number of monitoring well sampled, but from 100% of the sampled monitoring wells located north of Perimeter Road. Ground-water surface elevation data will be needed from at least 80% of the total number of monitoring wells measured, but from 100% of the monitoring wells measured north of Perimeter Road.

8. SAMPLING PROCESS DESIGN

8.1 Sampling Design Rationale

For this project, the sampling design and rationale and planned sampling locations are provided in Chapter 3 of the Work Plan. A summary of the sampling and the analytical program for this joint investigation is provided in Tables 8-1 through 8-3.

8.2 Quality Assurance Samples

As required by USACE, 10% percent of the soil and water samples collected for USACE portion of this investigation will be collected as replicate samples and sent to the following independent government testing laboratory (quality assurance [QA] laboratory) selected by USACE-NED. No QA samples will be collected for the Navy portion of this investigation.

Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

The directions for shipping of the samples to STL is included in Attachment A-3 ("Instruction for Shipment of Quality Assurance Samples").

The "QA Sample Summary" (Attachment A-3) shows the number of QA samples that are planned to be collected for the project. These samples will be preferentially selected from locations that are suspected of containing detectable levels of CVOC. The analytical program for these QA samples will be the same as that stated in Section 8.1 of this QAPP for the related sample that is submitted to Ceimic. The process for collection, handling, custody, and shipment of QA samples will be the same as those stated in Chapters 9 and 10 of this QAPP.

- QA samples for methane need not and will not be collected.
- The specific location for the soil sample will be the deeper of the 2 samples selected from EA-116D.
- The specific USACE ground-water samples to be collected in replicate for the analysis by the QA laboratory will be selected after the new monitoring wells have been installed.

9. SAMPLING PROCEDURES AND REQUIREMENTS

Sampling, decontamination, equipment calibration and maintenance procedures are provided in Chapter 4 of the Work Plan. Sample container, volume, preservation, and holding time requirements are provide in Table 9-1 for aqueous samples and Table 9-2 for soil samples.

10. SAMPLE HANDLING, TRACKING, AND CUSTODY REQUIREMENTS

Sample labeling, handling, tracking, and custody requirements are provided in Section 4.10 of the Work Plan, along with the field notes and documentation requirements.

11. FIELD ANALYTICAL METHODS REQUIREMENTS

The field analyses planned for this work include the use of a water quality unit (for pH, Eh, DO, temperature, conductivity, and salinity) and turbidity meter for measurements during well purging and sampling activities and a HACH field kit for the measurement of ferrous iron as stated in Chapter 4 of the Work Plan. The procedures stated in the manual with each piece of field analytical equipment will be followed.

Instruments will be calibrated before sampling each day and on an as-needed basis in accordance with the manufacturer's instructions. The instrument calibration will be verified after lunch and the end of each sampling day.

Each piece of equipment will be checked by EA to be in proper working order before its use and calibrated as required by the manufacturer. Prior to each use, field analytical equipment probe(s) will be decontaminated in accordance with Section 4.11 of the Work Plan. After each use, the instrument will be checked and stored in an area shielded from weather conditions.

12. FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

The water and soil samples will be analyzed by the selected CLP laboratory (i.e., Ceimic Corporation) using the analytical methods and project-specific reporting limits shown for aqueous and soil samples in Tables 12-1 and 12-2, respectively. The analytical method requirements, instrumentation, calibration, maintenance, and reporting from Ceimic Corporation have been provided in their Laboratory QA Plan, a copy of which is provided as Attachment A-1.

The project-specific analytical methods and reporting limits shown for aqueous and soil samples in Tables 12-1 and 12-2, respectively, and supercede related information in the general Laboratory QA Plan (Attachment A-1). Ceimic's analytical SOPs are maintained at their facility in Narragansett, RI. A copy of the cover page of various SOPs for various analytical methods to be used on this project are provided in Attachment A-2.

13. QUALITY CONTROL REQUIREMENTS

Ceimic's project-specific Quality Control Criteria for Precision and Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates, and Laboratory Control Samples are presented presented in Table 7-2. A summary of Ceimic's project-specific Laboratory Quality Control Criteria and Corrective Action Procedures are also included in Table 13-1. The project-specific criteria shown in Tables 7-2 and 13-1 supercede related information in the general Laboratory QA Plan (Attachment A-1).

The following presents the types of Quality Control Samples planned for this project:

Temperature Blank
One temperature blank will be included per shipping cooler containing soil or water samples submitted to Ceimic for chemical analysis. This will be used by Ceimic to document the temperature of the samples they receive for this project

Trip Blank
One trip blank will be included per shipping cooler containing water samples to be analyzed for Target Compound List (TCL) VOC.

Field Duplicate
Field duplicate of each sample type (i.e., ground-water and soil) will be collected at the rate of 1 per every 10 samples. The field duplicate samples will be analyzed for the same parameters as the duplicated samples.

Method (Reagent) Blank
Method (reagent) blanks are used to monitor laboratory contamination. This is usually a sample of laboratory reagent water or soil matrix treated with all the reagents and in the same manner as the sample (i.e., digested, extracted, distilled). One method blank will be prepared and analyzed every day that samples are prepared.

Fortified Method Blank Spike (Laboratory Control Sample)
Fortified method blank samples are analyzed with each batch of 20 or fewer samples. These samples generally consist of laboratory reagent-grade water or solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. They are prepared and analyzed with the associated sample batch. The analyte recovery from each is used to monitor analytical accuracy.

Fortified Sample (Matrix Spike)
A fortified sample (matrix spike) is an aliquot of a field sample that is fortified with the analyte(s) of interest and analyzed to monitor matrix effects associated with a particular batch of samples. Matrix spike and matrix spike duplicate samples will be performed for every batch of 20 or fewer samples for organic analyses.

Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries are calculated for each surrogate. Surrogates shall be spiked into samples according to the appropriate analytical method (Chapter 8)). Surrogate spike recoveries shall fall within the control limits set in accordance with procedures specified in the method. Surrogate recoveries will not be calculated if sample dilution causes the surrogate concentration to fall below the quantitation limit.

14. DATA ACQUISITION REQUIREMENTS

The validated data for ground-water samples collected during the Navy's Phase III Remedial Investigation (RI) of NCBC Davisville Site 03 will be used for comparison during assessment of the nature and extent of the CVOC plume in the 'deep' and 'bedrock' ground-water zones. Also, the hydrogeological data developed during that Navy RI will be refined with the related data developed during USACE's Nike PR-58 investigation.

15. DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

15.1 Project Documentation and Records

The project documentation, records, and field data files will be retained and maintained by EA.

15.2 Field Data Reporting

Field records are evaluated by the EA Project Manager for the following:

- Completeness
- Identification of valid samples
- Identification of anomalous field test data
- Accuracy and precision of field data and measurement.

The review of field record completeness checks that requirements for field activities in the work plan have been fulfilled, that complete records exist for each field activity, and that the procedures specified in the work plan have been implemented. Field documentation must ensure sample integrity and provide sufficient information to characterize each field event. The results of the completeness check are documented by the site manager, and any data affected by incomplete records are identified at this time.

The identification of valid samples involves interpreting and evaluating the field records to detect problems affecting representativeness of field samples. Field records can indicate whether a well is properly constructed; well-development records can indicate whether correct development has occurred. Field audits are another source of data for review. The EA Project Manager will perform periodic site visits during the field activities to check that the work is being performed in accordance with the Work Plan and to resolve observed deviations. The judgements for data validity will be documented in the technical report, and field data associated with incorrect field work will be identified. Anomalous field data will be identified and explained to the extent possible in the technical report. The field records will be maintained and retained in the project file at the EA Project Managers office.

15.3 Laboratory Reporting

Ceimic has been a participant in the EPA CLP program since 1988. The Ceimic laboratory report will be a Level IV deliverable that follow the CLP guidelines for both organics and inorganics. The intent of Ceimic's level IV data report is to provide a fully validatable report via CLP summary Forms and will include raw data from instruments and bench sheets. The standard Level IV package will include a Sample Data Group (SDG) narrative detailing instrumentation, cross-reference of client to laboratory IDs, and any difficulties encountered during the analysis and tenure of the samples while at Ceimic..

15.4 Data Management

Ground-water level elevation data; sampling locations; and fixed laboratory results of soil and low-flow collected ground-water samples will be added to the GIS database.

Geographic Information Systems Preparation

Software: ARCVIEW Version 3.1

Base Maps: The basis of the ARCVIEW project will be existing base maps which may include USGS Digital Raster Graphs, CADD Base maps, Digital Orthophoto Quadrangle's (DOQ's) and or scanned and geo-rectified aerial photographs. All CADD files should be produced as to be compatible with a GIS. (i.e.; closed polygons for polygonal features, such as buildings, polylines instead of lines, blocks with attributes, elevations assigned to features when appropriate, and a distinct and clear layering system).

GIS Data Integration: Upon compilation of all sample, chemical and positional data (i.e.: Tables 1, 2 and 3 of Attachment A-4), the data shall be incorporated into an ARCVIEW GIS project. Table 2 shall be joined to Table 3 on the SAMPLE_NO field. Table 1 shall be linked to the new table to be named Analytic Results (Tables 2 and 3 combined) on the location field. Within the ARCVIEW Project a separate SAMPLE LOCATION theme per media, shall be provided (i.e.; groundwater, soil, etc.).

NOTE: Tables 1, 2 and 3 (Attachment A-4) allow access to all the data in (XYZ) space. If the environmental project effort requires comparison to various criteria such as MCL's or risk based screening levels than those fields should be incorporated. This allows users to quickly identify exceedances, produce tag maps as necessary and to view spatial relationships. (i.e.; Result > MCL's)

Figure Preparation: The GIS system shall be used as applicable to generate site location maps, sample location maps, contaminant ISO-contour maps, potentiometric surface maps, bedrock contour maps and contaminant tag maps. Any figures or drawings prepared in CADD software packages or EQUIS, shall be included in the ARCVIEW Project deliverable as a theme with attribute tables or layout as appropriate. All site plan view figures generated in a CADD software shall utilize the specified coordinate system and shall not be rotated. (i.e.; north is north!)

GIS Deliverable: The ARCVIEW Project shall be delivered on CD-ROM. The complete EQUIS database shall be delivered on a separate CD_ROM in a MDB format.
Electronic Data Deliverables

The EA Project Manager shall tabulate, organize, and reduce the results of the laboratory analyses. The EQUIS data structure shall be utilized, however the data shall be parceled out, merged, and delivered to the USACE and Navy to be consistent with the data collected and delivered to the USACE and Navy during previous investigations of the site.

Database Format & Structure: Provide electronic deliverable in a Dbase IV file format (file name.dbf). The structure of the database/flat files is described in Tables 1, 2 and 3 in Attachment A-4. It shall be the responsibility of the EA Project Manager to ensure that all data received from the laboratory is in accordance with Table 3. *(USE OF EQUIS DEFINED FIELDS/VALID VALUES IS ACCEPTABLE IN LIEU OF THE STRUCTURE IDENTIFIED IN THE (TABLES)*

Sample Information: Before electronic files are received from the laboratory, sample specific information will be entered into Tables 1 and 2 of Attachment A-4 (with the exception of VALIDATED field and OUR_RESULT field). The sample information file will allow for the Laboratory Analytic Results (Table 3) to be joined on the SAMPLE_NO.field (Table 2).

Field duplicates shall be averaged for statistical purposes for all aqueous data (i.e. groundwater). The maximum concentration will be used to represent field duplicate concentrations in solid media (i.e. soil). The normal, duplicate and average/maximum concentrations will all be reported.

Survey Data: The files will contain a minimum of location, northing, easting, ground surface elevation and elevation of top of casing, Unless otherwise specified the horizontal geodetic datum North American Datum (NAD) 1983 and the North American Vertical Datum (NAVD) 1988 shall be referenced. (USE NAD 27 & NGVD 29 FOR THIS CTO.)

Data Validation: Once all samples and analyses have been accounted for, the electronic data files shall be printed for each Sample Delivery Group (SDG) and analytical fraction and submitted for data validation. Validators will incorporate data qualifiers into the electronic database and report the status/results as identified in Table 2 of Attachment A-4.

A single Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03 will be prepared by EA for the USACE and the Navy in draft and final versions for submittal to the distribution list for review and comment by the BCT.

16. ASSESSMENTS AND RESPONSE ACTIONS

The EA Project Manager, the USACE Remedial Project Manager, or the Navy Remedial Project Manager (or their designee) may conduct audits of the field activities for this project. Two formal field audits are planed by EA during the monitoring well drilling and the ground-water sampling activities. The EA Project Manager (or his designee) will have the authority to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data.

The EPA or RIDEM Remedial Project Managers (or their designee) may at their discretion conduct an audit of the field activities for this project. Upon finding a significant condition that would adversely affect the quality and usability of the data, these Remedial Project Managers (or their designee) shall immediately contact the EA Project Manager, the USACE Remedial Project Manager, and the Navy Remedial Project Manager.

The EA Project Manager will have the responsibility for initiating and implementing response actions associated with findings identified during these on-site audits. Once the response actions have been implemented, the auditor will perform a follow-up audit to verify and document that the response actions were implemented effectively.

17. QA MANAGEMENT REPORTS

Monthly project status reports are prepared by the EA Project Manager and submitted to the USACE and the Navy by the 20th of the following month. Ceimic's related QA reporting is referenced in Chapter 17 of Attachment A-1.

18. VERIFICATION AND VALIDATION REQUIREMENTS

The analytical data from CEIMIC Corp for the soil and low-flow method collected ground-water samples will require validation in accordance with the Tier II US EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analyses (1988) modified to fit the non-CLP analytical methods (SW846). Such modification would include, e.g. comparing the analytical results to the quality control acceptance limits and calibration requirements of the SW846 analytical methods which are different from CLP analytical methods for which the EPA guidelines were developed. Tier III validation will not be necessary because this project does not include human health or eco risk assessment. The EA Project Manager, the USACE Remedial Project Manager, and Navy Remedial Project Manager will be responsible for overall validation and final approval of the data in accordance with project purpose and use of the data.

19. VERIFICATION AND VALIDATION PROCEDURES

The analytical data from CEIMIC Corp for the soil and low-flow method collected ground-water samples will be validated in accordance with the procedures of the Tier II EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analyses (1988), modified to fit the non-CLP analytical methods (SW846). The data validation will be performed by a qualified independent firm contracted to EA. The EA Project Manager (or his designee) will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

20. DATA USEABILITY/RECONCILIATION WITH PROJECT QUALITY GOALS

Once the data results are compiled, the EA Project Manager will review the field and lab QA/QC samples duplicates to determine if they fall within the acceptance limits as defined in this QAPP. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP (including the accuracy for lab spikes), the data may be discarded and re-sampling may occur. The EA Project Manager will evaluate the cause of the failure and evaluate with the USACE and Navy Remedial Project Managers and make the decision to discard the data and re-sample. If the failure is tied to the analysis, calibration and maintenance techniques will be reassessed as identified by the appropriate laboratory personnel. If the failure is associated with the sample collection and re-sampling is needed, the samplers will be retrained.

The project quality goals are considered to have been met if the data quality indicators meet the project requirements as outlined in Section 7 of the QAPP (e.g., if the project quality goals are met, then the investigation has been successful).

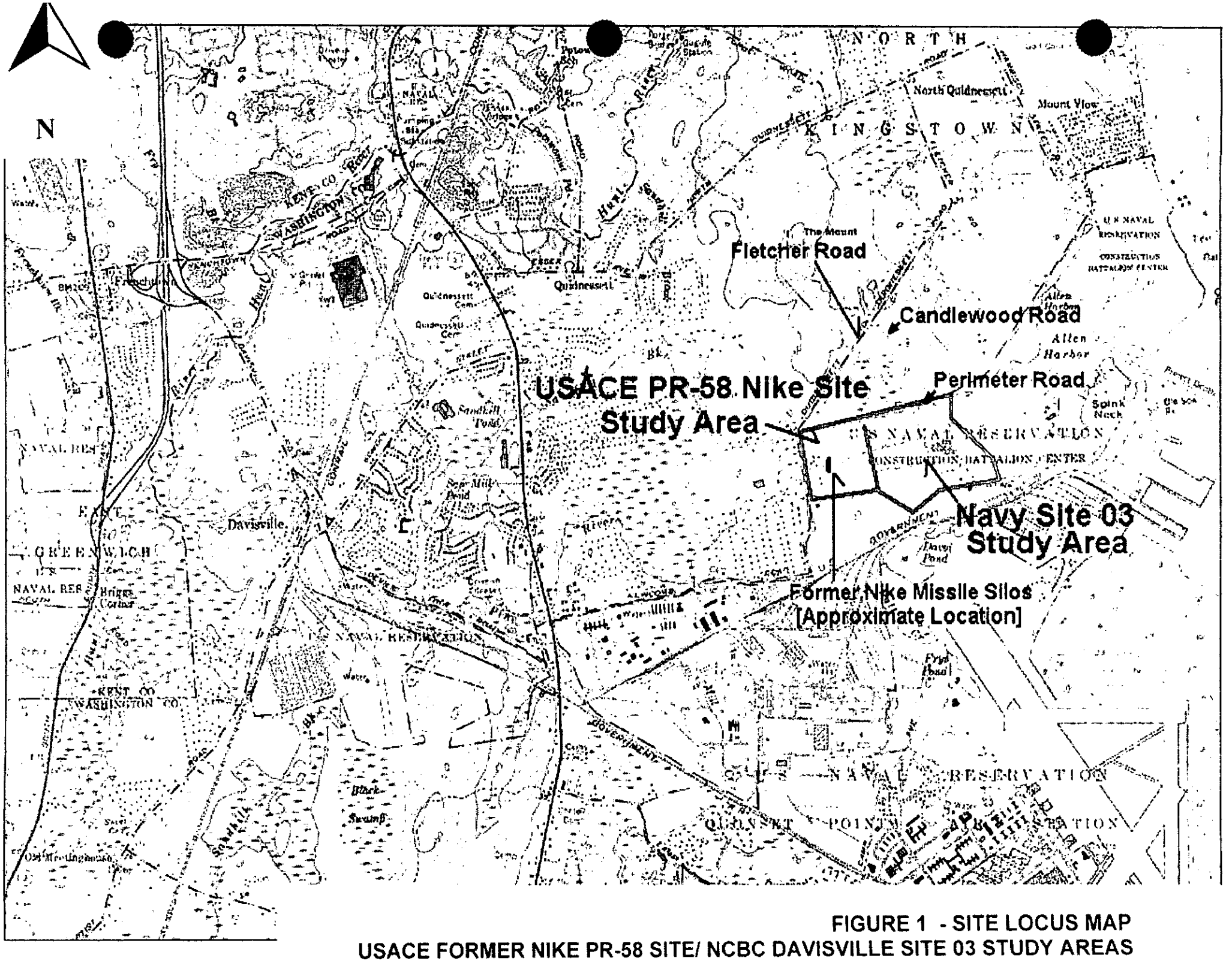
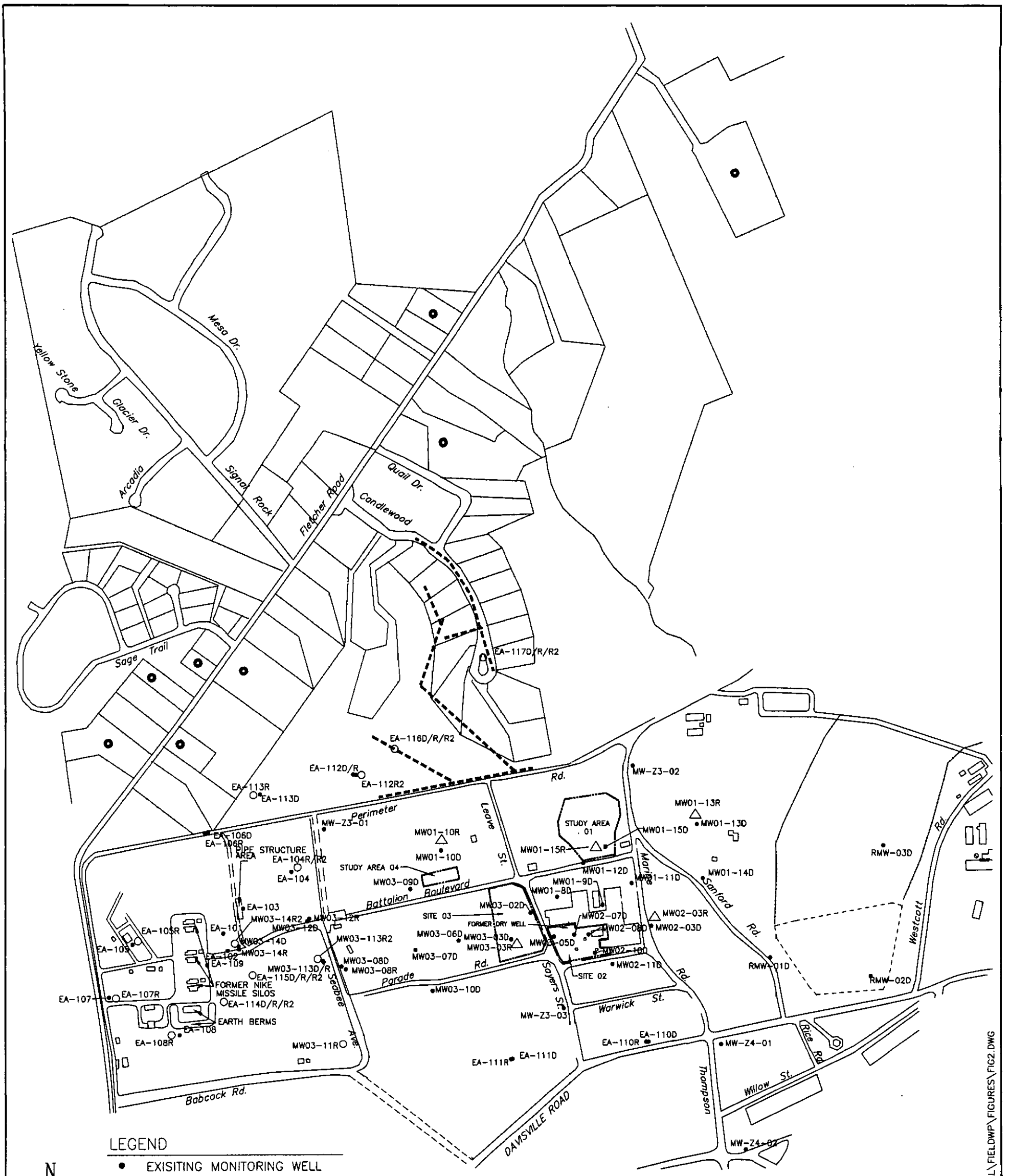


FIGURE 1 - SITE LOCUS MAP
USACE FORMER NIKE PR-58 SITE/ NCBC DAVISVILLE SITE 03 STUDY AREAS



LEGEND

- EXISITING MONITORING WELL
- LOCATION OF PROPERTY WITH PRIVATE USE WELLS
- PROPOSED MONITORING WELL FOR USACE
  - D – DEEP ZONE
  - R – SHALLOW COMPETENT BEDROCK ZONE
  - R2 – DEEPER COMPETENT BEDROCK ZONE
- PROPOSED MONITORING WELL FOR THE NAVY
- SEISMIC REFRACTION SURVEY LINE

N

500 250 0 500 1000

GRAPHIC SCALE IN FEET

NOTES:

MONITORING WELL LOCATIONS ARE APPROXIMATE

BASE MAP (SOUTH OF PERIMETER RD) DIGITIZED FROM: NCBC CENTER DAVISVILLE RI STATION MAP, SEPT 1992, ADDITIONAL ROADS ADDED FROM AERIAL PHOTO DATED 4/95

OFFSITE AREA (NORTH OF PERIMETER RD) DIGITIZED FROM A DRAWING PROVIDED BY THE TOWN OF NORTH KINGSTOWN, RI.

G:\PROJECTS\60957.56\0001.WPS\FINAL\FIELDWP\FIGS\FIG2.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

U.S. ARMY CORPS OF ENGINEERS
FORMER PR-58 NIKE SITE CHARACTERIZATION
NORTH KINGSTOWN, RHODE ISLAND

SITE MAP

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
JAS	JAS	JBN	JAS	04-19-00	AS SHOWN	60957.56	FIG.2	–	2

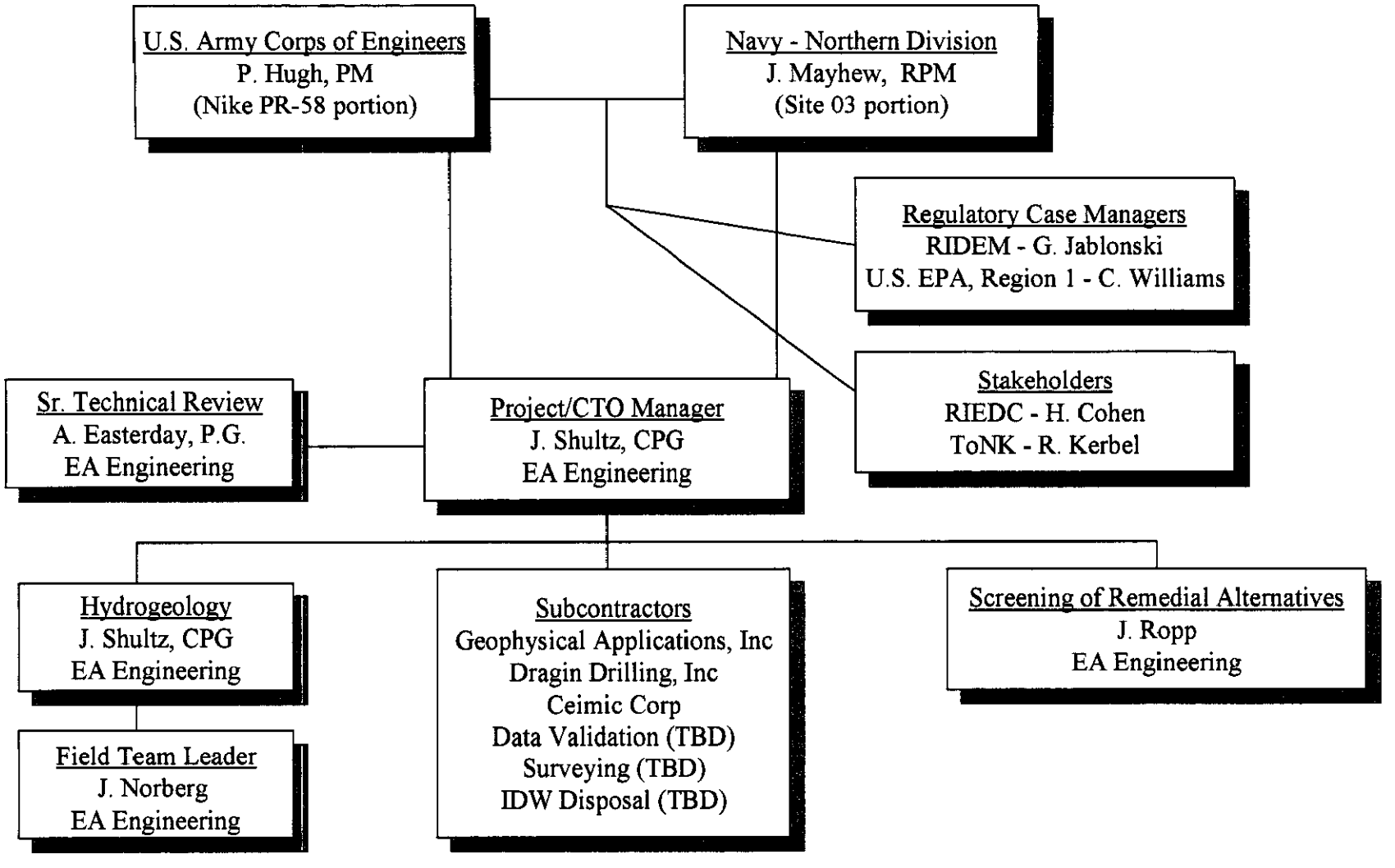


Figure 3: Project Organization

Nike PR-58/ Site 03 Additional Site Characterization

North Kingstown, RI

TABLE 7-1 FORMULAS FOR THE CALCULATION OF DATA QUALITY CHARACTERISTICS FOR CHEMICAL DATA

CHARACTERISTIC	FORMULA	SYMBOLS
Precision (as relative percent difference, RPD)	$RPD = \frac{\lvert X1 - X2 \rvert}{(X1 + X2)/2} \times 100$	X1, X2 = duplicate values
Precision (as relative standard deviation, %RSD)	$\%RSD = \frac{s}{A} \times 100$	s = standard deviation A = mean of the measurements
Accuracy (as percent recovery (%R) for samples without a background level of the analyte, such as reference materials, laboratory control samples, and performance evaluation samples)	$\%R = \frac{X}{T} \times 100$	X = found concentration T = true or assumed concentration
Accuracy (as percent recovery (%R) for measurements in which a known amount of analyte (a spike) is added to an environmental sample)	$\%R = \frac{X - B}{T} \times 100$	X = found concentration B = background concentration T = true or assumed concentration
Completeness	$C = \frac{N}{S} \times 100$	C = completeness (%) N = number of valid data S = number of samples collected

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
SW6010B Metals by Inductively Coupled Plasma Atomic Emission Spectroscopy (Water, Sediment, Soil)					
Matrix Spike	Aluminum	75-125	75-125	≤20	≤20
	Antimony (TRACE)	75-125	75-125	≤20	≤20
	Arsenic (TRACE)	75-125	75-125	≤20	≤20
	Barium	75-125	75-125	≤20	≤20
	Beryllium (TRACE)	75-125	75-125	≤20	≤20
	Cadmium (TRACE)	75-125	75-125	≤20	≤20
	Calcium	75-125	75-125	≤20	≤20
	Chromium (TRACE)	75-125	75-125	≤20	≤20
	Cobalt	75-125	75-125	≤20	≤20
	Copper (TRACE)	75-125	75-125	≤20	≤20
	Iron	75-125	75-125	≤20	≤20
	Lead (TRACE)	75-125	75-125	≤20	≤20
	Magnesium	75-125	75-125	≤20	≤20
	Manganese	75-125	75-125	≤20	≤20
	Nickel (TRACE)	75-125	75-125	≤20	≤20
	Potassium	75-125	75-125	≤20	≤20
	Silver (TRACE)	75-125	75-125	≤20	≤20
	Sodium	75-125	75-125	≤20	≤20
	Selenium (TRACE)	75-125	75-125	≤20	≤20
	Vanadium	75-125	75-125	≤20	≤20
	Zinc	75-125	75-125	≤20	≤20
LCS	Aluminum	80 - 120	60-108	≤20	(c)
	Antimony (TRACE)	80 - 120	37-153	≤20	(c)
	Arsenic (TRACE)	80 - 120	71-127	≤20	(c)
	Barium	80 - 120	67-123	≤20	(c)
	Beryllium (TRACE)	80 – 120	80-112	≤20	(c)
	Cadmium (TRACE)	80 – 120	76-108	≤20	(c)

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS, Cont'd:	Calcium	80 – 120	71-130	≤20	(c)
	Chromium (TRACE)	80 – 120	80-112	≤20	(c)
	Cobalt	80 - 120	78-104	≤20	(c)
	Copper (TRACE)	80 - 120	75-111	≤20	(c)
	Iron	80 - 120	46-128	≤20	(c)
	Lead (TRACE)	80 - 120	79-115	≤20	(c)
	Magnesium	80 - 120	70-104	≤20	(c)
	Manganese	80 - 120	82-104	≤20	(c)
	Nickel (TRACE)	80 - 120	68-114	≤20	(c)
	Potassium	80 - 120	78-122	≤20	(c)
	Silver (TRACE)	80 - 120	79-119	≤20	(c)
	Sodium	80 - 120	73-107	≤20	(c)
	Selenium (TRACE)	80 - 120	59-129	≤20	(c)
	Vanadium	80 - 120	73-111	≤20	(c)
	Zinc	80 - 120	79-109	≤20	(c)
SW7470A/SW7471A Mercury by Cold Vapor Atomic Absorption (Water, Sediment, Soil)					
Matrix Spike:	Mercury	75-125	75-125	≤20	≤20
LCS (b)	Mercury	80 - 120	67-117	≤20	(c)
SW6010B Thallium by ICP (Water, Sediment, Soil)					
Matrix Spike	Thallium	75-125	75-125	≤20	≤20
LCS (b)	Thallium	80 - 120	77-127	≤20	(c)
SW5030B/8260B Volatile organic compounds by GC/MS (Water - 25 mL purge)					
Surrogate Spike	1,2-Dichloroethane-d4	76-114	--	--	--
	4-Bromofluorobenzene(BFB)	86-115	--	--	--
	Toluene-d8	88-110	--	--	--
	Dibromofluoromethane	86-118	--	--	--
LCS/MS/MSD	Benzene	78-123	--	≤28	--
	Toluene	77-122	--	≤27	--

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS/MS/MSD, Cont'd	Chlorobenzene	79-123	--	≤27	--
	1,1-Dichloroethene	75-118	--	≤27	--
	Trichloroethene	73-122	--	≤30	--
SW5035/8260B Volatile organic compounds by GC/MS (Sediment, Soil)					
Surrogate Spike	1,2-Dichloroethane-d4	--	70-121	--	--
	4-Bromofluorobenzene	--	74-121	--	--
	Toluene-d8	--	81-117	--	--
	Dibromofluoromethane	--	80-120	--	--
LCS/MS/MSD	Benzene	--	78-119	--	≤25
	Toluene	--	73-130	--	≤35
	Chlorobenzene	--	69-139	--	≤43
	1,1-Dichloroethene	--	74-128	--	≤33
	Trichloroethene	--	72-122	--	≤31
SW3520C/3540C/8270C Semivolatile Organics by GC/MS (Water, Sediment, Soil)					
Surrogate Spike	Nitrobenzene d5	35-114	23-120	--	--
	2-Fluorobiphenyl	43-116	30-115	--	--
	Terphenyl-d14	33-141	18-137	--	--
	2-Fluorophenol	21-100	25-121	--	--
	Phenol-d5	10-94	24-113	--	--
	2,4,6-Tribromophenol	10-123	19-122	--	--
LCS/MS/MSD	Phenol	38-91	35-97	≤33	≤38
	2-Chlorophenol	42-94	39-98	≤32	≤36
	1,4-Dichlorobenzene	28-90	39-102	≤38	≤39
	N-Nitroso-di-n-propylamine	53-115	51-115	≤38	≤39
	1,2,4-Trichlorobenzene	33-94	50-104	≤38	≤33
	4-Chloro-3-methylphenol	45-97	51-96	≤32	≤28
	Acenaphthene	49-103	51-109	≤33	≤36
	4-Nitrophenol	52-117	50-120	≤40	≤43

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 7-2 Quality Control Criteria for Precision & Accuracy for Matrix Spikes, Matrix Spike Duplicates, Surrogates and Laboratory Control Samples for the Former PR-58 Nike Site and NCBC Davisville Site 03

QC Parameter	Spiking Compounds	Accuracy (%R)		Precision (b)	
		Water	Sediment/Soil	Water	Sediment/Soil
LCS/MS/MSD, Cont'd	2,4-Dinitrotoluene	57-115	54-126	≤35	≤45
	Pentachlorophenol	38-119	16-119	≤50	≤63
	Pyrene	45-114	44-119	≤43	≤46
General Chemistry Parameter EPA 300.0 Anions (water)					
MS/MSD	Nitrate	75-125	--	<25	--
	Sulfate	75-125	--	<25	--
	Chloride	75-125	--	<25	--
LCS	Nitrate	80-120	--	--	--
	Sulfate	80-120	--	--	--
	Chloride	80-120	--	--	--
General Chemistry Parameter EPA 376.2 (water)					
MS/MSD	Sulfide	75-125	--	<25	--
LCS	Sulfide	80-120	--	--	--
General Chemistry Parameters EPA 310.1 (water)					
MS/MSD	Alkalinity	75-125	--	<25	--
LCS	Alkalinity	80-120	--	--	--
General Chemistry Parameters RSK-175 (water)					
MS/MSD	Methane	60-140	--	<40	--
LCS	Methane	60-140	--	--	--

-- not applicable

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for matrix spikes is listed for relative % difference (%RPD); for the LCS the value is the precision calculated as the moving range for successive LCS recoveries.
(c) LCS is commercially prepared reference standard. QC Limits differ with each lot.

Table 8-1 Sampling and Analytical Program for the USACE Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (15 new wells + 19 existing wells)	TCL Volatile Organics – (GC/MS (detection limit, < 1 ug/L) SW-5030B/8260B	34	4		8 & 2/2	50
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	34	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	34	4		-- & 2/2	42
In addition to all of the above parameters ground-water samples from EA-104D/R/R2, EA-106D/R, EA-112D/R/R2, and EA-113D/R will also be analyzed for the following:	TAL Inorganics – (Cold Vapor Atomic Absorption (detection limit, < 0.08 ug/L) SW846 7470A (Mercury Only)	10	1		-- & 1/1	13
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3010A/6010B	10	1		-- & 1/1	13

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
In addition to all of the above parameters ground-water samples from EA-114D/R/R2 will also be analyzed for the following:	TCL Semi-Volatile Organics –GC/MS (detection limit, see QAPP) SW-3520C/8270C	3	1		-- & 1/1	6
Soil Samples (EA-114D and EA-116D)	TCL Volatile Organics – (GC/MS (detection limit , ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12
In addition the above parameters soil samples from EA-114D will also be analyzed for the following:	TCL Semi-Volatile Organics –(GC/MS (detection limit, see QAPP) SW-3540C/8270C	2	1	1	-- & 1/1	6
	TAL Inorganics –(Cold Vapor Atomic Absorption (detection limit , < 0.08 mg/kg) SW846 7471A (Mercury Only)	2	1	1	-- & 1/1	6
	TAL Inorganics – (Inductively Coupled Plasma (detection limit, see QAPP) SW 3050A/6010B	2	1	1	-- & 1/1	6

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the QA analysis (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 8-2 Sampling and Analytical Program for the USACE Optional Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (up to 7 new wells)	TCL Volatile Organics – (GC/MS (detection limit , < 1 ug/L) SW-5030B/8260B	7	1		2 & 1/1	12
	Field Measured Parameters • Dissolved Oxygen • Turbidity • PH • Eh • Conductivity • Temperature • Ferrous Iron	7	1 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	7	1		-- & 1/1	10
Soil Samples (EA-115D and EA-117D)	TCL Volatile Organics – (GC/MS detection limit ≈125 ug/Kg) SW-5035/8260B	4	1	1	4 & 1/1	12

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

The USACE-Missouri River Division (MRD) Laboratory has selected Severn Trent Laboratories to perform the **QA analysis** (using the same extraction and analytical method numbers) for the USACE portion of this investigation at the government's expense.
Document (COCs), handle, and ship in accordance with this PR-58 Nike Site Work Plan and QAPP.
Ship QA Samples to:
Severn Trent Laboratories, QA Lab Project No. E0853
55 South Park Drive
Colchester, VT 05446
Lab POC: Brian Blair
Phone: (802) 655-1203
FAX: (802) 655-1248

Table 8-3 Sampling and Analytical Program for the Navy Samples

Sample	Analysis	# Field Samples	Duplicate	QC Samples		Totals
				Rinsate	Trip Blanks & MS/MSD	
Ground-Water Samples (5 new wells + 30 existing wells)	TCL Volatile Organics – (GC/MS (detection limit , < 1 ug/L) SW-5030B/8260B	35	4		9 & 2/2	51
	Field Measured Parameters • Dissolved Oxygen • Turbidity • pH • Eh • Conductivity • Temperature • Ferrous Iron	35	4 (Fe^{+2})			
	General Lab Chemistry Parameters • Nitrate – 353.2 • Sulfate – 300.0 • Sulfide – 376.2 • Manganese – 6010B • Chloride – 300.0 • Alkalinity – 310.1 • Methane – RSK-175	35	4		-- & 2/2	43

Each cooler shipped with samples will include a temperature blank supplied by CEIMIC Corp.

For the Navy portion of this investigation, there will be no samples collected and shipped for QA lab analysis.

TABLE 9-1 REQUIRED CONTAINERS, PRESERVATION TECHNIQUE, AND HOLDING TIMES FOR AQUEOUS SAMPLES AND BLANKS[a]

Parameter	Volume Required (mL)	Container	Preservative	Recommended Holding Time
METALS				
Mercury	100	250 ml, P	HNO_3 to pH <2	28 days
Other Metals	200	250 ml, P	HNO_3 to pH <2	6 months
METHANE				
Methane	80	40 ml vial, Teflon-lined septum	Cool, 4 C 4 drops conc. HCL to pH <2	14 days
INORGANICS, NONMETALLIC				
Alkalinity	100	250 ml, P	Cool, 4 C	14 days
Chloride	50	250 ml, P	None required	28 days
Nitrate	50	250 ml, P	Cool, 4 C H_2SO_4<2	28 days
Sulfate	50	250 ml, P	Cool, 4 C	28 days
Sulfide	100	500 ml, P	ZnAC/ NaOH>9	7 days
TCL ORGANICS				
Volatile Organics	120 ml	40 ml vial, Teflon-lined septum	Cool, 4 C 4 drops conc. HCL to pH <2	14 days
Semivolatile Organic Compounds: Base Neutrals/Acid Extractables & Polynuclear Aromatic Hydrocarbons	2,000	1 Liter Amber Glass, Teflon-lined cap	Cool, 4 C	7 days to extraction 40 days after extraction

A temperature blank (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp.

(a) From time of sample collection (40 CFR 136).

Notes:
Polyethylene (P) or glass (G).

TABLE 9-2 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES [a]

Parameter	Weight Required (g)	Container	Preservative	Holding Time
METALS				
Mercury	10	8 oz G, P	None required	28 days
Other Metals	20	8 oz G, P	None required	180 days
ORGANICS[c]				
Volatile Organics	5	4 oz G	10 g soil with 10 mL methanol, 4 C	14 days
Semivolatile Organic Compounds: Base Neutrals/Acid Extractables & Polynuclear Aromatic Hydrocarbons	30	8 oz G	Cool, 4 C	14 days to extraction 40 days after extraction

A temperature blank (provided by Ceimic) will be included with each cooler of samples submitted to Ceimic Corp.

(a) From time of sample collection (40 CFR Part 136.3, 40 CFR Part 261).
Notes:
Polyethylene (P) or glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

TABLE 12-1 PROJECT-SPECIFIC REPORTING LIMITS FOR AQUEOUS SAMPLES

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
Semivolatile Organics GC/MS (SW846 Method 3520C/8270C)			
Acenaphthene	µg/L	10	---
Acenaphthylene	µg/L	10	---
Anthracene	µg/L	10	---
Benzo(a)anthracene	µg/L	10	---
Benzo(b)fluoranthene	µg/L	10	---
Benzo(k)fluoranthene	µg/L	10	---
Benzo(a)pyrene	µg/L	10	0.2
Benzo(ghi)perylene	µg/L	10	---
Benzyl butyl phthalate	µg/L	10	---
Bis(2-chloroethyl) ether	µg/L	10	---
Bis(2-chloroethoxy)methane	µg/L	10	---
Bis(2-ethylhexyl) phthalate	µg/L	10	---
4-Bromophenyl phenyl ether	µg/L	10	---
Carbazole	µg/L	10	---
4-Chloroaniline	µg/L	20	---
4-Chloro-3-methylphenol	µg/L	20	---
2-Chloronaphthalene	µg/L	10	---
2-Chlorophenol	µg/L	10	---
4-Chlorophenyl phenyl ether	µg/L	10	---
Chrysene	µg/L	10	---
Dibenz(a,h)anthracene	µg/L	10	---
Dibenzofuran	µg/L	10	---
Di-n-butyl phthalate	µg/L	10	---
1,2-Dichlorobenzene	µg/L	10	---
1,3-Dichlorobenzene	µg/L	10	---
1,4-Dichlorobenzene	µg/L	10	---
3,3'-Dichlorobenzidine	µg/L	20	---
2,4-Dichlorophenol	µg/L	10	---
Diethyl phthalate	µg/L	10	---
2,4-Dimethylphenol	µg/L	10	---
Dimethyl phthalate	µg/L	10	---
2,4-Dinitrophenol	µg/L	40	---
2,4-Dinitrotoluene	µg/L	10	---
2,6-Dinitrotoluene	µg/L	10	---
Di-n-octyl phthalate	µg/L	10	---
Fluoranthene	µg/L	10	---
Fluorene	µg/L	10	---
Hexachlorobenzene	µg/L	10	1
Hexachlorobutadiene	µg/L	10	---
Hexachlorocyclopentadiene	µg/L	10	---
Hexachloroethane	µg/L	10	---
Indeno(1,2,3-cd)pyrene	µg/L	10	---
Isophorone	µg/L	10	---
2-Methyl-4,6-dinitrophenol	µg/L	40	---
2-Methylnaphthalene	µg/L	10	---
2-Methylphenol	µg/L	10	---
4-Methylphenol	µg/L	10	---
Naphthalene	µg/L	10	20

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
2-Nitroaniline	µg/L	40	---
3-Nitroaniline	µg/L	40	---
4-Nitroaniline	µg/L	40	---
Nitrobenzene	µg/L	10	---
2-Nitrophenol	µg/L	10	---
4-Nitrophenol	µg/L	40	---
N-Nitrosodiphenylamine	µg/L	10	---
N-Nitroso-di-n-propylamine	µg/L	10	---
2,2'-Oxybis (1-chloropropane)	µg/L	10	---
Pentachlorophenol	µg/L	40	1
Phenanthrene	µg/L	10	---
Phenol	µg/L	10	---
Pyrene	µg/L	10	---
1,2,4-Trichlorobenzene	µg/L	10	70
2,4,5-Trichlorophenol	µg/L	40	---
2,4,6-Trichlorophenol	µg/L	10	---
Volatile Organics GC/MS (SW846 Method 5030B/8260B)			
Acetone	µg/L	5	---
Benzene	µg/L	1	5
Bromodichloromethane	µg/L	1	---
Bromoform	µg/L	1	---
Bromomethane	µg/L	1	---
2-Butanone	µg/L	5	---
Carbon disulfide	µg/L	1	---
Carbon tetrachloride	µg/L	1	5
Chlorobenzene	µg/L	1	100
Chloroethane	µg/L	1	---
Chloroform	µg/L	1	---
Chloromethane	µg/L	1	---
Dibromochloromethane	µg/L	1	---
1,1-Dichloroethane	µg/L	1	---
1,2-Dichloroethane	µg/L	1	5
1,1-Dichloroethene	µg/L	1	7
1,2-Dichloroethene (total)	µg/L	1	70(cis)/100(trans)
1,2-Dichloropropane	µg/L	1	5
cis-1,3-Dichloropropene	µg/L	1	---
trans-1,3-Dichloropropene	µg/L	1	---
Ethylbenzene	µg/L	1	700
2-Hexanone	µg/L	5	---
4-Methyl-2-pentanone (MIBK)	µg/L	5	---
Methylene chloride	µg/L	1	5
Styrene	µg/L	1	100
1,1,2,2-Tetrachloroethane	µg/L	1	---
Tetrachloroethene	µg/L	1	5
Toluene	µg/L	1	1000
1,1,1-Trichloroethane	µg/L	1	200
1,1,2-Trichloroethane	µg/L	1	5
Trichloroethene	µg/L	1	5
Vinyl chloride	µg/L	1	2
Xylenes (total)	µg/L	1	10000

Parameter	Units	Project Reporting Limit[a]	Project Action Limits[b]
Methane (RSK-175)			
Methane	µg/L	1	
Metals - Cold Vapor Atomic Absorption (SW846 7470A)			
Mercury	µg//L	0.2	2
Metals - Inductively Coupled Plasma (SW3010/6010B)			
Aluminum	µg/L	200	---
Antimony	µg/L	5	6
Arsenic (TRACE)	µg/L	10	---
Barium	µg/L	10	2000
Beryllium	µg/L	10	4
Cadmium	µg/L	10	5
Calcium	µg/L	500	---
Chromium	µg/L	20	100
Cobalt	µg/L	20	---
Copper	µg/L	20	---
Iron	µg/L	100	---
Lead	µg/L	5	15
Magnesium	µg/L	500	---
Manganese	µg/L	10	---
Nickel	µg/L	40	100
Potassium	µg/L	500	---
Selenium	µg/L	5	50
Silver	µg/L	10	---
Sodium	µg/L	500	---
Thallium	µg/L	3	2
Vanadium	µg/L	50	---
Zinc	µg/L	20	---
Inorganic Nonmetals			
Alkalinity (EPA 310.1)	mg/L	1.0	---
Chloride (EPA 300.0)	mg/L	0.1	---
Nitrate (EPA 353.2)	mg/L	0.1	---
Sulfate (EPA 300.0)	mg/L	0.1	---
Sulfide (EPA 376.2)	mg/L	1.0	---

(a) Project Reporting Limit is the Practical Quantitation Limit (PQL), i.e. the lowest point on the calibration curve normalized for mass of sample extracted.
(b) Project Action Limit is based on RIDEM GA Ground -Water Objectives

NOTE: GC/MS = Gas chromatograph/mass spectrometry.
Dashes (---) indicate no Ground-Water GA or GB Criteria available.

TABLE 12-2 PROJECT-SPECIFIC REPORTING LIMITS FOR SOIL SAMPLES

Parameter	Units	Project Reporting Limit[a]	
Semivolatile Organics GC/MS (SW846 Method 3540C/8270C)			
Acenaphthene	µg/kg	330	
Acenaphthylene	µg/kg	330	
Anthracene	µg/kg	330	
Benzo(a)anthracene	µg/kg	330	
Benzo(b)fluoranthene	µg/kg	330	
Benzo(k)fluoranthene	µg/kg	330	
Benzo(a)pyrene	µg/kg	330	
Benzo(ghi)perylene	µg/kg	330	
Benzyl butyl phthalate	µg/kg	330	
Bis(2-chloroethyl) ether	µg/kg	330	
Bis(2-chloroethoxy)methane	µg/kg	330	
Bis(2-ethylhexyl) phthalate	µg/kg	330	
4-Bromophenyl phenyl ether	µg/kg	330	
Carbazole	µg/kg	330	
4-Chloroaniline	µg/kg	670	
4-Chloro-3-methylphenol	µg/kg	670	
2-Chloronaphthalene	µg/kg	330	
2-Chlorophenol	µg/kg	330	
4-Chlorophenyl phenyl ether	µg/kg	330	
Chrysene	µg/kg	330	
Dibenz(a,h)anthracene	µg/kg	330	
Dibenzofuran	µg/kg	330	
Di-n-butyl phthalate	µg/kg	330	
1,2-Dichlorobenzene	µg/kg	330	
1,3-Dichlorobenzene	µg/kg	330	
1,4-Dichlorobenzene	µg/kg	330	
3,3'-Dichlorobenzidine	µg/kg	670	
2,4-Dichlorophenol	µg/kg	330	
Diethyl phthalate	µg/kg	330	
2,4-Dimethylphenol	µg/kg	330	
Dimethyl phthalate	µg/kg	330	
2,4-Dinitrophenol	µg/kg	1330	
2,4-Dinitrotoluene	µg/kg	330	
2,6-Dinitrotoluene	µg/kg	330	
Di-n-octyl phthalate	µg/kg	330	
Fluoranthene	µg/kg	330	
Fluorene	µg/kg	330	
Hexachlorobenzene	µg/kg	330	
Hexachlorobutadiene	µg/kg	330	
Hexachlorocyclopentadiene	µg/kg	330	
Hexachloroethane	µg/kg	330	
Indeno(1,2,3-cd)pyrene	µg/kg	330	
Isophorone	µg/kg	330	
2-Methyl-4,6-dinitrophenol	µg/kg	1330	
2-Methylnaphthalene	µg/kg	330	
2-Methylphenol	µg/kg	330	
4-Methylphenol	µg/kg	330	

Parameter	Units	Project Reporting Limit[a]	
Naphthalene	µg/kg	330	
2-Nitroaniline	µg/kg	1330	
3-Nitroaniline	µg/kg	1330	
4-Nitroaniline	µg/kg	1330	
Nitrobenzene	µg/kg	330	
2-Nitrophenol	µg/kg	330	
4-Nitrophenol	µg/kg	1330	
N-Nitrosodiphenylamine	µg/kg	330	
N-Nitroso-di-n-propylamine	µg/kg	330	
2,2'-Oxybis (1-chloropropane)	µg/kg	330	
Pentachlorophenol	µg/kg	1330	
Phenanthrene	µg/kg	330	
Phenol	µg/kg	330	
Pyrene	µg/kg	330	
1,2,4-Trichlorobenzene	µg/kg	330	
2,4,5-Trichlorophenol	µg/kg	1330	
2,4,6-Trichlorophenol	µg/kg	330	
Volatile Organics GC/MS (SW846 Method 5035/8260B)			
Acetone	µg/kg	250	
Benzene	µg/kg	125	
Bromodichloromethane	µg/kg	125	
Bromoform	µg/kg	125	
Bromomethane	µg/kg	125	
2-Butanone	µg/kg	250	
Carbon disulfide	µg/kg	125	
Carbon tetrachloride	µg/kg	125	
Chlorobenzene	µg/kg	125	
Chloroethane	µg/kg	125	
Chloroform	µg/kg	125	
Chloromethane	µg/kg	125	
Dibromochloromethane	µg/kg	125	
1,1-Dichloroethane	µg/kg	125	
1,2-Dichloroethane	µg/kg	125	
1,1-Dichloroethene	µg/kg	125	
1,2-Dichloroethene (total)	µg/kg	125	
1,2-Dichloropropane	µg/kg	125	
cis-1,3-Dichloropropene	µg/kg	125	
trans-1,3-Dichloropropene	µg/kg	125	
Ethylbenzene	µg/kg	125	
2-Hexanone	µg/kg	250	
4-Methyl-2-pentanone (MIBK)	µg/kg	250	
Methylene chloride	µg/kg	125	
Styrene	µg/kg	125	
1,1,2,2-Tetrachloroethane	µg/kg	125	
Tetrachloroethene	µg/kg	125	
Toluene	µg/kg	125	
1,1,1-Trichloroethane	µg/kg	125	
1,1,2-Trichloroethane	µg/kg	125	
Trichloroethene	µg/kg	125	
Vinyl chloride	µg/kg	125	
Xylenes (total)	µg/kg	125	

Parameter	Units	Project Reporting Limit[a]	
Metals - Cold Vapor Atomic Absorption (SW846 7471A)			
Mercury	mg/kg	0.1	
Metals - Inductively Coupled Plasma (SW3050A/6010B)			
Aluminum	mg/kg	20	
Antimony	mg/kg	2	
Arsenic (TRACE)	mg/kg	1	
Barium	mg/kg	1	
Beryllium	mg/kg	0.5	
Cadmium	mg/kg	1	
Calcium	mg/kg	50	
Chromium	mg/kg	2	
Cobalt	mg/kg	2	
Copper	mg/kg	2	
Iron	mg/kg	10	
Lead	mg/kg	0.5	
Magnesium	mg/kg	50	
Manganese	mg/kg	1	
Nickel	mg/kg	4	
Potassium	mg/kg	50	
Selenium	mg/kg	0.5	
Silver	mg/kg	1	
Sodium	mg/kg	50	
Thallium	mg/kg	1	
Vanadium	mg/kg	5	
Zinc	mg/kg	2	

(a) Project Reporting Limit is the Practical Quantitation Limit (PQL), i.e. the lowest point on the calibration curve normalized for mass of soil extracted.

NOTE: GC/MS = Gas chromatograph/mass spectrometry.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Metals by ICP: SW3010A/6010B in water; SW3050A/6010B in soil and sediment			
Holding time	6 months from sampling	Digestion /analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. Coefficient of variation for linear fit, r, ∃0.995	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Check	After each Initial Calibration	%R is 95%-105%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentration of any analyte of concern <RL	1. If the applicable criteria is not met, recalibrate the instrument. 2. Reanalyze all associated QC and field samples 3. Document actions taken.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 90%-110%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Interelement Check Sample (ICS)	Beginning and end of each analytical run	Concentration of analyte subject to potential spectral interference is within 20 percent of known value.	1. Recalibrate instrument and reanalyze interelement check sample. 2. Check interelement correction factors or background correction points, and update if necessary. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentration of any analyte of concern <RL	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. If preparation in error reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken in a Nonconformance Record, and in the analytical report

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, validate preparation of samples. If no errors or problems are discovered for sample preparation, data is apprpropriately flagged and reported with discussion in analytical narrative.
Serial Dilution	1+4 dilution for one samples per analytical batch	1+4 dilution for one sample per analytical batch; %D $\leq$ 10%. Criteria applies only to analytes where the original concentration is $\exists$ 50X RL.	1. If the dilution analysis for one or more analytes is not within 10%, no further action is required 2. A chemical or physical interference effect must be suspected, and the data for all affected analytes in the samples received associated with that serial dilution must be qualified.
Mercury by CVAA: SW7470A in water; SW7471A in soil and sediment			
Holding time	28 days	Digestion/analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. Initial calibration correlation coefficient, r $\geq$ 0.995.	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentration of any analyte of concern <RL	1. If the applicable criteria is not met, recalibrate the instrument. 2. Reanalyze all associated QC and field samples 3. Document actions taken.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 80%-120%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Method Blank	1 per analytical batch	Concentration of any analyte of concern <RL	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. If preparation in error reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken in a Nonconformance Record, and in the analytical report
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, validate preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.
Volatile Organic Compounds SW5030B/8260B in water; SW5035/8260B in soil and sediment			
Holding time	14 days from sampling	Analysis is performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration curve	Established initially at 5 concentration levels.	1. Initial calibration %RSD for all CCCs is #30 %; RF for SPCCs is ≥ method specified minimum. 2. Average %RSD is # 15%, or use linear regression with r ≥ 0.990 (r2 ≥ 0.980).	1. Recalibrate instrument. 2. Reanalyze samples since last criteria met. 3. Document actions taken.
Initial Calibration Verification (ICV)	Second source mid-level standard immediately following initial calibration	%D for all CCCs is # 20 %; RF for SPCCs is ≥ method specified minimum.	1. Verify standard preparation, if incorrect reprepare ICV 2. Verify preparation of calibration standards if incorrect reprepare standards, and recalibrate instrument. 3. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Continuing Calibration Verification (CCV)	Mid-level standard every 12 hours of analysis	%D for all CCCs is # 20 %; RF for SPCCs is ≥ method specified minimum.	1. Verify standard preparation and instrument operations, correct problem. 2. Repeat initial calibration. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentration is less than the project RL for all analytes except the common laboratory contaminates MeC12 and Acetone are less than five times the RL.	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. Reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken.
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
Surrogate spike	All field and QC samples	Surrogate recoveries must be within project specified control limits in Attachment B-6.	1. Examine all QC (including but not limited to LCS, MB). 2. If surrogate in LCS and/or MB is out-of-control, check quantitation. If quantitation is correct reanalyze. 3. If similar results are obtained from reanalysis, obtain fresh, verified surrogate solution, and reprepare and reanalyze the analytical batch. 4. If samples cannot be reprepared, qualify data. 5. If surrogate recoveries in LCS and MB are acceptable but outside the control limits for any sample, reanalyze sample to determine if matrix effect. If matrix effect confirmed, report both analyses. Document actions taken in the analytical narrative.
Internal Standard Responses and Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	1. Retention time for any internal standard must be within 30 seconds of the initial calibration, the retention times are compared to the 10 µg/L standard (water) or the 50 µg/L standard (soil and sediment) 2. The area counts for all internal standards in the CCVs must be within a factor of two (-50% to +100%) of the 10 µg/L standard (water) or the 50 µg/L standard (soil and sediment) of the most recent initial calibration.	1. Inspect the mass spectrometric system for malfunction and correct. 2. Reanalyze affected samples. If the areas meet criteria, report data from the compliant analysis. 3. If reanalysis of the sample does not solve the problem, submit data from both runs, and document all inspection and corrective actions taken in the analytical narrative.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, review preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.
Semivolatile Organics by GC/MS: SW3520C/8270C in water; SW3540C/8270C in soil and sediment			
Holding time	Water: extract within 7 days of sampling; analyze within 40 days of extraction. Solid: extract within 14 days of sampling; analyze within 40 days of extraction.	Extraction and analysis are performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration curve	Established initially at 5 concentration levels	1. Initial calibration %RSD for all CCCs is $\leq$ 30%; RF for SPCCs is $\geq$0.05. 2. Average %RSD is # 15%, or use linear regression with r $\geq$ 0.990 (r2 > 0.980).	1. Reanalyze check standard. 2. If similar results are obtained recalibrate instrument. 3. Reanalyze samples since last criteria met. 4. Document actions taken.
Initial Calibration Verification (ICV)	Second source mid-level standard immediately following initial calibration	%D for all CCCs is # 20 %; RF for SPCCs is $\geq$ 0.05.	1. Verify standard preparation, if incorrect reprepare ICV 2. Verify preparation of calibration standards if incorrect reprepare standards, and recalibrate instrument. 3. Document actions taken.
Continuing Calibration Verification (CCV)	Mid-level standard every 12 hours of analysis	%D for all CCCs is # 20 %; RF for SPCCs is $\geq$ 0.05.	1. Verify standard preparation and instrument operations, correct problem. 2. Repeat initial calibration. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentrations are less than the project RL for all analytes except the common laboratory contaminate bis-2-ethylhexyl-phthalate is less than five times the RL.	1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. Reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. 5. Document actions taken.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Table 13-1: Summary of Project-Specific Laboratory Quality Control Requirements and Corrective Action Procedures

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Laboratory Control Sample (LCS)	1 per analytical batch	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. Reanalyze the LCS. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare the LCS, and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is no impact on data usability. 4. If data is not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a NCR and in the report narrative.
Surrogate spike	All field and QC samples	Surrogate recoveries must be within project specified control limits in Attachment B-6.	1. Examine all QC (including but not limited to LCS, MB). 2. If surrogate in LCS and/or MB is out-of-control, check quantitation. If quantitation is correct reanalyze. 3. If similar results are obtained from reanalysis, obtain fresh, verified surrogate solution, and reprepare and reanalyze the analytical batch. 4. If samples cannot be reprepared, qualify data. 5. If surrogate recoveries in LCS and MB are acceptable, and a) if 2 base/neutral or 2 acid surrogates are outside of QC limits or b) the recovery for any one surrogate is <10% in any sample, reprepare and reanalyzed sample to determine if matrix effect. If matrix effect is confirmed, report both analyses. Document all actions in the analytical narrative.
Internal Standard Responses and Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	1. Retention time for any internal standard must be within 30 seconds of the initial calibration, the retention times are compared to the 50 µg/L standard. 2. The area counts for all internal standards in the CCVs must be within a factor of two (-50% to +100%) of the 50 µg/L in the most recent initial calibration.	1. Inspect the mass spectrometric system for malfunction and correct. 2. Reanalyze affected samples. If the areas meet criteria, report data from the compliant analysis. 3. If reanalysis of the sample does not solve the problem, submit data from both runs, and document all inspection and corrective actions taken in the analytical narrative.
MS/MSD	1 set per 20 samples	All target analyte values are within limits for precision and accuracy in Attachment B-6.	1. If analyte recovery is outside control limits in LCS and data is judged unusable, reanalyze the analytical batch. 2. If LCS is acceptable but recovery is outside control limits in MS/MSD, review preparation of samples. If no errors or problems are discovered for sample preparation, data is reported with discussion in analytical narrative.

(a) Abbreviations: **CCC**, calibration check compound; **CCV**, continuing calibration verification standard; **CVA**, cold vapor atomic absorption; **F**, graphite furnace atomic absorption; **D**, analytical duplicate; **ICV**, initial calibration verification standard; **LCS**, laboratory control sample; **MDL**, method detection limit; **MEK**, 2-butanone (methyl ethyl ketone); **MS/MSD**, matrix spike/matrix spike duplicate; **$MeCl_2$**, methylene chloride; **NCR**, Nonconformance Record; **IS**, internal standard; **QC**, quality control; **RL**, reporting limit; **RPD**, relative percent difference; **SD**, standard deviation; **SPCC**, system performance check compound.

Attachment A-1

Ceimic Corporation's General Laboratory Quality Assurance Plan

CEIMIC Corporation
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(401) 782-8900

LABORATORY QUALITY ASSURANCE PLAN

FINAL

Approved by: _____
Laboratory Director

_____
QA/QC Officer

Control No.: LQAP-02

Revision Date: March 24, 1999

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2.0 INTRODUCTION

Ceimic Corporation is an environmental testing and research laboratory, incorporated in the State of Delaware (1988). The laboratory provides a wide range of analytical services for soil, air, and water samples in support of all major environmental regulations. These services are provided to the U.S. EPA, all branches of the U.S. Armed Forces, and to private industries.

The following Laboratory Quality Assurance Plan (LQAP) describes the policies, organization, objectives, quality control activities, and specific quality assurance functions employed at Ceimic Corporation, 10 Dean Knauss Dr., Narragansett, RI, and demonstrates Ceimic's dedication to producing accurate, consistent data of known quality. The LQAP is based on the "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" published by the USEPA, December, 1980, and the NELAC Standards, approved July 1997.

3.0 ORGANIZATION AND PERSONNEL

3.1 ORGANIZATION

Ceimic Corporation is a private corporation. The laboratory was incorporated in Delaware in 1988. In 1996, Ceimic acquired a second laboratory in San Diego, California. In late 1997 the San Diego sister laboratory's operations were consolidated with the Narragansett facility. Ceimic's organizational chart is presented in Figure 3-1. Ceimic's organizational structure is top-down from the President, QA/QC Officer, Lab Director, Lab Managers, Lab Supervisors, and Lab Analysts. The President directly oversees the QA/QC Officer and Lab Director. The Lab Director oversees the Lab Managers, who in turn oversee the Lab Supervisors, who oversee the Lab Analysts. Personnel who are not directly involved in laboratory operations, such as the System's Manager, and Support Staff are overseen by the Lab Director.

3.2 PERSONNEL

The success of Ceimic's quality assurance (QA) program relies on the cooperation and support of the entire organization. Ceimic's most valuable resource is its staff of dedicated professionals who take personal pride in the quality of their work. Quality assurance is a company-wide function that relies on cooperative working relationships and multi-level review. Responsibilities for quality assurance functions begin with the Lab Analysts, continue to the Lab Supervisors, Lab Managers, and Lab Director, and extend to the QA/QC Officer and ultimately to the President of Ceimic.

3.2.1 Lab Analysts

The Lab Analysts have the following QC related responsibilities: 1) precisely following the analytical methods and Standard Operating Procedures (SOPs), 2) carefully documenting each step in the appropriate format, 3) conscientiously obtaining peer review as required, 4) promptly alerting the respective Lab Supervisor and/or the QA/QC Officer to problems or anomalies, and 5) initiating documented corrective action as required.

3.2.2 Lab Supervisors

The Lab Supervisors have the following QC related responsibilities: 1) reviewing SOPs for accuracy and compliance with the methodology, 2) training Lab Analysts to properly follow the SOPs, 3) conducting on-going checks to verify that the Lab Analysts are following the SOPs, 4) reviewing data prior to release to the Lab Manager, 5) reviewing QC trends evident in LCS data, external performance evaluation results, etc. and implementing corrective actions when required, 6) promptly alerting the Lab Manager and/or the QA/QC Officer to problems or anomalies, and 7) initiate documented corrective action.

3.2.3 Lab Managers

The Lab Managers have the following QC related responsibilities: 1) equipping each laboratory with sufficient equipment and personnel to perform the QC function, 2) training the Lab Supervisors, 3) reviewing each data package for technical accuracy prior to release from the laboratory, 4) aiding the QA/QC Officer in enforcing QC procedures and helping the Lab Analysts to implement corrective actions as required, 5) reviewing trends evident from internal laboratory audits, performance evaluation results, etc. and implementing corrective actions as required, 6) reviewing the standard operating procedures for compliance with method requirements, 7) stopping work in response to quality problems, and 8) acting as Internal Coordinator to oversee specific assigned projects.

3.2.4 Lab Director

The Lab Director has the following QC related responsibilities: 1) working with the QA/QC Officer and Lab Managers to establish QA/QC goals for the laboratory, 2) providing the Lab Managers with adequate resources to perform the QC function, 3) training the Lab Managers, 4) managing projects as they come into the laboratory and verifying that the client's QA/QC needs are being met, 5) reviewing the complete data package, the case narrative and elctrnic diskette deliverable (EDD) if required and approving its release from the laboratory, 6) reviewing internal and external audit results and implementing corrective actions as required, 7) stopping work in response to quality problems, and 8) acting as Internal Coordinator to oversee specific assigned projects.

3.2.5 Internal Coordinators

Upon receipt of a new project, the Lab Director assigns an Internal Coordinator to oversee the project. The Internal Coordinator is chosen from among the Lab Managers, Supervisors or Lab Director. Specific responsibilities of the Internal Coordinator are outlined in SOP No. Q13 and in summary consist of the following: The Internal Coordinator familiarizes himself with the project QAP or client's requirements, notes deviations from standard laboratory operations, and communicates the special requirements to the Lab Supervisors. Minor requirements, such as analysis of an extra target analyte, are written on the Sample Log-In sheet and distributed to each Lab Supervisor. At the beginning of a project the Internal Coordinator holds a meeting with Lab Supervisors and distributes a memo with all of the project specific requirements to the Lab Supervisors.

3.2.6 QA/QC Officer

The QA/QC Officer is responsible for: 1) keeping the lab up to date on federal and state regulations and maintaining laboratory certifications, 2) providing the laboratory with the most up to date method revisions, 3) writing and editing Standard Operating Procedures (SOPs) and Laboratory Quality Assurance Plans (LQAPs), 4) conducting internal systems, performance, and data audits on a routine basis, 5) responding to external auditor's comments and implementing corrective actions as required, and 6) training Lab Analysts, Lab Supervisors, and Lab Managers in QA/QC, 7) providing the Lab Director with QA reports, and 8) stopping work in response to quality problems.

3.2.7 President

The President of Ceimic is firmly committed to the production of valid data of known quality. His QA policy statement is presented in Figure 3-2. The President's QA/QC related responsibilities include: 1) appointing the QA/QC Officer to oversee the entire QA program, and 2) providing the QA/QC Officer with adequate resources to perform the QA/QC function.

In the event of the temporary absence of a person in any of the above positions, the person directly overseeing that person will assume his duties (i.e, Lab Managers assume the role of Lab Supervisors, Lab Director assumes the role of Lab Managers, etc.) In the event of the temporary absence of the Lab Director, the President assumes his duties. In the event of the temporary absence of the QA/QC Officer, only the President may assume her/his duties.

The QA/QC Officer, Lab Director and Lab Managers each have the authority to stop work in response to quality problems. Lab Analysts and Lab Supervisors will notify their Lab Manager of any quality problems, and the Lab Manager will in turn make the decision to stop work.

Ultimately, the success of the QA program depends on the cooperation and support of the entire organization. Ceimic's most valuable resource is its staff of dedicated professionals who take personal pride in the quality of their performance.

3.3 SUBCONTRACTORS

Ceimic is a full service laboratory and limits its use of subcontractors to radiological or microbiological analyses. In the event that a subcontractor is used, the Internal Coordinator responsible for the project is responsible for oversight of that subcontractor. The Internal Coordinator reviews the QC data to verify compliance with project DQOs prior to supplying the analytical data to the client.

Figure 3-1. Laboratory Organizational Chart

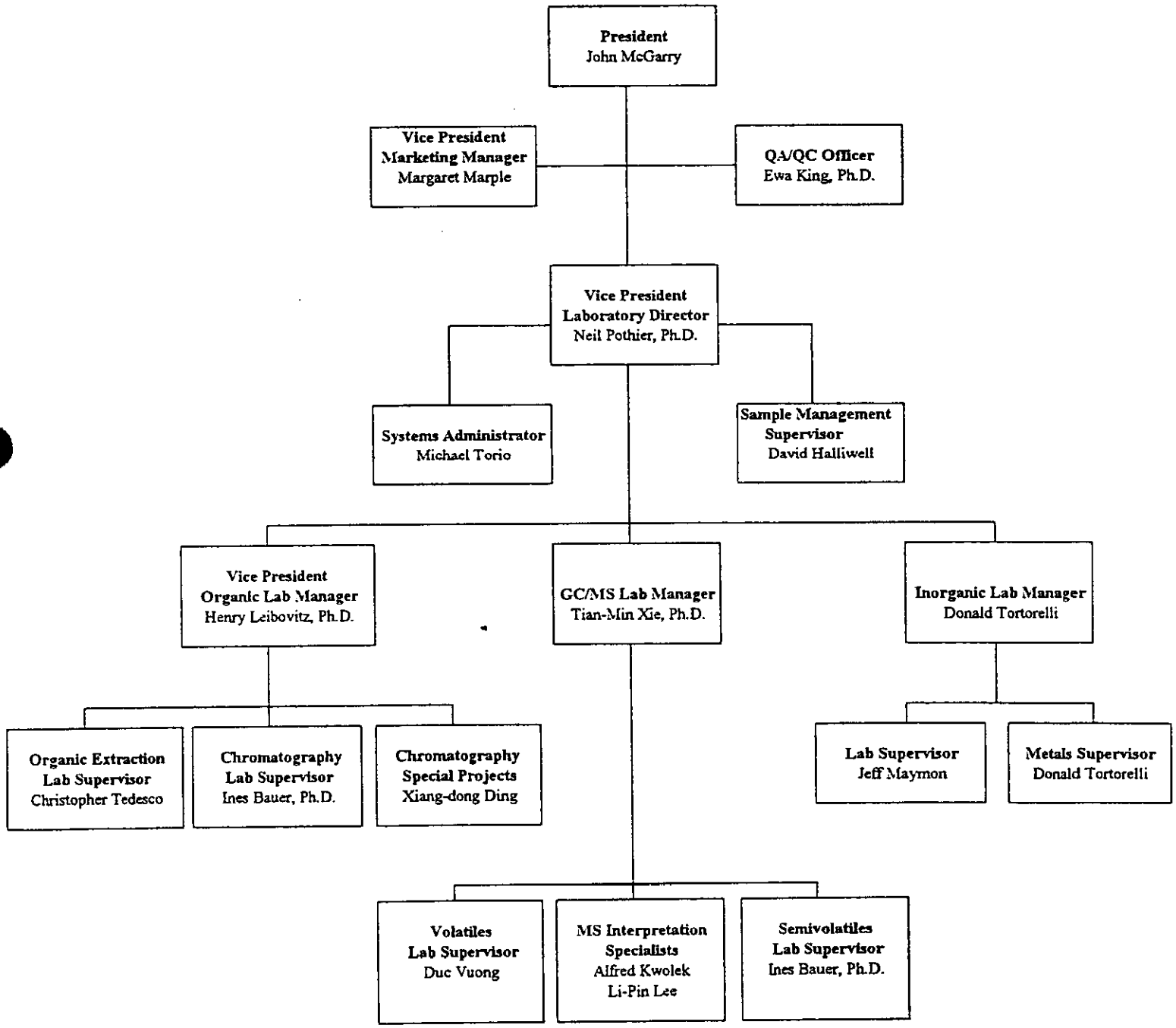

Figure 3-2

QUALITY ASSURANCE POLICY STATEMENT
CEIMIC CORPORATION
JUNE 1991

The success of our laboratories is directly related to client perception of the reliability and accuracy of the data we generate. From the moment an environmental sample arrives in our laboratory, each step it passes through in sample management, preparation, analysis, and reporting will affect data reliability and accuracy. Thus, Quality Assurance and Quality Control procedures have been imposed at each step and operation in our laboratory to ensure our clients' satisfaction. Ceimic is firmly committed to the effective implementation of these procedures.

It is incumbent on every employee at all operation and management levels to thoroughly understand and carry out said procedures.

Our Quality Assurance and Quality Control Program is the key to our success and, as a company policy, will be strictly enforced. The QA/QC Officer will direct and oversee this function, but we are all individually responsible for its execution.

John F. McGarry, Jr.
President
Ceimic Corporation

4.0 LABORATORY PERSONNEL TRAINING AND QUALIFICATIONS

It is Ceimic's practice to employ the most qualified people available. For technical support positions the minimum requirements are a degree in chemistry and a high GPA from an accredited college. The minimum requirements for supervisors and managers is 3-5 years relevant experience and preferably an advanced degree in chemistry. They must possess a high degree of knowledge of the functions their group will be performing and the associated quality control and health and safety requirements.

The Lab Managers are responsible for ensuring that their personnel receive essential training to perform their tasks and that they possess the necessary qualifications. An analytical method training record is maintained for each employee as evidence of his training. Training of new personnel is conducted as specified in SOP No. O33. All employees are required to sign the Ethics and Data Integrity Agreement (Figure 4-1) prior to performing analytical work.

The Lab Manager, Lab Supervisor, or a Lab Analyst experienced in the method of interest conducts the analytical methods training and the associated health and safety training on a one-on-one basis. For each procedure that an employee will perform, he is trained in the following (if applicable):

- preparation of reagents;
- calibration;
- method application;
- data reduction;
- quality control requirements; and
- health and safety.

Alternatively, an employee may previously possess qualifications necessary to be considered trained by virtue of education, experience, or demonstrated competence.

All new employees must demonstrate proficiency as described in SOP No. O33 prior to analyzing field samples. A successful analysis of a blind performance evaluation (PE) sample is required to demonstrate proficiency in a SW-846 Method. The results of the analysis of a blind PE sample are placed in the QA Training records and if they are within acceptance criteria the trainee is permitted to analyze field samples without supervision. If an employee has not performed a specific task for more than a year, he/she will be retrained as deemed appropriate by the Lab Manager.

The QA Officer is responsible for the quality assurance awareness and training of the laboratory personnel. This is accomplished by means of the initial quality assurance indoctrination of new employees as described in SOP No.

O33. Additionally, retraining meetings are routinely conducted in response to speci fic QA problems identified in the laboratory during internal or external audits.

The Lab Director trains the Lab Managers in all aspects of the laboratory's operation. Each Lab Manager is expected to attend seminars and read the latest material to stay current in his field. Additionally, each Lab Manager is trained in the QA/QC requirements and regulations affecting the laboratory's operation, and is trained in Health and Safety.

The President of Ceimic trains the Lab Director in Ceimic's operational philosophy, QA/QC policies, and health and safety policy. The Lab Director is expected to attend relevant seminars and read the latest material to stay current in their field.

Figure 4-1

ETHICS AND DATA INTEGRITY AGREEMENT

I. I, _____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Ceimic Corporation.

II. I agree that in the performance of my duties at Ceimic :

A. I shall not intentionally report data values that were not the actual values obtained.

B. I shall not intentionally report dates and times of data analyses that are not the actual dates and times of data analyses, and

C. I shall not intentionally represent another individual's work as my own.

III. I agree to inform Ceimic QA Officer of any reporting of non-authentic data by myself in a timely manner.

IV. I agree to inform Ceimic QA Officer of any reporting of non-authentic data by other employees.

_____

(Signature)

_____

(Date)

5.0 SAMPLE HANDLING PRACTICES AND CHAIN-OF-CUSTODY

5.1 SAMPLE BOTTLE PREPARATION

Ceimic provides its clients with appropriate sampling kits to meet the test requirements and schedule of the project. The kits include sample containers with preservatives, labels, sampling instructions, chain-of-custody forms and seals, blue ice and ice chests for shipment of perishable samples. Clients are advised to either cool samples to 4°± 2°C or to add ice cubes to the cooler, as blue ice will only maintain the sample temperature - it will not cool the samples.

All sample containers are purchased by Ceimic pre-cleaned by the manufacturer to EPA specifications. The containers are stored in a clean area in their original cartons until preparation for shipment. At this time, they are removed from their cartons, preserved according to SOP No. O07, and placed in a cooler for shipment. If requested, the laboratory can track the container and preservatives lot numbers by completing the Bottle Order Form shown in Figure 5-1. The bottleware request is initiated by the Internal Coordinator and the Bottle Order Form is completed by the Sample Receipt Staff prior to sample container shipment. A Packing List shown in Figure 5-2 is also included for some clients.

The required containers, preservation techniques, minimum sample volume or weight, and maximum holding times (based on 40CFR 136) are presented in Table 5-1.

5.2 SAMPLE RECEIPT

Sample shipments are received at Ceimic by the designated Sample Custodian. Shipping information is recorded in the Incoming Project Logbook and the paperwork filed chronologically. The shipping containers are then inspected and opened by the Sample Custodian, who fills out a Sample Receiving Checklist (Figure 5-3) as he/she unpacks the coolers.

Sample coolers are to be opened in the hood to prevent cross-contamination. The pH of (non-volatile) samples is checked using a pH paper by pouring a separate aliquot into a polystyrene beaker. All out-of-control events require documented corrective actions as described in SOP No. SC01.

The Sample custodian then signs the Sample Receiving Checklist and initiates a Custody File for the set of samples, including in it the Sample Receiving Checklist, Chain-of-Custody, Airbill and a copy of a Corrective Action Form, if applicable.

When the Sample Custodian is not available to receive samples, the sample container is signed for by a Ceimic staff member and the time, date, and name of the person receiving the container are recorded in the Incoming Log, along with the appropriate shipping information. The samples are then stored in the sample receipt area, which is located within the secured area (see Section 5.6). If the samples are not going to be

removed from the cooler for more than 4 hours, cooler temperatures are checked and recorded and more ice added if necessary. The samples are officially received and documented by the Sample Custodian or designee on the next business day.

5.3 HOLDING TIMES AND PRESERVATION

Samples that require preservation are checked by the Sample Custodian at the time of receipt and again by the Lab Analyst before analysis. The Sample Custodian verifies that the sample label indicates the appropriate preservation and measures and documents the temperature of the sample cooler and the pH of the samples (except samples designated for volatile analyses).

If samples are found to be improperly preserved, a documented corrective action is initiated by the sample receipt staff and the client is notified immediately by the Internal Coordinator. Refer to Ceimic SOPs # SC01, O02, O04, and O05 for sample receiving, sample identification, laboratory security, sample storage, and sample tracking procedures.

Ceimic uses a Laboratory Information Management System (LIMS) to track samples throughout the laboratory, from sample receipt to preparation, analysis, and data reporting. Each Lab Supervisor maintains and reviews a Sample Tracking Logbook, generated from the LIMS, which is used to check that the samples are prepared or analyzed within the required holding times.

5.4 SAMPLE IDENTIFICATION AND LOG-IN

5.4.1 Sample Identification

After inspecting the samples, the Sample Custodian assigns each sample a unique Ceimic Sample ID Number. These numbers are chronologically sequenced. Ceimic Sample ID Numbers appear in the following format:

ww xxxx - yyzzz,

where,

"ww" represents the last two digits of the current year;

"xxxx" represents a four-digit project number which is assigned sequentially when a sample group (case) is received at Ceimic;

"yy" represents the sample number within the group (case); and

"zzz" represents an individual QC code (i.e., MS, MSD, DL, RE, DUP, etc.) or unique bottle ID for the same sample location.

e.g.: 980014 - 06ABC

The Ceimic Sample Custodian assigns each sample a "wwxxxx-yy" identification number. The "zzz" suffices can be assigned by the sample custodian for unique bottle IDs or within the individual laboratories and vary from one laboratory to another.

Sample container labels also include Client name and sample disposal date as well as a field for comments.

The Ceimic Sample ID Numbers are recorded on the Sample Log-In Sheet (Figure 5-4), where they are cross-referenced with Client IDs. Each sample is clearly labelled with its Ceimic Sample ID Number by the Sample Custodian. The same Sample ID Number appears on each sample preparation container and extract vial associated with the sample.

5.4.2 Sample Log-In

The sample log-in system at Ceimic consists of computerized entry into the Laboratory Information Management System (LIMS). The information recorded includes:

-Header:

- Date (that Log-In is updated)
- Date Samples Received
- Date Due
- Client Name
- Project Name
- Client Project/Task
- Client Contact
- Project Number
- SDG Number
- Case Number
- Refrigerator Number Stored In
- Marketing Rep
- Internal Coordinator

-List of Samples:

- Ceimic ID
- Client ID
- Matrix
- Date Received
- Date Sampled

- Time Sampled
- Analysis & Method
- Number of Containers/Samples

-Comments

-Requirements

-Initials of Approval

5.4.3 Sample Information

Prior to sample receipt, the Lab Director will have assigned an Internal Coordinator to the project. The Internal Coordinator's main responsibility is to work with the lab and the client to make sure the needs of the client are being met.

After signing and dating the Sample Log-In Sheet, the Sample Custodian notifies the Internal Coordinator of the arrival of the samples. The Internal Coordinator verifies that the information on the Sample Log-In Sheet is correct by performing a 100% review of the COC and project requirements and approves it by countersigning and dating the form. The original Sample Log-In Sheet is placed in the chain-of-custody file for the case or project.

Copies of the Sample Log-In Sheet are distributed to the Ceimic Lab Director, Lab Managers, and Lab Supervisors. Another copy of the sheet may be sent to the client upon request as confirmation of sample receipt and specified analyses and serves as an SDG declaration form.

5.5 CHAIN-OF-CUSTODY

Samples are physical evidence collected from a facility or the environment. Sample data may be used as evidence in litigation. In support of potential litigation, laboratory chain-of-custody procedures have been established to ensure sample traceability from the time of receipt through completion of analysis.

The National Enforcement Investigations Center (NEIC) of EPA considers a sample in custody under the following conditions:

1. it is in your actual possession; or
2. it is in your view, after being in your physical possession; or
3. it was in your possession and then you locked or sealed it to prevent tampering; or
4. it is in a secure area.

Chain-of-custody originates as samples are collected. Chain-of-custody documentation accompanies the samples as they are moved from the field to the laboratory, with shipping information and appropriate

signatures indicating custody changes along the way. A Chain-of-Custody Record is included as Figure 5-5.

Laboratory chain-of-custody is initiated as samples are received and signed for by the Sample Custodian at Ceimic. Internal Chain of Custody for sample storage begins by all samples being logged into the Sample Control Login /Disposal Record (Figure 5-6). This record serves as documentation of the transfer of samples from coolers to refrigerated storage and from refrigerated storage to long term storage and/or disposal. Documentation of internal custody continues as samples are signed in and out of the refrigerated storage for analysis to several Ceimic laboratories using the Sample Control Record (Figure 5-7). Sample extracts and digestates are tracked through the laboratory using the Extract/Digestate Transfer Logbook (Figure 5-8). After analysis, extracts and digestates and any remaining samples are held in the central storage area to await disposal. Notification prior to disposal of samples may be provided upon request by the client.

5.6 SAMPLE TRACKING

Ceimic uses a Laboratory Information Management System (LIMS) to track samples throughout the laboratory, from sample receipt to preparation, analysis, and data reporting. Each Lab Supervisor maintains a Sample Tracking Logbook, generated from the LIMS, which is used to check that samples are prepared or analyzed within the required holding times. SOP No. O05 describes procedures used in the laboratory for Sample Tracking and Internal Chain of Custody.

5.7 SAMPLE STORAGE

Samples at Ceimic are kept within secure areas during all stages of tenure, including the periods of time spent in preparation, analysis, and storage. The laboratory area is designated as a secure area. The doors to this area are kept locked at all times and may be accessed by key or combination only. Authorized personnel only are allowed to enter the secure areas. Visitors to the laboratories must sign in and be accompanied by a Ceimic staff member.

After sample receipt and log-in procedures are completed, the Sample Custodian places the samples in their original containers within the appropriate refrigerators in the sample storage area. Samples for volatile organics analysis (VOA) are separated from other samples upon receipt and stored in an independent refrigerator in the VOA laboratory. No other type of sample may be stored in this refrigerator. The sample storage area is for samples only; no standards or reagents are present.

Refrigerators are maintained at 4°C ± 2°C. The temperature of each sample storage refrigerator is taken and recorded daily in the Temperature Log (Figure 5-9) by a designated Lab Analyst.

Access to the sample storage area is controlled by the Sample Custodian (or Volatile Lab Supervisor, for VOA samples) who is responsible for monitoring sample custody. All transfers of samples into and out of storage are documented on a laboratory internal chain-of-custody form, the Sample Control Record. When an analyst removes a sample for preparation and/or analysis, the sample is signed out. Similarly, a sample is signed back in when the analyst returns it to storage prior to the end of his/her working day or when the procedure is complete.

When the analysis is complete, extracts and any remaining samples are retained in the central storage area until disposal may be executed. Broken or damaged samples are promptly disposed of in a safe manner and the disposal documented.

All custody documentation is kept in case custody files originated by the Sample Custodian until samples are removed from storage for disposal. At that time, the case custody files are entered into the central case files and the disposal of samples and extracts documented.

Chain-of-custody of a sample ensures that the sample is traceable from when it was taken in the field through laboratory receipt, preparation, analysis and, finally, disposal. The primary chain-of-custody documents which may be used to locate a sample at any point in time are:

1. the Chain-of-Custody Form from the field describing the origin and transportation of a sample;
2. the laboratory Sample Receipt Log and supporting log-in records, documenting acceptance of a sample by the Ceimic laboratory;
3. the Sample Control Log-in /Disposal documenting transfer from coolers to refrigerated storage and from refrigerated storage to long term storage or disposal;
4. the Ceimic Sample Control Forms, documenting the Lab Analyst who has custody of the sample and the reason for removal of a sample from storage.
5. the Ceimic Extract Transfer Logs, documenting the Lab Analyst who has custody of the extract;
6. the Transfer Log to disposal.

5.8 SAMPLE AND WASTE DISPOSAL POLICY

All sample and chemical waste is disposed of in a manner consistent with State and Federal Regulations.

5.8.1 Waste Profiles

5.8.1.1 Solid Waste

Non DOT or EPA Regulated Material, Profile #35965.

Solid waste can include any solid material that comes in contact with samples, standards, or chemical solvents, and thus may not be disposed of in normal refuse. It includes used pipettes, solid sample waste, used gloves, used sodium sulfate, open used vials, spent filters, etc. Under no circumstances are there to be containers with covers in solid waste. There are to be no liquids in solid waste.

5.8.1.2 Acid Waste

Water for Recycling, Water Corrosive Liquid, Acid, Inorganic NOS (Nitric/Hydrochloric Acid); 8, ON3264 (D002), Profile # 35964.

Acid Waste is any aqueous sample waste with a pH <2.

5.8.1.3 Halogenated Solvent/Recycle Waste, Waste Dichloromethane, 6.1, UN1593 (FO02), P6III, Recyclable Methylene chloride solvent waste with yield > 90%.

5.8.1.4 Halogen Waste. Liquid-fuel Blending Hazardous Waste, Liquid NOS (Methylene chloride/Methanol), 9, NA 3082, (F002, F003) ERG171, PG III.

Sample waste is all solvent waste including flammable solvents.

5.8.2 In-Lab Storage

5.8.2.1 Solid Waste

Solid waste is interim-stored in a heavy cardboard box that has been lined with aluminum foil in Statellite Accumulation Areas. When the box is full, solid waste is taken to the Hazardous Waste Storage Area (HWSA) and placed in the proper drum.

5.8.2.2 Acid Waste and Sample Waste

Acid and sample waste is interim-stored in plastic containers with covers in designated Satellite Storage Areas. These containers are clearly and properly labelled. As is necessary, these containers are taken to the HWSA and poured into the proper drum.

5.8.2.3 Organic Solvent Waste

Organic solvent waste is initially collected in organic solvent waste beakers. These are identified by colored tape around the beaker. The beakers, when full, are poured into 15-gallon polypropylene intermediate storage drums. When the intermediate drums are half-full, they are taken into the HWSA and poured into the proper drum.

5.8 GLASSWARE CLEANING

5.8.1 Inorganic Laboratory

5.8.1.1 Metals Laboratory

All metals glassware used in the laboratory is cleaned prior to use by first soaking in HNO_3 for a minimum of 30 minutes. The glassware is then rinsed with deionized water three times and then allowed to dry before use.

5.8.1.2 Classical Chemistry Laboratory

All classical chemistry glassware is washed with soap and water, then rinsed three times with deionized water. Additional cleaning may be performed for certain analyses as described in the appropriate SOP.

5.8.2 Organic Laboratory

5.8.2.1 Organic Extraction Laboratory

The availability of clean glassware is vital to the analysis of organics trace levels. Each laboratory is responsible for cleaning its own glassware. To thoroughly remove the contaminants, which might interfere with the analysis and result in higher detection limits for the target compounds, the following steps are followed to ensure clean glassware:

- The dirty glassware used in the laboratory is washed in non-phosphate detergent solution (Alkonox).
- The washed glassware is rinsed with copious amounts of tap water.
- Glassware that was used for particularly contaminated samples will then be muffled.
- The glassware is rinsed twice with reagent grade Methanol.
- The glassware is rinsed twice with pesticide grade Methylene chloride.
- The rinsed glassware is air dried, capped with aluminum foil, and placed in a clean glassware rack.
- Immediately prior to use, the clean glassware is rinsed with the solvent that will be added to it.

Note: For petroleum hydrocarbon analysis by EPA Method 418.1, detergent-washed, tap water rinsed, glassware is rinsed with Freon only after it has been allowed to dry thoroughly.

5.8.2.2 Volatile Laboratory

Glassware in the volatile laboratory is washed as follows:

- The glassware is rinsed with copious amounts of tap water.
- Oil contaminated glassware will then be washed with methanol.
- The glassware is baked in an oven until dry.

Table 5-1. Container requirements, Minimum Sample Volumes and Maximum Holding Times

Parameter	Method	Minimum Sample Volume Required		Container Type		Preservative (Liquid)	Holding Time
		Solid	Liquid	Solid	Liquid		
INORGANICS							
Acidity	305.1	20 grams	100 ml	4 oz. G, P	250 ml P	Cool 4°C	14 days
Alkalinity	310.1	20 grams	100 ml	4 oz. G, P	250 ml P	Cool 4°C	14 days
Ammonia (as N)	350.2	10 grams	500 ml	4 oz. G, P	1 Liter P	Cool 4°C H_2SO_4<2	28 days
Biochemical Oxygen Demand (BOD)	405.1		1 liter		1 Liter P	Cool 4°C	48 hrs
Bromide	4500-Br-B		100 ml		250 ml P	None Required	28 days
Chemical Oxygen Demand (COD)	410.4		50 ml		250 ml P	Cool 4°C H_2SO_4<2	28 days
Chloride	325.3/9252	10 grams	50 ml	4 oz. G, P	250 ml P	None Required	28 days
Chlorine Total /Residual	330.5		200 ml		500 ml P	None Required	A. I.
Color	110.2		50 ml		250 ml P	Cool 4°C	48 hrs.
Cyanide (Total & Amenable)	335.2/9010	10 grams	500 ml	4 oz. G, P	1 Liter P	NaOH>12*	14 days
Fluoride	340.2	10 grams	300 ml	4 oz. G, P	500 ml P	None Required	28 days
Hardness	2340-B		100 ml		250 ml P	HNO_3<2	6 months
Kjeldahl and Organic Nitrogen	351.3	20 grams	500 ml	4 oz. G, P	1 Liter P	Cool 4°C	
Chromium VI	7196	10 grams	100 ml	8 oz. G, P	250 ml P	Cool 4°C	24 hrs.
Mercury	245.2	10 grams	100 ml	8 oz. G, P	250 ml P	HNO_3<2	28 days
Metals (Except Cr VI and Hg)	200.7/200.9 6010/7000	20 grams	200 ml	8 oz. G, P	500 ml P	HNO_3<2	6 months

Method sources are: EPA 600/4-79-020, SW-846 and Standard Methods, 18th Edition.
Holding times are from date sampled (40 CFR Part 136)
* If residual chlorine is present, preservation should include $Na_2S_2O_3$ for organics and ascorbic acid for cyanide.

P = Polyethlylene bottles — HNO_3 = nitric acid — HCl= hydrochloric acid
G = Glass jars — H_2SO_4= sulfuric acid — NaOH= sodium hydroxide
AG = Amber glass bottles — $Na_2S_2O_3$=sodium thiosulfate — A.I. = Analyze Immediately

Table 5-1. Container requirements, Minimum Sample Volumes and Maximum Holding Times

Parameter	Method	Minimum Sample Volume Required		Container Type		Preservative (Liquid)	Holding Time
		Solid	Liquid	Solid	Liquid		
Nitrate-Nitrite (NO_3-NO_2)	353.3	10 grams	100 ml	4 oz. G, P	250 ml P	Cool 4° C H_2SO_4<2	28 days
Nitrite (NO_2-N)	353.3	10 grams	50 ml	4 oz. G, P	250 ml P	Cool 4°C	48 hrs.
Oil & Grease	413.1/9070	10 grams	1 Liter	8 oz. G	1 Liter AG	Cool 4°C H_2SO_4<2	28 days
Orthophosphate	365.2		50 ml		250 ml P	Filter Immed. Cool 4°C	48 hrs.
Oxygen, Dissolved	360.1,360.2		300 ml		250 ml AG	None Required	A.I.
pH	150.1 9040, 9045	10 grams	25 ml	4 oz. G, P	250 ml P	None Required	Analyze Immediately
Phosphate (Total)	365.2	10 grams	50 ml	4 oz. G, P	250 ml P	Cool 4°C HCl or H_2SO_4<2	28 days
Phenols (Total)	420.1/9065		500 ml		1 Liter AG	Cool 4°C H_2SO_4<2	28 days
Solids (Total) TS	160.3		100 ml		250 ml P	Cool 4°C	7 days
Solids (Filterable) - TDS	160.1		100 ml		250 ml P	Cool 4°C	7 days
Solids (Soluble) - TSS	160.2		100 ml		250 ml P	Cool 4°C	7 days
Solids (Settleable)	160.5		1 Liter		1 Liter P	Cool 4°C	48 hrs.
Solids (Volatile) - TVS	160.4		100 ml		250 ml P	Cool 4°C	7 days
Specific Conductance	120.1/9050	100 grams	100 ml	4 oz. G, P	250 ml P	Cool 4°C	28 days
Sulfate	375.4/9038	10 grams	50 ml	4 oz. G, P	250 ml P	Cool 4°C	28 days
Sulfide	376.2/9030	20 grams	500 ml	4 oz. G, P	1 Liter P	ZnAc/ NaOH>9	7 days
Sulfite	377.1		50 ml		250 ml P	None Required	A.I.
Surfactants (MBAS)	425.1		250 ml		500 ml P	Cool 4°C	48 hrs.
Turbidity	180.1		100 ml		250 ml P	Cool 4°C	48 hrs.

Method sources are: EPA 600/4-79-020, SW-846 and Standard Methods, 18th Edition.
Holding times are from date sampled (40 CFR Part 136).
* If residual chlorine is present, preservation should include $Na_2S_2O_3$ for organics and ascorbic acid for cyanide.

P = Polyethlylene bottles — HNO_3 = nitric acid — HCl= hydrochloric acid
G = Glass jars — $H2SO_4$= sulfuric acid — NaOH= sodium hydroxide
AG = Amber glass bottles — $Na_2S_2O_3$=sodium thiosulfate — A.I. = Analyze Immediately

Table 5-1. Container requirements, Minimum Sample Volumes and Maximum Holding Times

Parameter	Method	Minimum Sample Volume Required		Container Type		Preservative (Liquid)	Holding Time
		Solid	Liquid	Solid	Liquid		
ORGANICS							
Purgable Halocarbons	624/8260	5 grams	40 ml	4 oz. G, P	40 ml vial	Cool 4°C*	14 days
Purgeable Aromatic Hydrocarbons	624/8260	5 grams	40 ml	4 oz. G, P	40 ml vial	Cool 4°C*	14 days
Acrolein & Acrylonitrile	624/8260	5 grams	40 ml	4 oz. G, P	40 ml vial	Cool 4°C*	14 days
Volatile Organics	624/8240	5 grams	40 ml	4 oz. G, P	40 ml vial	Cool 4°C* HCl<2	7 d unpres. 14 d preserv
Nonhalogenated Volatile Organics	8015, 8260	5 grams	40 ml	4 oz. G, P	40 ml vial	Cool 4°C* HCl<2	7 d unpres. 14 d preserv
Phenol	604 625/8040	10 grams	1 Liter	8 oz. G	1 Liter AG	Cool 4°C*	7 d til extr. 40 d after extraction
EDB/DBCP	504	5 grams	40 ml	4 oz. G	40 ml vial	Sodium Thiosulfate Cool 4°C* HCl<2	28 days
Polynuclear Aromatic Hydrocarbons (PAH)	610/8100 8270, 8310	30 grams	1 Liter	8 oz. G	1 Liter AG	Store in Dark	7 d til extr. 40 d after extraction
Pesticides, PCBs	608 8081, 8082	30 grams	1 Liter	8 oz. G	1 Liter AG	Cool 4°C	7 d til extr. 40 d after extraction
Herbicides	615/8151	30 grams	1 Liter	8 oz. G	1 Liter AG	Cool 4°C	7 d til extr. 40 d after extraction
Semivolatile Organics	625/8270	30 grams	1 Liter	8 oz. G	1 Liter AG	Cool 4°C	7 d til extr. 40 d after
Total Organic Carbon (TOC)	415.1/9060	10 grams	25 ml	4 oz. G, P	250 ml P	Cool 4°C* HCl or H_2SO_4<2	28 days
Total Organic Halogens (TOX)or (EOX in soil)	9020	10 grams	250 ml	4 oz. G	1 Liter AG	H_2SO_4<2 Cool 4°C	14 days
Total Petroleum Hydrocarbons (TPH)	418.1 8015B	50 grams	1 Liter	8 oz. G	1 Liter AG	HCl<2 Cool 4°C	28 days

Method sources are: EPA 600/4-79-020, SW-846 and Standard Methods, 18th Edition.
Holding times are from date sampled (40 CFR Part 136).
* If residual chlorine is present, preservation should include $Na_2S_2O_3$ for organics and ascorbic acid for cyanide.

P = Polyethlylene bottles — HNO_3 = nitric acid — HCl= hydrochloric acid
G = Glass jars — $H2SO_4$= sulfuric acid — NaOH= sodium hydroxide
AG = Amber glass bottles — $Na_2S_2O_3$=sodium thiosulfate — A.I. = Analyze Immediately

Table 5-1. Container requirements, Minimum Sample Volumes and Maximum Holding Times

Parameter	Method	Minimum Sample Volume Required		Container Type		Preservative (Liquid)	Holding Time
		Solid	Liquid	Solid	Liquid		
HAZARDOUS WASTE							See Table below.
TCLP Extraction	1311	200 grams		2 x 8 oz.G		None	
TCLP Volatiles	8260		40 ml		40 ml vial	None	
TCLP Semivolatiles	8270		1 Liter		1 liter AG	None	
TCLP Pesticides	8081		1 Liter		1 liter AG	None	
TCLP Herbicides	8150		1 Liter		1 liter AG	None	
Metals	6010		500 ml		500 ml P	HNO_3	
Ignitability	1010	25 grams	100 ml	4 oz. G, P	250 ml P	None	
Corrosivity (pH)	9040/9045	10 grams	25 ml	4 oz. G, P	250 ml P	Cool 4°C	
Reactivity	7.3.3.2,7.3.	50 grams	500 ml	8 oz. G, P	500 ml P	Cool 4°C	

TCLP Sample Maximum Holding Times (Days)

	From: Field Collection To: TCLP Extraction	From:TCLP Extraction To: Organic Extraction	From: Organic Extraction or TCLP Extraction To: Instrumental Analysis	Total Elapsed Time
Volatiles	14	NA	14	28
Semivolatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, except Mercury	180	NA	180	360

Method sources are: EPA 600/4-79-020, SW-846 and Standard Methods, 18th Edition.
Holding times are from date sampled (40 CFR Part 136).
* If residual chlorine is present, preservation should include $Na_2S_2O_3$ for organics and ascorbic acid for cyanide.

P = Polyethlylene bottles — HNO_3 = nitric acid — HCl= hydrochloric acid
G = Glass jars — H_2SO_4= sulfuric acid — NaOH= sodium hydroxide
AG = Amber glass bottles — $Na_2S_2O_3$=sodium thiosulfate — A.I. = Analyze Immediately

Figure 5-1. Bottle Order Form

Ceimic Corporation - Bottle Order

Date Requested: _____ Shipping Address: _____ Date Required: _____

Client: _____ Date Shipped: _____

Project: _____ Attn: _____ Tel: _____ Total # Pkgs.: _____

Analyses	Matrix	Bottles	Scientific Specialties	Container Lot #	# of Bottles	Preservative	Preservative Lab ID
	soil	2 oz. jar				none	
	soil	4 oz. jar				none	
	soil	8 oz. jar				none	
	soil	16 oz. jar				none	
	aqueous	125 ml plastic					
	aqueous	250 ml plastic					
	aqueous	500 ml plastic				HNO_3	
	aqueous	500 ml plastic				H_2SO_4	
	aqueous	1000 ml plastic				NaOH	
	aqueous	1000 ml plastic					
	aqueous	125 ml amber					
	aqueous	500 ml amber					
	aqueous	1L amber				none	
	aqueous	1L amber				H_2SO_4	
	aqueous	4L amber				none	
	aqueous	40 ml VOA vial				HCl	
	aqueous	Trip Blanks				HCl	

Sorbent Material	
Bubble Wrap	
Chain of Custody	

Labels	
Blue Ice	
Custody Seals	

Coolers	
Temp Blanks	

Figure 5-2. Packing Slip
Container Requirements

Client:	Date:
Project:	

Parameter	Analytical Method	Container Type		Preserv. (Liquid)	# of Client samples[1]	# of Containers per sample	Total # of Containers sent[2]
		Solid	Liquid				

Sorbent Material		Labels		Coolers	
Bubble Wrap		Blue Ice		Temp Blanks	
Chain of Custody		Custody Seals			

P = Polyethylene bottles	HNO_3 = nitric acid	HCl = hydrochloric acid
G = Glass jars	H_2SO_4 = sulfuric acid	NaOH = sodium hydroxide
AG = Amber glass bottles	$Na_2S_2O_3$ = sodium thiosulfate	ZnOAc = zinc acetate

[1] MS/MSD requires 3X normal volume for aqueous and 2X normal volume for soil.
[2] Additional glass bottles have been included for breakage.

Shipping Address:

Ceimic Corporation, 10 Dean Knauss Drive, Narragansett, RI 02882 - Tel: (401) 782-8900, Facsimile: (401) 782-8905

Figure 5-3. SAMPLE RECEIVING CHECKLIST

LIMS #_____ Cooler Number:

Client: _____ Number of Coolers:

Project:_____ Date Received:___/___/

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened:___/___/

1. Have designated person initial here to acknowledge receipt of cooler:_____(date):_____/_____/

2. Did cooler come with a shipping slip (airbill, etc.)? ..... YES NO

   If YES, enter carrier name & airbill number here:

3. Were custody seals on outside of cooler? ..... YES NO
   How many & where:_____ seal date:_____/_____/_____ seal name:

4. Were custody seals unbroken and intact at the date and time of arrival ..... YES NO

5. Did you screen samples for radioactivity using a Geiger Counter? ..... Reading:_____ YES NO

6. Chain of Custody #:

7. Were custody papers sealed in a plastic bag & taped inside to the lid? ..... YES NO

8. Were custody papers filled out properly (ink, signed, etc.)? ..... YES NO

9. Did you sign custody papers in the appropriate place? ..... YES NO

10. Was project identifiable from custody papers? ..... YES NO

11. If required, was enough ice used? ..... Cooler Temperature:_____°C Type of ice:_____ YES NO

B. LOG-IN PHASE: Date samples were logged-in:_____/_____/

   by (print):_____ (sign):

12. Describe type of packing in cooler:

13. Were all bottles sealed in separate plastic bags? ..... YES NO

14. Did all bottles arrive unbroken and were labels in good condition? ..... YES NO

15. Were all bottle labels complete (ID, date, time, signature, preservative, etc.)? ..... YES NO

16. Did all bottle labels agree with custody papers? ..... YES NO

17. Were correct containers used for the tests indicated? ..... YES NO

18. Were samples received at the correct pH? ..... YES NO

19. Was a sufficient amount of sample sent for tests indicated? ..... YES NO

20. Were bubbles absent in VOA samples? If NO, list by sample#:_____ YES NO

21. Laboratory labelling verified by: (Initials):_____ (date): ___/___/

Figure 5-4. Ceimic Sample Log-in Sheet

Sample Log In Information

Date:

Date Samples Received: **Stored:**

Date Due: **Ceimic Rep:**

Client: **Coordinator:**

Project Name: **Report To:**

Client Task:

Client Contact: Attn:

Project #:
SDG:
Case:
Invoice To:

Project Amount: Attn:

LAB ID	CLIENT ID	# OF CONT.	MATRIX	DATE RECEIVED	DATE SAMPLED	TIME SAMPLED	ANALYSIS &METHOD
-01							
-02							
-03							

Comments:

Requirements:

LIMS Identifier:

LIMS Project Code:

Approved By _____

Figure 5-5

Chain of Custody

Original Chain of Custody goes to Laboratory

Page _____ of _____

Project #	Project Name	Cooler Temp.
Samplers (please print)		Cooler #

Lab ID	Date	Time	Comp. / Grab	Sample Identification	Sample Matrix	No. of Containers	Analyses															Remarks
								pH		pH		pH		pH		pH		pH		pH		

Ceimic Project #	Relinquished by (signature) Date/Time	Received by (signature) Date/Time
	Relinquished by (signature) Date/Time	Received by (signature) Date/Time
Storage Location	Relinquished by (signature) Date/Time	Received by Ceimic (signature) Date/Time

Remarks:

☐ = Lab Use Only

Ceimic Corporation, 10 Dean Knauss Drive, Narragansett, RI 02882 - Tel: (401) 782-8900, Fax: (401) 782-8905

Figure 5-6
Ceimic Corporation --Sample Receiving
Sample Control Login/Disposal Record

Refrigerator # _____

Project #	Bottles	Total of Bottles	Date In	Date Out	Initials	Comments	Review By

Figure 5-7

Ceimic Corporation

Sample Control Record

Refrigerator No.: _____

Lab Sample ID	Bottle No.	Date/Time Removed	Initials	Date/Time Returned	Initials	Comments

Page: _____

Figure 5-8
Ceimic Corporation--BNA Laboratory
Extract Transfer Log

	Prep lab transfer				BNA manipulation				
Lab ID	Date	Time	Vol	Initial	Date Spiked	Internal Std ID	Initial	Comments (OP lab dilution/ possible spill)	Review By

Figure 5-9
Ceimic Corporation - Sample Receiving
Refrigerator Temperature Log

Month: _____ Year: _____

Refrigerator ID

Day of Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Tech./ Time	Init.	Comments	Review By
1																										
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6.0 MATERIAL PROCUREMENT AND TRACEABILITY

6.1 PURCHASING MATERIALS

All materials purchased at Ceimic, such as glassware, filter paper, solvents, and standards are approved by the Lab Manager and ordered by the Lab Supervisor. Ceimic routinely uses a number of vendors that have provided quality materials in the past. However, new vendors may be used with the approval of the Lab Manager. Purchases of major analytical instrumentation are approved by the Lab Director and ordered by the Lab Manager.

6.2 QC OF MATERIALS PRIOR TO USE

6.2.1 QC of Glassware

The Lab Supervisor inspects all glassware on receipt for cracks or breakage. Additionally, thermometers, graduated cylinders, pipettes, and syringes are calibrated on receipt to verify accuracy.

6.2.2 QC of Solvents

For solvents that are used in large quantities, such as Methylene chloride, Hexane and Acetone, the Lab Supervisor initially requests the supplier to hold aside an entire lot of the solvent and to send Ceimic one bottle. Upon receipt the Lab Supervisor checks the quality of the solvent according to SOP No. O15. If the QC criteria are passed, then additional bottles of the same lot are sent to the lab.

For solvents that are used in smaller quantities, each time a new lot is received at the laboratory, the Lab Supervisor QCs the solvent according to SOP No. O15.

6.2.3 Quality Control of Standards

Upon receipt of a new lot of standards, the Lab Supervisors control the quality of the standard against a primary NIST traceable standard as described in the appropriate SOPs. Refer to SOPs O25V, O25S, O25OP and O25P for acceptability criteria.

6.2.4 QC of Analytical Instruments

Upon receipt of a new analytical instrument, the manufacturer sets up the instrument and performs an initial calibration, as specified in the method the instrument will be used for. The manufacturer provides the Lab Analysts with appropriate documentation and training in the use and maintenance of the instrument. In the case of more complicated instrumentation, the Lab Analysts must undergo a formal manufacturer training course. Prior to analysis of any samples on the new instrument, an IDL study must be performed. A Precision and Accuracy and MDL studies are then carried out for the analytical methods to be used on this instrument.

6.3 STANDARDS INVENTORY

Upon receipt of standards, the Lab Supervisor records the date received, lot #, supplier, and concentration in the Standard Receipt Logbook. Each standard is labelled with a unique Ceimic ID used to track the standard. Refer to SOP No. O25 for additional standard tracking information. Upon receipt of reagents, the Lab Supervisor verifies the agreement between the packing slip and the contents. Additionally, an inventory list of standards and reagents in storage in the laboratory is maintained and updated on an on-going basis by each laboratory.

6.4 STANDARDS AND REAGENT TRACEABILITY

Standards used for calibration and in QC samples, as well as specific reagents required for analytical tests are traceable to manufacturer's lot numbers and ultimately to Standard Reference Materials (SRM). Whenever possible standards traceable to NIST or A2LA materials are purchased and if these are not available for a particular analyte or group of analytes, Ceimic uses standards from ISO-certified vendors.

Traceability of materials is accomplished by following a system of carefully documenting every step in preparartion of calibration standards and spiking solutions for QC samples. With every standard manupulation (opening of the original ampule and all subsequent dilutions), standard solutions are given a new ID and expiration date. When analyzed, the working standard IDs are documented in the instrument or sample runlogs. Details of the traceability system are given in the following SOPs: O25V, O25OP, O25P and O25S.

6.4 SOLVENT STORAGE

Solvents are stored in a solvent closet in the Sample Preparation Laboratory. This solvent closet is especially designed to minimize fire hazards and is equipped with a blow-out roof. Small quantities of solvents may also be stored under hoods or under lab benches with hoods above them.

7.0 FACILITIES AND EQUIPMENT

Ceimic Corporation is located in a 12,500 square foot, one-story building. Approximately 4,400 square feet are actual laboratory space, 5,000 square feet are offices and support areas, and another 2,500 square feet are designated as storage.

7.1 ORGANIC LABORATORIES

The organic laboratories consist of two preparation laboratories, Organic Preparation Laboratory 1 and 2, and two instrument rooms (Volatile Organics and Semivolatile Organics/GC/LC). The Organic Preparation Laboratory 1 is a large (1,170 sq. ft.) laboratory for the routine preparation of environmental samples. The Organic Preparation Laboratory 2 is a smaller (324 sq. ft.) area where environmental samples which require special handling are prepared.

The Volatile Organic Analysis (VOA) Instrument Room (750 sq. ft.) is situated well apart from the Organic Preparation Laboratories to avoid contamination of VOA samples by solvents used in the sample preparation process.

The Base/Neutral/Acid Extractables (BNA or Semivolatiles) and Gas Chromatography (GC/LC) Instrument Room (850 sq. ft.) is located between the VOA Instrument Room and the Organic Preparation Laboratories.

7.2 INORGANIC LABORATORIES

The inorganic laboratories are divided into an Inorganic Preparation/Wet Chemistry Laboratory (950 sq. ft.), an Inorganic Instrument Room (350 sq. ft.), and a second Inorganic Instrument Room (300 sq. ft.).

7.3 SAMPLE RECEIVING AREA

Samples are received and initially stored in a designated Sample Receiving Room accessible from the separate locked entrance. Additional sample storage space is available in the organic preparation laboratories. Samples for VOA analysis are stored in the VOA Instrument Room.

7.4 EQUIPMENT - ORGANIC LABORATORIES

The Organic Preparation Laboratory 1 contains 98 linear feet of bench space and is outfitted with four (4) 6' fume hoods. This laboratory contains a 6' x 8' solvent storage room with a "blow-out" roof. Standard organic laboratory equipment located in this laboratory includes:

- Kiln Furnace
- Analytical Balance (0.1 mg accuracy)
- Soxhlet Extractors
- Rapidvaps
- Water Baths

- 4 GPC Systems with Fraction Collectors
- 2 HP 5890 Series II GC/FIDs
- Standard Laboratory Glassware
- Nitrogen Blow-down equipment

The Organic Preparation Laboratory 2 has 40 linear feet of bench space and two (2) 6' fume hoods. Standard organic laboratory equipment located in this laboratory include:

- Rotovaps
- Sonicators
- Drying Oven
- Continuous Liquid-Liquid Extractors
- Separatory Funnels
- Dispersive Infrared Spectrophotometer

The VOA Instrument Room contains 64 linear feet of bench space and a canopy hood and sink bench (6 linear feet). This instrument room is equipped with eight Hewlett Packard 5970 or 5971 GC/MS units, and Hewlett-Packard 1000 RTE-A data systems and accessories. This laboratory is also equipped with the Hewlett Packard 5973 GC/MS interfaced with the closed vessel O-I autosampler/purge and trap for soils.

A separate Instrument Room dedicated to the volatile GC analyses is currently being established. It contains two (2) HP 5890 GC/ELCD/PID and HP 5890 NPD/NPD.

The BNA/GC Instrument Room contains 84 linear feet of bench space and a canopy hood and sink bench (6 linear feet). This instrument room is equipped with seven (7) Hewlett-Packard 5970 GC/MS's and nine (9) Hewlett-Packard 5890-A GCs, and two (2) Waters HPLC systems. The GCs are outfitted with dual electron capture detectors (ECDs) and an automatic samplers.

Data acquisition on the GC's is performed through a dedicated Hewlett-Packard 1000/LAS data system.

7.4 EQUIPMENT - INORGANIC LABORATORIES

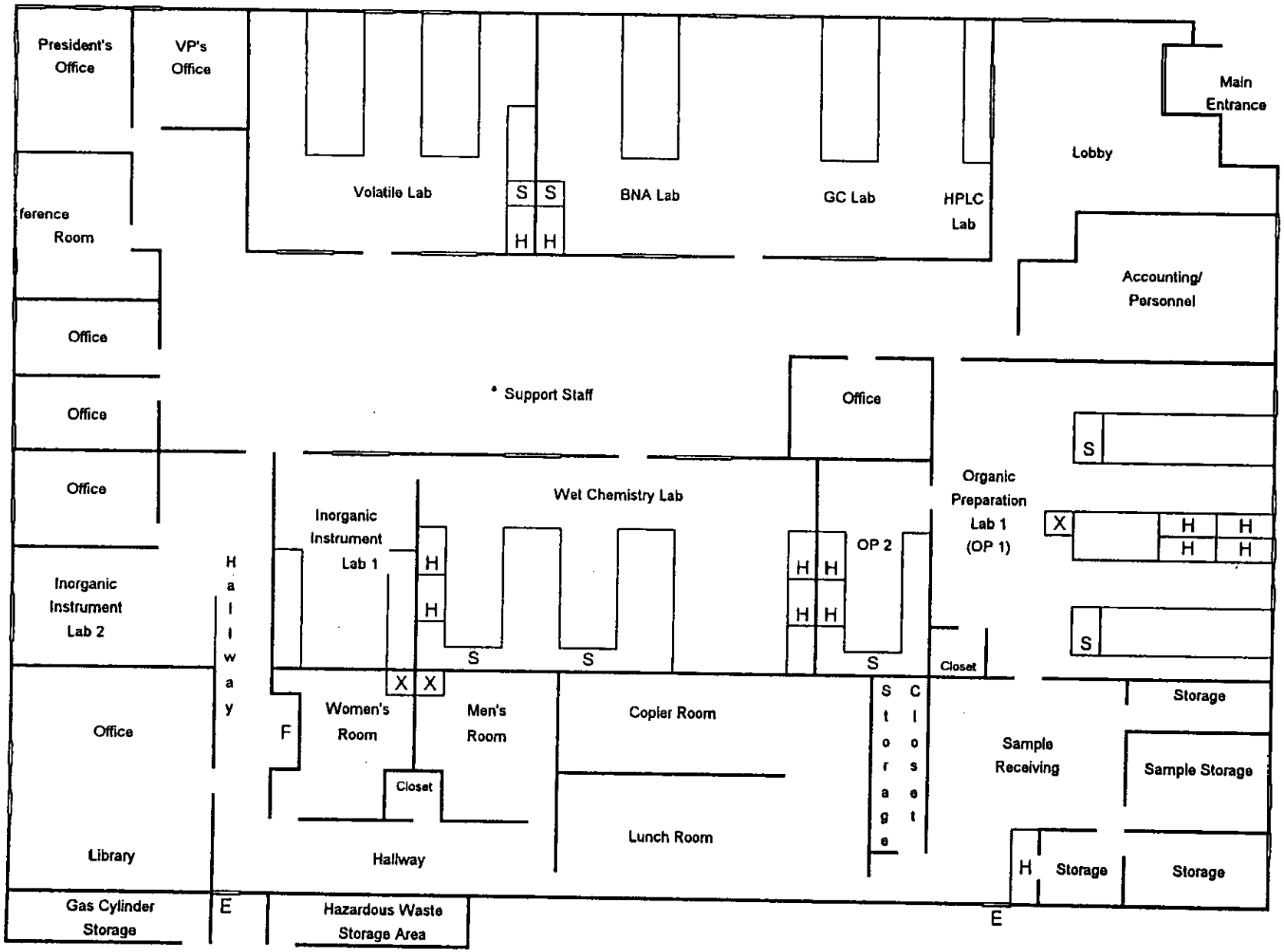
The Inorganic Preparation/Wet Chemistry Laboratory contains 131 linear feet of bench space and two (2) 6' fume hoods. A Millipore Mili-Q ultrapure water system is located in this laboratory. The laboratory contains twelve (12) cyanide distillation columns and a mercury analyzer. Standard inorganic laboratory equipment includes:

- analytical balance (0.1 mg accuracy)
- air compressor and storage tank
- muffle furnace

- vacuum pump
- microwave digestion oven
- TCLP extraction apparatus

The Inorganic Instrument Room is equipped with a Perkin-Elmer Zeeman 5100Z graphite furnace atomic absorption spectrophotometer, an automated mercury analyzer, a Total Organic Carbon (TOC) analyzer, a Total Organic Halide (TOX) analyzer, a LACHAT QuickChem 8000 Wet Chemistry FIA Autoanalyzer, a Dionex ion chromatograph and a Thermo Jarrell Ash Model 61 ICP. A second Inorganic Instrument room is equipped with a Thermo Jarrell-Ash Trace Analyzer ICP and a Thermo Jarrell Ash Environ II Sequential/Simultaneous ICP .

Figure 7-1 Facilities Diagram



H = Hood S = Sink F = Water Fountain X = Shower E = Emergency Exit

Table 7-1 MAJOR LABORATORY INSTRUMENTATION SUMMARY

16	Hewlett Packard Gas Chromatography/Mass Spectrometer systems with Hewlett Packard RTE 1000 Data Systems/ ChemStations
7	Tekmar LSC 2000 Purge and Trap and ALS 2016 Autosampler Systems
4	OI 4560 Purge and Trap and DPM-16 Autosamplers Systems
1	OI 4560 Purge/Trap and 4552 Closed Vessel Autosampler
28	Channels of Hewlett Packard 5890 Gas Chromatographs and Hewlett Packard RTE A-900 GC Data System 14 Electron Capture Detectors (ECD) 6 Flame Ionization Detectors (FID) 2 Flame Photometric Detectors (FPD) 2 Nitrogen Phosphorus Detector (NPD) 2 Photo Ionization Detector (PID) 2 Electron Conductivity Detector (ECD)
4	Gel Permeation Chromatography Systems with Fraction Collectors
1	Waters Millenium Gradient HPLC system equipped with a Waters Scanning Fluorescence detector and Waters 996 Photodiode Array Detector
1	Water Millenium Isocratic HPLC system equiped with Waters Tuneable UV detector
1	Perkin Elmer 1310 Infrared Spectrophotometer
1	Perkin Elmer 5100 Graphite Furnace Atomic Absorption Spectrometers
1	Thermo Jarrell Ash 61 Inductively Coupled Argon Plasma Spectrometer
1	Thermo Jarrell Ash 61E Trace Analyzer Inductively Coupled Argon Plasma Spectrometer
1	Thermo Jarrell Ash Environ II Sequential/Simultaneous Inductively Coupled Argon Plasma Spectrometer
1	Leeman PS-200 Automated Mercury Analyzer
1	Dionex 100 Ion Chromatographic System
1	Mitsubishi 10X-10 Total Organic Halide (TOX) Analyzer
1	Dohrmann DC-190 Total Organic Carbon (TOC) Analyzer with ASM 190 Autosampler
1	LACHAT QuikChem 8000 Wet Chemistry FIA Autoanalyzer
1	CEM MDS-2000 Microwave Digestion Oven

INSTRUMENTATION DETAILED HOLDINGS
GC/MS/DS INSTRUMENTATION

ID	Manufacturer	Model/Revision	Purchase Date
VOLATILES			
GC/MS ID#2	Hewlett-Packard	5890 GC 5970 MSD HP1000 RTE A	1988
	Tekmar	LCS2000 Purge/Trap ACS2016 Autosampler	
GC/MS ID#3	Hewlett-Packard	5890 GC 5970 MSD HP1000 RTE A	1988
	OI Analytical	4560 Purge/Trap DPM-16 Autosampler	1997
GC/MS ID#5	Hewlett-Packard	5890 GC 5971 MSD HP1000 RTE A/ChemStation	1997
	Tekmar	LCS 2000 Purge/Trap ACS 2016 Autosampler	
GC/MS ID#6	Hewlett-Packard	5890 GC 5970 MSD HP 1000 RTE A	1990
	Tekmar	LCS 2000 Purge/Trap ACS 2016 Autosampler	
GC/MS ID#7	Hewlett-Packard	5890 GC 5970 MSD HP 1000 RTE A	1991
	Tekmar	LCS 2000 Purge/Trap ACS 2016 Autosampler	
GC/MS ID#8	Hewlett-Packard	5890 GC 5971 MSD HP 1000 RTE A/ChemStation	1991
	OI Analytical	4560 Purge/Trap DPM-16	1997
GC/MS ID#12	Hewlett-Packard	6890 GC 5973 MSD ChemStation	1997
	OI Analytical	4560 Purge/Trap 4552 Autosampler	

GC/MS/DS INSTRUMENTATION (continued)

ID	Manufacturer	Model/Revision	Purchase Date
VOLATILES (cont.)			
GC/MS ID#15	Hewlett-Packard	5890 GC 5970 MSD ChemStation	1997
	OI Analytical	4560 Purge/Trap DPM-16 Autosampler	
GC/MS ID#16	Hewlett-Packard	5890 GC 5972 ChemStation	1997
	OI Analytical	4560 Purge/Trap DPM-16	
NBS Mass Spectral Library	NIH/EPA	62 K	1992
SEMIVOLATILES			
GC/MS ID#1	Hewlett-Packard	5890 GC 5970 MSD HP1000 RTE A	1988
GC/MS ID#4	Hewlett-Packard	5890 GC 5970 MSD HP1000 RTE A	1988
CG/MS ID#9	Hewlett-Packard	5890 GC 5970 MSD HP1000 RTE A	1991
GC/MS ID#10	Hewlett-Packard	5890 GC 5970 MSD HP 1000 RTE A	1991
GC/MS ID#11	Hewlett-Packard	5890 GC 5970 MSD HP 1000 RTE A	1996
GC/MS ID#13	Hewlett-Packard	5890 GC 5970 MSD HP 1000 RTE A/ChemStation	1997
GC/MS ID#14	Hewlett-Packard	5890 GC 5970 MSD ChemStation	1997
NBS Mass Spectra Library	NIH/EPA	75 K	1992

GC INSTRUMENTATION

ID	Manufacturer	Model	Detectors	Purchase Date
GC #1	Hewlett-Packard	5890 GC 18593B Autosampler HP 1000 A900 RTE A	ECD/ECD	1988
GC #2	Hewlett-Packard	5890 GC 18593B Autosampler HP 1000 A900 RTE A	FID/FID	1988
GC #3	Hewlett-Packard	5890 II GC 18593B Autosampler HP 1000 A900 RTE A	ECD/ECD	1988
GC #4	Hewlett-Packard	5890 II GC 18593A Autosampler HP 1000 A900 RTE A	FPD/FPD	1988
GC #4A	Hewlett-Packard	5890 II GC 18593A Autosampler HP 1000 A900 RTE A	FPD/FPD	1988
GC #5	Hewlett-Packard	5890 II GC 18593A Autosampler HP 1000 A900 RTE A	ECD/ECD	1988
GC #6	Hewlett-Packard	5890 GC 18593A Autosampler HP 1000 A900 RTE A	ECD/ECD	1989
GC #7	Hewlett-Packard	5890 II GC 18593A Autosampler HP 1000 A900 RTE A	ECD/ECD	1990
GC #8	Hewlett-Packard	5890 II GC 18593B Autosampler HP 1000 A900 RTE A	ECD/ECD	1990
GC #9	Hewlett-Packard	5890 GC 18593A Autosampler HP 1000 A900 RTE A	FID/FID	1991
GC #10	Hewlett-Packard	5890 GC 18593A Autosampler HP 1000 A900 RTE A	NPD/NPD	1997
GC #11	Hewlett-Packard Tekmar	5890 GC HP 1000 A900 RTE A LCS 2000 ACS 2016	FID/PID/ELCD	1998

GC #12	Hewlett-Packard	5890 GC HP 1000 A900 RTE A	FID/PID/ELCD	1998
	Tekmar	LCS 2000 ACS 2016		

OTHER ORGANIC ANALYSIS INSTRUMENTATION

ID	Manufacturer	Model	Purchase Date
HPLC	Waters	717 Autosampler 610 Gradient LC Pump 996 PDA Detector 470 Scanning Fluorescence 600 E System Controller Millenium Data Station	1993
HPLC	Waters	717 Autosampler 510 Isocratic LC Pump 484 UV Tuneable Detector Millenium Data Station	1996
GPC ID# System X	Waters ISCO ISCO ISCO	717 Autosampler LC 1000 Pump UA 6 UV Detector Foxy 200 Fraction Collector	1990
GPC ID# System Z	Waters ISCO ISCO ISCO	717 Autosampler LC 1000 Pump UA 6 UV Detector Foxy 200 Fraction Collector	1991
GPC ID# System Y	Waters SSI ISCO Waters	717 Autosampler 300 LC Pump UA 6 UV Detector Fraction Collector	1992
GPC ID# System W	Waters Waters Waters Waters	715 Autosampler 550 LC Pump UV Detector Fraction Collector	1997
Infra-Red Spectrophotometer	Perkin-Elmer	1310	1990
Total Organic Carbon Analyzer (TOC)	Dohrman	DC-190 Autosampler	1997
Total Organic Halide Analyzer (TOX)	Mitsubishi	10X-10	1997
Nitrogen Evaporator	Labconco	Rapidvap N2	1996

OTHER ORGANIC ANALYSIS INSTRUMENTATION cont'd

ID	Manufacturer	Model	Purchase Date
Nitrogen Evaporator	Labconco	Rapidvap N2	1996
Nitrogen Evaporator	Labconco	Rapidvap N2	1996
Nitrogen Evaporator	Labconco	Rapidvap N2	1997
Nitrogen Evaporator	Labconco	Rapidvap N2	1997
Nitrogen Evaporator	Labconco	Rapidvap N2	1997

INORGANIC INSTRUMENTATION

ID	Manufacturer	Model	Purchase Date
ICAP Simultaneous ID# J4	Thermo Jarrell Ash	Enviro 61 TJA-300 Autosampler	1996
ICAP Simultaneous ID# J3	Thermo Jarrell Ash	Trace 61E TJA-300 Autosampler	1993
ICAP Simultaneous/Sequential ID#J5	Thermo Jarrell Ash	Environ II TJA -300 Autosampler	1997
Graphite Furnace AA ID# Z2	Perkin-Elmer	Zeeman 5100 Z AS-60 Autosampler 0057-0759 EDL	1990
FIA Autoanalyzer	LACHAT	QuikChem 8000	1994
Mercury Analyzer	Leeman Labs	PS200	1992
Ion Chromatograph	Dionex	Dionex-100 Dionex-100 Autosampler Data Station	1996
Spectrophotometer	Spectronic 20	20	1988
Spectrophotometer	Spectronic 21	21	1993
Microwave Digestion Unit	CEM	2000	1991
Ratio Turbidimeter	HACH	18900	1991

INORGANIC INSTRUMENTATION cont'd

ID	Manufacturer	Model	Purchase Date
TCLP/Rotary Agitator	Associated Design	3740	1989
TCLP/Rotary Agitator	Associated Design	3740	1990
TCLP/Rotary Agitator	Associated Design	3740	1991
TCLP/Rotary Agitator	Associated Design	3740	1991
TCLP/Rotary Agitator	Associated Design	3740	1997
TCLP/Rotary Agitator	Associated Design	3740	1997
pH Meter	Orion	720A	1990
Conductivity Meter	Fisher Accumet	30	1996
Muffle Furnance	Thermolyne	62700	1994

8.0 EQUIPMENT MAINTENANCE

Preventive maintenance is a routine practice at Ceimic for each analytical instrument. Scheduled preventive maintenance minimizes instrument downtime and consequent interruption of analysis. The laboratory personnel at Ceimic are familiar with the maintenance requirements of the instruments they operate. This familiarity is based on conventional education, specialized courses, and hands-on experience. Designated staff members are trained at manufacturer facilities in the routine maintenance procedures for major analytical instrumentation. An example logbook page for GC/MS routine maintenance is presented as Figure 8-1. Instrument maintenance procedures are documented in the appropriate analysis SOP for each laboratory.

Ceimic maintains an inventory of replacement parts required for preventive maintenance and spare parts that often need replacement, such as electron multipliers for GC/MS systems and consumables such as ferrules and septa.

In the case of a downed instrument, the problem is diagnosed as quickly as possible. If necessary, replacement parts are ordered and repairs performed by skilled in-house personnel. Key instrumentation is maintained under service contract. As a third option, a service call is placed with the manufacturer.

Instrument problems and repairs are documented in logbooks kept in each laboratory; an example is given in Figure 8-2.

Figure 8-1. GC/MS ROUTINE INSTRUMENT MAINTENANCE FOR SEMIVOLATILES

Date	Operator/ Witness	Instrument ID	Septum Changed	Liner Changed	New O-Ring	Column Maintenance Front End	Comments	System In Control
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							
	/							

Figure 8-2 GC/MS NON-ROUTINE INSTRUMENT MAINTENANCE

Instrument: _____ Problem Site: _____

Date Reported: _____ By: _____ GC _____

Date Resolved: _____ By: _____ Gas Line _____

Comments on Repair: _____ Detector _____

_____ Other (Describe) _____

Description of Problem:

Resolution:

9.0 ANALYTICAL PROCEDURES

Ceimic is a full-service laboratory that provides a wide range of environmental analytical services for analysis of soil, hazardous waste, waste water, and drinking water samples in support of all major environmental regulations. These services include most organic, inorganic, and classical chemistry sample analyses. These services include most organic, inorganic, and classical chemistry sample analyses. Ceimic perform EPA CLP methods and most SW-846 and EPA analysis methods. In addition, selected Standard Methods and ASTM analysis methods also utilized.

The summary of analytical methods used by Ceimic is presented in Table 9-1. In addition, Ceimic will use other methodology as required by the specific project or contract. The following is a list of documents which provide the reference methods:

- U.S. EPA Office of Solid Waste SW-846, "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods."
- U.S. EPA EMSL-CI 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes."
- U.S. EPA Contract Lab Program, "Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration," OLMO3.2 and OLM04.1
- U.S. EPA Contract Lab Program, "Statement of Work for Organic Analysis, Low Concentration Water" OLC02.1
- U.S. EPA Contract Lab Program, "Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration," ILMO4.0.
- U.S. EPA Office of Drinking Water, "Methods for the Determination of Organic Compounds in Drinking Water."
- American Society for Testing and Materials, "Annual Book of ASTM Standards."
- American Public Health Association, "Standard Methods for the Examination of Water and Wastewater."

Analytical methods are reviewed and approved by the Lab Manager and the QA/QC Officer prior to use in project activities. Prior to use of any analytical method, the laboratory demonstrates the capability of performing the method by analysis of a precision and accuracy study and comparing the results of this study to the expected results described by the method. Prior to analyzing samples, the laboratory will perform an MDL study as described in section 11.0. The Lab Supervisor maintains the documentation of method capability data. The documentation of the MDL studies is stored in the QA files and maintained by the QA Officer.

The laboratory routinely uses the most recently promulgated version of a method unless requested to use a previous version. New method revisions should be adopted within 6 months of promulgation for use in new projects. The laboratory will not change the method used for a project in progress unless specifically requested to do so. The laboratory specifies which revision of a method will be used for a particular project in the proposal/quote for that project.

Any procedure modifications will require additional precision, accuracy, and detection limit data, either to demonstrate that the previous data are valid or to develop new data applicable to the new procedure. Major modifications of any methods must be approved by the client. Regional EPA approved and client approved method variances are documented in the case narrative to the client.

9.1 ANALYTICAL BATCHES

The Internal Coordinator is responsible for assigning the specific QC samples such as MS/MSD or duplicate/spike sampls to each batch of field samples. The Lab Supervisor is responsible for ensuring that all samples in an SDG are prepared and analyzed in a single batch. A batch is defined as a group of samples of similar matrix, not to exceed 20, that are processed as a unit with the same method sequence and the same lots of reagents and standards. Other required QC checks are assigned by the Lab Supervisor as specified by the applicable SOP. All laboratory QC checks are uniquely identified by analysis, date, and batch number.

Table 9-1. Analytical Methods

Parameter	Method				
	EPA CLP	Waste Water	Drinking Water	SW846	Standard Methods
INORGANICS					
Acidity		305.1			
Alkalinity		310.1			
Ammonia (as N)		350.2			
Biochemical Oxygen Demand		405.1			5210 B
Bromide					4500-Br^- B
Chemical Oxygen Demand		410.4			5220 D
Chloride		325.3		9252	4500-Cl^- B
Chlorine (Total Residual)		330.5			4500-Cl G
Color		110.2			2120 B
Cyanide (Total & Amenable)	ILM04.0	335.2		9010	4500-CN^- C
Fluoride		340.2			4500-F^- C
Hardness					2340 B
Kjeldahl and Organic Nitrogen		351.3			4500-N_{org} C
Chromium, Hexavalent				7196	3500-Cr D
Mercury	ILM04.0	245.2		7470/7471	
Metals (Except Chromium VI & Hg)	ILM04.0	200.9 200.7		7000 Series 6010A	
Nitrate-Nitrite (NO_3 - NO_2)		353.3			4500-NO_3^- E
Nitrite (NO_2-N)		353.3			
Oil & Grease		413.1		9070	
Orthophosphate		365.2			4500-P E
Oxygen, Dissolved		360.1,360.2			
pH		150.1		9040/9045	

Table 9-1. Analytical Methods

Parameter	Method				
	EPA CLP	Waste Water	Drinking Water	SW846	Standard Methods
Phosphate (Total)		365.2			4500-P E
Phenols (Total)		420.1		9065	
Solids (Total) TS		160.3			2540 B
Solids (Filterable) - TDS		160.1			2540 C
Solids (Non-Filterable) TSS		160.2			2540 D
Solids (Settleable)		160.5			2540 F
Solids (Volatile) - TVS		160.4			2540 E
Specific Conductance		120.1		9050	2510 B
Sulfate		375.4		9038	4500-SO_4^{2-} E
Sulfide		376.2		9030	4500-S^{2-} D
Sulfite		377.1			4500-SO_3^{2-} B
Surfactants (MBAS)		425.1			5540 C
Turbidity		180.1			2130 B
ORGANICS					
Purgeable Halocarbons				8260	
Purgeable Aromtic Hydrocarbons				8021, 8260	
Acrolein & Acrylonitrile				8030, 8260	
Volatile Organics	OLM04.1		524.2	8260	
Nonhalogenated Volatile Organics				8015M, 8260	
Phenol				8040	
EDB & DBCP			504	8011	
Polynuclear Aromatic Hydrocarbons (PAH)				8270, 8310	
Pesticides, PCBs	OLM04.1			8081, 8082	

Table 9-1. Analytical Methods

Parameter	Method				
	EPA CLP	Waste Water	Drinking Water	SW846	Standard Methods
Herbicides			515.1	8151	
Semivolatile Organics	OLM04.1			8270	
Total Organic Carbon (TOC)		415.1		9060	
Total Organic Halogens (TOX) (EOX in soil)				9020	
Total Petroleum Hydrocarbons (TPH)				8015B	
Total Recoverable Petroleum Hydrocarbons (TRPH)		418.1			
HAZARDOUS WASTE					
TCLP Extraction				1310/1311	
TCLP Volatiles				8260	
TCLP Semivolatiles				8270	
TCLP Pesticides				8081, 8082	
TCLP Herbicides				8151	
TCLP Metals				6010	
Ignitability				1010	
Corrosivity (pH)				9040/9045	
Reactivity				S 7.3.4.2	

Table 9-2 SAMPLE PREPARATION METHODS

Preparative Method	Description	Analytical Method
3005	Acid Digestion of Water Samples for Metals Analysis	6010, 7000 series
3010*	Acid Digestion of Aqueous Samples and Extracts for Metals Analysis	6010, 7000 series
3020	Acid Digestion of Aqueous Samples and Extracts for Metals Analysis	6010, 7000 series
3050	Acid Digestion of Solids, Sediments, and Sludges for Metals Analysis	6010, 7000 series
3510	Separatory Funnel Liquid-Liquid Extraction	8081, 8082, 8270, 8310
3520*	Continuous Liquid-Liquid Extraction	8270
3540*	Soxhlet Extraction	8081, 8082, 8270
3550	Ultrasonic Extraction	8081, 8082, 8270, 8310
5030	Purge and Trap Method	8021, 8260
5035	Closed-System Purge and Trap	8260

Methods marked with an * can be performed upon client request. If sample preparation method is not specified, Ceimic will prepare samples using methods 3005, 3050, 3510 or 3550, as appropriate.

10.0 CALIBRATION PROCEDURES AND FREQUENCY

10.1 INSTRUMENTS

Instrument calibration establishes that the system is functioning correctly and at a level of sensitivity sufficient to meet required detection limits. Routine calibration provides a means of rapid detection of instrument variance and possible malfunction, ensuring that data quality is maintained. Specific calibration and check procedures are given in the analytical methods referenced in Section 9 and in the corresponding SOPs. Frequency of calibration and concentration of standards are determined by the cited methods and special contract requirements, as well as manufacturer recommendations.

Standard calibration curves of signal response versus concentration are generated on each analytical instrument used for a project prior to analysis of samples. A calibration curve of the appropriate linear range is established for each parameter that is included in the analytical procedure employed and is verified on a regular basis with check standards. Ceimic adheres to the calibration criteria specified by the USEPA methodology for both organics and inorganics. The following are examples of calibration procedures for various instrument systems. These are typical examples only. For the specific calibration requirements of the method of interest refer to the appropriate method SOP.

10.1.1 Gas Chromatography

10.1.1.1 CLP analyses

For CLP analyses, an initial calibration is performed using three different concentration levels for each parameter of interest. The % RSD of the calibration factors must be less than 20%. A continuing calibration takes place once every twelve hours throughout the analytical sequence. The percent difference in calibration factors for each of the continuing calibration compounds must not exceed 20%. The retention time of each compound must not exceed ± 0.05 min. for the early eluting compounds and ± 0.07 min. for the later eluting compounds of the average of the retention times in the initial calibration. Additionally, breakdown of Endrin and 4,4'-DDT in the Performance Evaluation Mix (PEM) must not exceed 20%. Combined breakdown of Endrin and 4,4'-DDT must not exceed 30%. Refer to method speciifc SOPs for specific QC requirements.

10.1.1.2 SW846 analyses

For SW846 analyses, an initial calibration is performed using a minimum of five different concentration levels for each parameter of interest. The %RSD must be less than 20%. Following initial calibration, a second source calibration standards are analyzed. A second source standard is

a standard purchased from a different vendor than the standards used for the calibration. The results of the second standard analysis must be within 15% of the expected value.

A continuing calibration with a mid level standard takes place once every ten samples. The percent difference in calibration factors for each of the compounds must not exceed ± 15%. The retention time of each compound must be calculated by multiplying by three the standard deviations of three analyses of each analyte analyzed throughout the course of a 72 hour period. Additionally, breakdown of Endrin and DDT in the Performance Evaluation Mix (PEM) must not exceed 15%.

Refer to the appropriate method SOPs and the reference method for specific QC requirements.

10.1.2 Gas Chromatography/Mass Spectrometry (CLP and SW846 analyses)

Initial calibration at a minimum of five different concentration levels for each analyte is carried out for each system. % RSD must be less than 30% for the specified Calibration Check Compounds (CCC) and less than 15% for all other calibration compounds (20% for CLP). System Performance Check Compounds (SPCC) and target compounds must also meet minimum relative response factor criteria, as specified in the method. Refer to the SOP for the specific method of interest for additional information.

Initial calibration response curve is calculated using average response factors, but linear regression might be used for target analytes for which the % RSD exceeds 15%. Following initial calibration, a second source calibration standards are analyzed. A second source standard is a standard purchased from a different vendor than the standards used for the calibration. The results of the second standard analysis must be within 25% of the expected value.

Recalibration takes place whenever a major change occurs in the system, such as a column change in the GC or a source cleaning of the mass spectrometer. Continuing calibrations take place every twelve hours of instrument analysis time and must have a percent difference or percent drift of 20% (25% for CLP methods) or less for calibration check compounds.

Prior to analysis of any samples, QC samples, or standards, GC/MS systems are tuned to USEPA specifications for BFB and DFTPP for volatile and semi-volatile analyses, respectively. Refer to the SOP for the method of interest for the specific tune requirements. Verification of tuning criteria as specified in the appropriate SOP occurs every twelve hours of instrument run time.

Each sample is spiked with an internal standard to verify instrument response. The internal standard recovery must be between -50% to +100% of the internal standard area in the calibration standard. Refer to the appropriate method SOPs for specific QC requirements.

10.1.3 Inductively Coupled Plasma (ICP)

10.1.3.1 CLP analyses

A linear range is determined on the ICP quarterly. The measured concentration of the high level standard must be within 5% of the true value. At the beginning of each daily run the instrument is calibrated with a blank and high concentration of each standard. The Independent Check Standard from a second source is then analyzed to verify the calibration. This must be within 10% of the true value. Calibration check standards are analyzed at the beginning of the sequence and once every ten samples to verify instrument calibration. If the calculated concentration of the check standard deviates by more than 10% from the true value, the instrument must be returned to control. Interelement correction factors are calculated annually or more frequently. The interference check standards are run at the beginning and end of each batch of samples to verify interference calibration factors in common problem elements. The known values must be ±20% of the true values. Refer to SOP No. I22 for specific QC requirements.

10.1.3.2 SW846 analyses

At the beginning of each daily run the instrument is calibrated with a blank and 3 concentrations of each element. The high standard is then analyzed to verify the precision of the calibration. This standard must be within 5% of the true value. The Independent Check Standard from a second source is then analyzed to verify the calibration. This must be within 10% of the true value. After every 10 samples, the calibration check standard is analyzed. This must be within 10% of the true value. Refer to SOP No. 6010 for specific QC requirements.

10.1.4 Graphite Furnace Atomic Absorption

A blank and three standards at different concentrations are analyzed to establish the initial calibration curve for each metal. A calibration check standard is analyzed at the beginning and end of every analysis and after every ten samples to verify the calibration of the instrument. If a check standard falls outside the control limit of ±10% from the initial calibration, the instrument must be returned to control. Refer to SOP No. 7000 for specific QC requirements.

10.1.5 Cold Vapor Atomic Absorption

A blank and five standards at different concentrations are analyzed to establish the initial calibration curve for each metal. A calibration check standard is analyzed at the beginning and end of every analysis and after every ten samples to verify the calibration of the instrument. If a check standard falls outside the control limit of ±10% from the initial calibration, the instrument must be returned to control. Refer to the method SOP for specific QC requirements.

10.1.6 Cyanide Analysis.

A multipoint calibration curve (six calibration standards and a calibration blank) is used. In addition, one low and one high concentration distilled standards have to analyzed for each calibration. Second source calibration verification analysis takes place once per stock standard preparation.

Any instrument that does not meet these calibration requirements is considered out of control. The instrument must be maintained as specified in the appropriate SOP to bring it back in control. All samples affected by the out of control situation must be reanalyzed.

10.2 ANALYTICAL BALANCES

The calibration of the analytical balances are verified daily with ASTM Class 1 weights (which are equivalent to Class "S" weights. If the calibration shows a deviation of >0.01 g, the balance is recalibrated using auto-calibration. The Class 1 weights are recertified annually to be NIST traceable. The balances are inspected and serviced annually by All State Scale Company, Springfield, MA.

10.3 REFRIGERATORS

The temperature of sample storage refrigerators is checked daily, seven days a week. The acceptance criteria are 4°C ± 2°C. The thermometers used to measure the refrigerator temperature are calibrated annually against an NIST traceable thermometer.

10.4 DRYING OVENS

The temperature of drying ovens is recorded when samples are put into the drying oven and again when the samples are removed from the drying oven. The required temperature varies depending upon the analytical method employed. Refer to the appropriate Standard Operating Procedure for specifications.

10.5 BOD INCUBATOR

The BOD incubator must be maintained at 20°C ± 1°C. The thermometer used to measure the temperature of the BOD incubator is calibrated annually against an NIST traceable thermometer.

11.0 DETECTION LIMITS AND REPORTING LIMITS

Instrument detection limits (IDLs) are determined for each instrument used in the analysis of metals. Method detection limits (MDLs) are determined for each method, by matrix. Reporting limits (RLs) are determined from the Method detection limits along with the professional judgement of the analyst experienced with the particular analyte and method. Ceimic MDLs should be less than one half of the RLs.

The laboratory uses the terms Reporting Limit (RL) and Practical Quantitation Limit (PQL) interchangeably, based on the terminology used in the project specifications.

11.1 DETECTION AND QUANTITATION LIMITS FOR INORGANICS

Instrument detection limits are determined by multiplying by 3.143 the average of the standard deviations obtained on three non-consecutive days from the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x - 5x the estimated IDL, with seven consecutive measurements per day. Each measurement is performed as a separate analytical sample; that is, each measurement is followed by a rinse. IDLs are determined as specified in the CLP inorganic statement of work, ILM04.0, and the procedure is repeated every calendar quarter.

Method detection limits are determined annually according to the procedures published in the Appendix B to part 136 of the Federal Register and as described in details in SOP No. Q02. To be considered acceptable, the MDLs must not deviate greater than ten times the method MDLs and must be less than one-half times the project-required RLs.

The reporting limits used by the laboratory for CLP deliverables are the Contract Required Detection Limits (CRDL) presented in the USEPA "Statement of Work for Inorganic Analysis", ILM04.0.

The Reporting Limits (RLs) or Practical Quantitation Limits (PQLs) for other analyses are determined from the method detection limit. Generally, the method reporting limit should be greater than 2 times the method detection limit, at a minimum.

Typical Practical Quantitation Limits for metal analysis using SW-848 methodology are shown in Table 11-1.

11.2 DETECTION AND QUANTITATION LIMITS FOR ORGANICS

The method detection limits are determined for all applicable organic methods according to the procedures published in the Appendix B to 40 CFR part 136 of the Federal Register and described in detail in SOP No. Q02. Seven to ten samples are spiked with all the analytes of interest at a concentration 3-5 times the estimated detection limit. The samples are carried through the extraction or preparation process and analyzed. The method detection limit is determined by multiplying the appropriate statistical Student's t-

value (3.143 for seven replicates) by the standard deviations of the analyzed replicate samples. The MDL is determined annually on the instrument, matrix and method basis. To be considered acceptable, the MDLs must not deviate greater than ten times the method MDLs and must be less than one-half of the project-required RLs.

The reporting limits used by the laboratory for CLP deliverables are the Contract Required Quantitation Limits presented in the USEPA "Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration", OLM03.2.

The Reporting Limits (RLs) or Practical Quantitation Limits (PQLs) for other analyses are determined from the method detection limit and the professional experience of the analyst with that particular analyte. Generally, the method reporting limit should be greater than 2 times the method detection limit, at a minimum. Typical Practical Quantitation Limits for organic analyses using SW846 mehods are shown in Table 11-2.

Table 11-1. TYPICAL CEIMIC PQLs FOR METALS AND INORGANIC ANALYSES

Analytical Method	Analyte	PQL	
		Water (mg/L)	Soil (mg/kg)
Metals by ICP SW6010	Aluminum	0.2	20.0
	Antimony	0.05	5.0
	Arsenic	0.03	3.0
	Barium	0.005	0.5
	Beryllium	0.005	0.5
	Cadmium	0.007	0.7
	Calcium	1.0	100.0
	Chromium	0.01	1.0
	Cobalt	0.006	0.6
	Copper	0.01	1.0
	Iron	0.20	20.0
	Lead	0.025	2.5
	Magnesium	0.10	100.0
	Manganese	0.004	0.4
	Molybdenum	0.015	1.5
	Nickel	0.01	1.0
	Potassium	0.50	50.0
	Selenium	0.03	3.0
	Silver	0.01	1.0
	Sodium	0.5	20.0
	Thallium	0.08	8.0
	Vanadium	0.01	1.0
	Zinc	0.01	1.0
SW7041	Antimony	0.005	0.5
SW7060	Arsenic	0.005	0.5
SW7131A	Cadmium	0.001	0.1
SW7191	Chromium	0.005	0.5
SW7421	Lead	0.005	0.5
SW7470A/SW7471A	Mercury	0.001	0.1
SW7740	Selenium	0.005	0.5
SW7196A	Hexavalent Chromium	0.02	1.0
SW9010A/SW9012	Total Cyanide	0.01	
Common Anions SW9056	Bromide	0.05	0.5
	Chloride	0.10	1.0
	Fluoride	0.10	1.0
	Nitrate	0.10	1.0
	Nitrite	0.10	1.0
	Phosphate	0.10	1.0
	Sulfate	0.10	1.0

Table 11-2. TYPICAL CEIMIC PQLs FOR ORGANIC ANALYSES

Analytical Method	Analyte	PQL	
		Water (µg/L)	Soil (µg /kg)
Organochlorine Pesticides and PCBs SW8081/8082	α-BHC	0.05	1.7
	β-BHC	0.05	1.7
	δ-BHC	0.05	1.7
	γ-BHC (Lindane)	0.05	1.7
	α-Chlordane	0.05	1.7
	γ-Chlordane	0.05	1.7
	4,4'-DDD	0.10	3.3
	4,4'-DDE	0.10	3.3
	4,4'-DDT	0.10	3.3
	Aldrin	0.05	1.7
	Dieldrin	0.10	3.3
	Endosulfan I	0.05	1.7
	Endosulfan II	0.10	3.3
	Endosulfan Sulfate	0.10	3.3
	Endrin	0.10	3.3
	Endrin Aldehyde	0.10	3.3
	Heptachlor	0.05	1.7
	Heptachlor Epoxide	0.05	1.7
	Methoxychlor	0.50	17
	PCB-1016	1.00	33
	PCB-1221	2.00	67
	PCB-1232	1.00	33
	PCB-1242	1.00	33
	PCB-1248	1.00	33
	PCB-1254	1.00	33
	PCB-1260	1.00	33
	Toxaphene	5.00	170
Chlorinated Phenoxy Acid Herbicides SW8151	2,4-D	1.0	20
	2,4-DB	1.0	20
	2,4,5-T	0.1	2
	2,4,5-TP	0.1	2
	Dalapon	2.5	50
	Dicamba	0.1	2
	Dichloroprop	1.0	20
	Dinoseb	0.5	10
	MCPA	100	2000
	MCPP	100	2000

Table 11.2 cont'd

Parameter/Method	Analyte	PQL	
		Water (µg/L)	Soil (mg/kg)
VOCs	1,1,1,2-Tetrachloroethane	1.0	0.005
SW8260	1,1,1-TCA	1.0	0.005
(25ml purge for water)	1,1,2,2-Tetrachloroethane	1.0	0.005
	1,1,2-TCA	1.0	0.005
	1,1-DCA	1.0	0.005
	1,1-DCE	1.0	0.005
	1,1-Dichloropropene	1.0	0.005
	1,2,3-Trichlorobenzene	1.0	0.005
	1,2,3-Trichloropropane	1.0	0.005
	1,2,4-Trichlorobenzene	1.0	0.005
	1,2,4-Trimethylbenzene	1.0	0.005
	1,2-DCA	1.0	0.005
	1,2-DCB	1.0	0.005
	1,2-Dibromo-3-	1.0	0.005
	1,2-Dichloropropane	1.0	0.005
	1,2-EDB	1.0	0.005
	1,3,5-Trimethylbenzene	1.0	0.005
	1,3-DCB	1.0	0.005
	1,3-Dichloropropane	1.0	0.005
	1,4-DCB	1.0	0.005
	1-Chlorohexane	1.0	0.005
	2,2-Dichloropropane	1.0	0.005
	2-Butanone	5.0	0.025
	2-Chlorotoluene	1.0	0.005
	2-Hexanone	5.0	0.025
	4-Chlorotoluene	1.0	0.005
	4-Methyl-2-pentanone	5.0	0.025
	Acetone	5.0	0.025
	Benzene	1.0	0.005
	Bromobenzene	1.0	0.005
	Bromochloromethane	1.0	0.005
	Bromodichloromethane	1.0	0.005
	Bromoform	1.0	0.005
	Bromomethane	1.0	0.005
	Carbon tetrachloride	1.0	0.005
	Chlorobenzene	1.0	0.005
	Chloroethane	1.0	0.005
	Chloroform	1.0	0.005
	Chloromethane	1.0	0.005
	Cis-1,2-DCE	1.0	0.005
	Cis-1,3-Dichloropropene	1.0	0.005
	Dibromochloromethane	1.0	0.005
	Dibromomethane	1.0	0.005
	Dichlorodifluoromethane	1.0	0.005
	Ethylbenzene	1.0	0.005
	Hexachlorobutadiene	1.0	0.005
	Isopropylbenzene	1.0	0.005

Table 11.2 cont'd

Parameter/Method	Analyte	PQL	
		Water (µg/L)	Soil (mg/kg)
VOCs SW8260 (concluded)	Methylene chloride	1.0	0.005
	m, p-Xylenes	1.0	0.005
	n-Butylbenzene	1.0	0.005
	n-Propylbenzene	1.0	0.005
	Naphthalene	1.0	0.005
	o-Xylene	1.0	0.005
	p-Isopropyltoluene	1.0	0.005
	Sec-Butylbenzene	1.0	0.005
	Styrene	1.0	0.005
	TCE	1.0	0.005
	Tert-Butylbenzene	1.0	0.005
	Tetrachloroethene	1.0	0.005
	Toluene	1.0	0.005
	Trans-1,2-DCE	1.0	0.005
	Trans-1,3-Dichloropropene	1.0	0.005
	Trichlorofluoromethane	1.0	0.005
	Vinyl chloride	1.0	0.005
Semivolatile organics Base/Neutral SW8270B	1,2,4-Trichlorobenzene	10.0	0.33
	1,2-DCB	10.0	0.33
	1,3-DCB	10.0	0.33
	1,4-DCB	10.0	0.33
	2,4-DNT	10.0	0.33
	2,6-DNT	10.0	0.33
	2-Chloronaphthalene	10.0	0.33
	2-Methylnaphthalene	10.0	0.33
	2-Nitroaniline	40.0	1.33
	2,2'-oxybis (1-	10.0	0.33
	3-Nitroaniline	40.0	1.33
	3,3'-Dichlorobenzidine	20.0	0.67
	4-Bromophenyl phenyl ether	10.0	0.33
	4-Chloroaniline	20.0	0.67
	4-Chlorophenyl phenyl ether	10.0	0.33
	4-Nitroaniline	40.0	1.33
	Acenaphthylene	10.0	0.33
	Acenapthene	10.0	0.33
	Anthracene	10.0	0.33
	Azobenzene	10.0	0.33
	Benzidine	10.0	0.33
	Benz (a) anthracene	10.0	0.33
	Benzo (a) pyrene	10.0	0.33
	Benzo (b) fluoranthene	10.0	0.33
	Benzo (k) fluoranthene	10.0	0.33
	Benzo (g,h,i) perylene	10.0	0.33
	Benzyl alcohol	20.0	0.67
	Bis (2-chloroethoxy)	10.0	0.33
	Bis (2-chlorethyl) ether	10.0	0.33

Table 11.2 cont'd

Parameter/Method	Analyte	PQL	
		Water (µg/L)	Soil (mg/kg)
Semivolatile organics Base/Neutral SW8270 (concluded)	Bis (2-chloroisopropyl) ether	10.0	0.33
	Bis (2-ethylhexyl) phthalate	10.0	0.33
	Butyl benzylphthalate	10.0	0.33
	Carbazole	10.0	0.33
	Chrysene	10.0	0.33
	Di-n-butylphthalate	10.0	0.33
	Di-n-octylphthalate	10.0	0.33
	Dibenz (a,h) anthracene	10.0	0.33
	Dibenzofuran	10.0	0.33
	Diethyl phthalate	10.0	0.33
	Dimethly phthalate	10.0	0.33
	Fluoranthene	10.0	0.33
	Fluorene	10.0	0.33
	Hexachlorobenzene	10.0	0.33
	Hexachlorobutadiene	10.0	0.33
	Hexachlorocyclopentadiene	10.0	0.33
	Hexachloroethane	10.0	0.33
	Indeno(1,2,3-cd)pyrene	10.0	0.33
	Isophorone	10.0	0.33
	N-nitrosodiphenylamine	10.0	0.33
	N-nitroso-n-propylamine	10.0	0.33
	Naphthalene	10.0	0.33
	Nitrobenzene	10.0	0.33
	Phenanthrene	10.0	0.33
	Pyrene	10.0	0.33
Semivolatile organics Acid Extractables SW8270	2,4,5-Trichlorophenol	40.0	1.33
	2,4,6-Trichlorophenol	10.0	0.33
	2,4-Dichlorophenol	10.0	0.33
	2,4-Dimethylphenol	10.0	0.33
	2,4-Dinitrophenol	40.0	1.33
	2-Chlorophenol	10.0	0.33
	2-Methylphenol	10.0	0.33
	2-Nitrophenol	10.0	0.33
	4,6-Dinitro-2-methylphenol	40.0	1.33
	4-Chloro-3-methylphenol	20.0	0.67
	4-Methylphenol	10.0	0.33
	4-Nitrophenol	40.0	1.33
	Benzoic acid	10.0	0.33
	Pentachlorophenol	40.0	1.33
	Phenol	10.0	0.33

Table 11.2 concluded.

Parameter/Method	Analyte	PQL	
		Water (µg/L)	Soil (mg/kg)
Polynuclear Aromatic Hydrocarbons SW8310	Acenaphthene	0.5	0.015
	Acenaphthylene	1.0	0.03
	Anthracene	0.05	0.0015
	Benzo (a) anthracene	0.05	0.0015
	Benzo (a) pyrene	0.05	0.0015
	Benzo (b) fluoranthene	0.1	0.003
	Benzo (g,h,i) perylene	0.1	0.003
	Benzo (k) fluoranthene	0.05	0.0015
	Chrysene	0.05	0.0015
	Dibenzo (a,h) anthracene	0.1	0.003
	Fluoranthrene	0.1	0.003
	Fluorene	0.1	0.003
	Indeno (1,2,3-c,d) pyrene	0.05	0.0015
	Naphthalene	0.5	0.015
	Phenanthrene	0.05	0.0015
	Pyrene	0.05	0.0015
Explosive Residues SW8330	1,3,5- TNB	0.5	0.25
	1,3- DNB	0.5	0.25
	2,4,6- TNT	0.5	0.25
	2,4-DNT	0.5	0.25
	2,6-DNT	0.5	0.25
	HMX	0.5	0.25
	m-Nitrotoluene	0.5	0.25
	Nitrobenzene	0.5	0.25
	o-Nitrotoluene	0.5	0.25
	p-Nitrotoluene	0.5	0.25
	RDX	0.5	0.25

12.0 ANALYSIS OF QC SAMPLES AND DOCUMENTATION

Ceimic analytical and field QC procedures are based on sound quality control methodology, which derives from three primary sources:

1. Standards for Good Laboratory Practice,
2. specific EPA and other approved analytical methods, and
3. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories" (EPA 600/4-79-019).

In the application of established analytical procedures, Ceimic employs, at a minimum, the QC protocols described in the references found in the Analytical Methods section. Quality Control procedures are analyzed on a batch basis. An analytical batch is a numer of samples (not to exceed 20 field samples plus the associated QC samples) of similar composition (matrix) and analyzed sequentially.

Each of the Ceimic laboratories has an individual QC program which includes, but is not limited to, the practices described below:

12.1 GENERAL QC PROTOCOLS

12.1.1 Organics Laboratory

12.1.1.1 Trip blanks and holding blanks, when applicable, to detect contamination during sample shipping, handling, and storage.

12.1.1.2 Method blanks, at a minimum of one per batch, to detect contamination during analysis.

12.1.1.3 One Laboratory Control Sample of laboratory water or soil per batch to determine accuracy.

12.1.1.4 Matrix Spikes and Matrix Spike Duplicates, one (pair) per batch to determine precision and the presence of matrix effects.

12.1.1.5 Calibration verification standards from a second source to verify NIST/A2LA traceability.

12.1.1.6 Instrument Blanks to determine the level of contamination associated with the analytical instruments.

12.1.1.7 Surrogate spikes to determine matrix effects.

12.1.1.8 Internal standard spikes for GC/MS analysis to account for sample-to-sample variation.

12.1.1.9 Initial Calibration of instruments to establish calibration curves.

12.1.1.10 Continuing calibration of instruments.

12.1.1.11 Tuning of GC/MS systems once every 12 hours to EPA specifications for consistency in data generation.

12.1.2 Metals Laboratory

12.1.2.1 One Preparation Blank per batch to detect contamination during sample preparation.

12.1.2.2 One Lab Control Sample of laboratory water or soil per batch to determine accuracy.

12.1.2.3 One Sample Spike per batch to determine accuracy and matrix effects.

12.1.2.4 Method of Standard Additions if analytical post-digestion spike recovery falls outside ±15% control limit for Zeeman AA analyses.

12.1.2.5 One Sample Duplicate per batch to determine precision and matrix effects for AA and ICP analyses.

12.1.2.6 Initial Calibration Verification is run immediately after calibration to verify NIST/A2LA traceability of standards.

12.1.2.7 Calibration Verification Standard is run after every ten (10) samples.

12.1.2.8 Calibration Blank analyzed after every ICV and CCV to determine the level of contamination associated with the analytical instruments.

12.1.2.9 Initial Calibration of instruments to to define the quantitative response, linearity, and dynamic range of the instrument to the target analytes.

12.1.2.9 Control limit of ±10%; recalibration if check standard deviates by more than 10% from true value.

12.1.2.10 Interference Control Sample every 20 samples to check interference correction inaccuracies for ICP analyses.

12.1.3 Classical Chemistry Laboratory

12.1.3.1 One Preparation Blank per sample batch (minimum of 1 per 20 samples) to detect contamination during preparation or analysis.

12.1.3.2 One Laboratory Control Sample of laboratory water or soil every sample batch to determine accuracy.

12.1.3.3 One Sample Spike per batch to determine accuracy and matrix effects.

12.1.3.4 One Sample Duplicate per batch to determine precision and matrix effects.

12.1.3.5 Calibration verification standard from a second source to verify NIST/A2LA traceability

12.1.3.6 Initial calibration to establish calibration curves.

12.1.3.7 Calibration checks to verify calibration as specified in the method.

12.2 DEFINITIONS

12.2.1 A trip blank is a sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

12.2.2 A holding blank or storage blank is reagent water (two 40.0 ml aliquots) stored with samples in an SDG. It is analyzed after all samples in that SDG have been analyzed; and is used to determine the level of contamination acquired during storage.

12.2.3 A method blank or preparation blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

12.2.4 A laboratory control sample is a known matrix spiked with compound(s) representative of the target analytes. This is used to document laboratory performance.

12.2.5 A matrix spike or sample spike is an aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

12.2.6 A matrix spike duplicate is intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

12.2.7 A duplicate is a second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the method.

12.2.8 A calibration verification standard is an analytical standard from an independent source from the initial calibration standards that is analyzed after the initial calibration to verify the NIST/A2LA traceability of the initial calibration standards.

12.2.9 A surrogate spike is a solution of compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard for organics analysis. The surrogate compounds are brominated,

fluorinated, or isotopically labelled compounds not expected to be detected in environmental media. Surrogate spike recovery is used to evaluate analytical efficiency.

12.2.10 An internal standard spike is a solution of compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatiles), and sample extract (for semivolatiles) at a known concentration, prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

12.2.11 An initial calibration is the analysis of analytical standards for a series of different method-specified concentrations. The initial calibration is used to define the linearity and dynamic range of the response of the instrument to the target analytes.

12.2.12 A continuing calibration or daily calibration is an analytical standard run at a method-specified frequency throughout the analytical run to verify the initial calibration of the system.

12.2.13 A tune or instrument performance check is a compound used in GC/MS to establish mass spectral instrument performance. In VOA, the compound is 4-Bromofluorobenzene (BFB). In BNA, the compound is Decafluorotriphenylphos- phine (DFTPP).

12.2.14 An instrument blank is a solvent blank spiked with surrogate designed to determine the level of contamination associated with the analytical instruments.

12.2.15 The method of standard additions is the addition of 3 increments of a standard solution (spikes) to sample aliquots of the same size. Measurements are made on the original and after each addition. The slope, x-intercept and y-intercept are determined by least-square analysis. The analyte concentration is determined by the absolute value of the x-intercept. Ideally, the spike volume is low relative to the sample volume (approximately 10% of the volume). Standard addition may counteract matrix effects; it will not counteract spectral effects. Also referred to as Standard Addition.

12.2.16 An interference check sample (ICS) consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents (Al, Ca, Fe, Mg) and solution AB consists of the analytes mixed with the interferents. Analysis of the ICS is used to verify interelement and background correction factors.

12.2.17 A calibration blank is a volume of acidified deionized/distilled water designed to determine the level of contamination associated with the analytical instruments.

12.2.18 Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the

variability associated with duplicate (two) or replicate (more than two) analyses. The precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results.

12.2.19 Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a Lab Control Sample to a control limit.

12.3 EVALUATION CRITERIA FOR BLANKS

12.3.1 Metals

An initial calibration blank, continuing calibration blank, and a method blank (reagent blank) are prepared and analyzed with every batch of samples. The method blank is processeed through the entire digestion procedure with the samples. The ICB and CCB are the acidified reagent blanks. The CCB sample is analyzed at a frequency of one per ten samples. IF GFAA analysis is required, the method blank is analyzed and a post spike analysis will be performed on the method blank to evaluate the matrix recovery.

The method and calibration blanks should have no analytes present at or above the PQL.

12.3.2 Organics

A method blank consists of reagent water in a volume approximate to the samples being analyzed. One blank is processed through sample preparation and analysis with each analytical batch. Method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are minimized. The concentration of target analytes in a method blank must be below the PQL for this analyte. If the method blank exceeds the acceptance criteria, the analytical system is out of control and the source of the problem is investigated. Corrective action is employed and documented before analysis is continued. All samples processed with an out-of-control blank are reextracted, repurged, and reanalyzed. If the corrective action and reextraction and reanalysis were not effective, all associated sample data has to be flagged.

12.4 EVALUATION CRITERIA FOR LAB CONTROL SAMPLES

Each time a preparation blank is prepared, a Laboratory Control Sample (LCS) is also prepared by spiking a known concentration of a representative number of analytes into

$$\%\,\text{Recovery} = \frac{\text{LCS Concentration}}{\text{Concentration Spiked}} \times 100\%$$

The % Recovery must be within the control limits calculated from the historical data by the laboratory. If the LCS recovery is outside the control limits, the analytical system is out of control and the source of the problem is investigated. Corrective action is employed and documented before analysis is continued. Samples associated with an out of control LCS must be reextracted or redigested and reanalyzed.

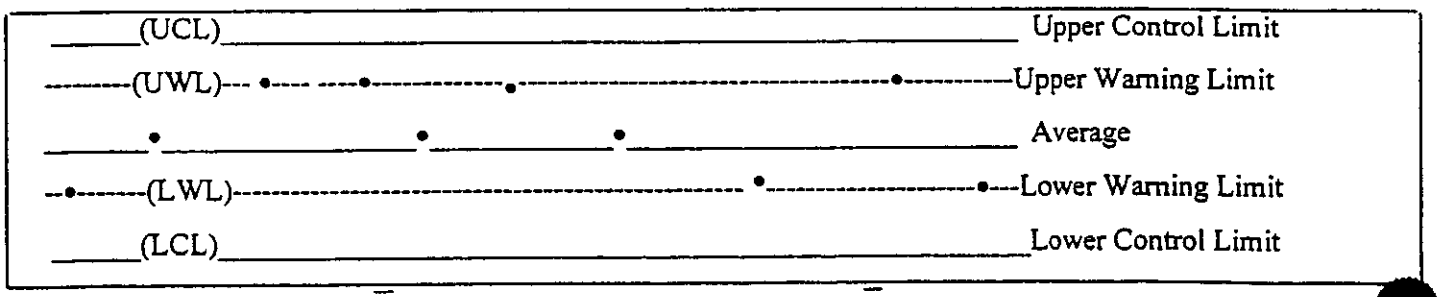
12.4.1 Laboratory Control Limits

Statistically derived laboratory control limits are calculated and updated annually based on the last 20 LCS recoveries generated on a method and matrix basis. Specific procedures for generation, approval and utilization of control limits are given in SOP No. Q09. Control limits must fall within the method specified limits, or the laboratory's procedure must be reviewed to determine why these limits are not being achieved. While the new control limits are being recalculated, the laboratory will use the acceptance criteria specified in the reference methods. New control limit calculations must be approved by the Lab Director and QA/QC Officer prior to use in the laboratory.

12.4.2 Control Charts

Control charts are used to monitor the day-to-day variation in the analyses routinely performed by the laboratory and are intended to detect trends in these variations. Construction of a control chart requires a database of at least 20 points. As shown in the following figure, the date of analysis is plotted on the horizontal axis against the percent recoveries of target analytes spiked into the LCSs. The limits shown on the chart are used as criteria for action. The central line represents the average value of the statistical measure being plotted.

ESSENTIAL OF A CONTROL CHART



Control Limit = $\bar{X} \pm 3 * SD$ Warning Limit = $\bar{X} \pm 2 * SD$

Ceimic employs a measurement control program that monitors the results of laboratory and analysis of control samples using statistical control charts. Two specific types of control samples

will be utilized in the generation of the laboratory control limits and control charts: spiked laboratory blank water and spiked blank soil. The blank water spike is analyte-free laboratory water, which will be spiked with the analyte(s) of interest, as specified in the SOP. The blank soil spike is obtained by using blank sand or other suitable matrix which is spiked with the analyte(s) of interest. The blank sand is stored at ambient temperature in a controlled access room until it is needed for analysis.

The spike solutions utilized for both the water and soil spikes are prepared as are other standard and spiking solutions in the laboratory and added to the blank water or soil at sample preparation or analysis.

A laboratory control sample shall be introduced into each batch of aqueous or soil samples analyzed. A batch will be defined by the number of samples grouped together for QC purposes; not to exceed 20 environmental samples. The warning and control limits will be established using the calculations in the following table using the last 20 or more data points.

12.4.3 Out-of-Control Events

The majority of the points are expected to fall within the bounds of the UWL and LWL, and then the process is considered in control. Whenever the % Recovery for an analyte falls outside the control limits, then the process is considered out of control. Upon correcton of the problem, appropriate action specified in method SOPs must be followed. The most common corrective action in response to the LCS recoveries exceeding the acceptance criteria consists of the reanalysis of that LCS and the entire analytical batch or, if this fails, repreparation and reanalysis of the LCS and all associated samples.

13.0 OUT-OF-CONTROL EVENTS AND CORRECTIVE ACTION

13.1 OUT-OF-CONTROL EVENTS

An out-of-control event is defined when the necessary QC criteria for method blanks, lab control samples, duplicates, surrogates, internal standards, tunes, continuing calibration verifications, etc. is outside of the acceptance limits. For example, if a Lab Control Sample result is outside of the control limits, an out-of-control event is defined. All out-of-control events require that corrective action be implemented to return the analytical system to control.

13.2 CORRECTIVE ACTION

An essential element of the QA Program, Corrective Action provides systematic, active measures to be taken in the resolution of problems and the restoration of analytical systems to control. Corrective actions for laboratory problems are described in Ceimic Standard Operating Procedures (SOPs). Personal experience often is most valuable in alerting the bench scientist to suspicious results or malfunctioning equipment. Specific QC procedures are designed to help analysts determine the need for corrective actions (see Section 14.0, "Data Reduction, Validation, and Reporting"). Corrective actions taken in the laboratory help to avoid the collection of poor quality data.

Examples of conditions that may warrant corrective actions are given below:

1. Tuning or calibration of instruments outside of specifications.
2. QC data for precision and accuracy outside of acceptance limits.
3. Undesirable trends in concentration, surrogate and spike recoveries, response factors, or relative percent difference.
4. Abnormal variation in detection limits.
5. Check sample results out of range.

Problems not immediately detected during the course of analysis may require more formalized, long-term corrective action. The essential steps in the corrective action system are listed below.

1. Identify and define the problem.
2. Assign and accept responsibility for investigating the problem.
3. Investigate and determine the cause of the problem.
4. Determine a corrective action to eliminate the problem.
5. Assign and accept responsibility for implementing the corrective action.
6. Implement the corrective action and establish effectiveness.
7. Document that the corrective action has returned the system to control.

Corrective actions are documented for non-routine out of control situations on the Corrective Action Report (Figure 13-1). A routine out of control situation is defined as one that is noted in the appropriate SOP. Each SOP defines the routine out of control situations and the appropriate corrective action procedures for these situations. All out of control situations that are not addressed in the SOP must be treated as non-routine and documented in the corrective action logbook.

Using the Corrective Action Logbook, any employee may notify the QA/QC Officer of a problem. The QA/QC Officer initiates the corrective action by relating the problem to the appropriate Lab Manager and/or Internal Coordinator, who then investigates or assigns responsibility for investigating the problem and its cause. Once determined, an appropriate corrective action is approved by the QA/QC Officer. Its implementation is verified and documented on the corrective action log and is further documented through audits.

Information contained on Corrective Action Reports is kept confidential within Ceimic and is generally limited to the individuals involved. Severe problems and difficulties may warrant special reports to the President of Ceimic, who will ensure that the appropriate corrective actions are taken.

Figure 13-1 Corrective Action Report

CEIMIC CORPORATION

Corrective Action Form

Name: _____ Date: _____

Out of Control Situation:
(describe what happened, when, where and how, and who discovered the problem):

Client(s):
Samples Affected:
(Reference both Ceimic and Client IDs)

Action Taken:
(If client contacted reference client contact name and date)

Name: _____ Date: _____

Proof of Return to Control:

Supervisor: _____ QA/QC Officer: _____
Date: _____ Date: _____

Corrective Action Tracking #

14.0 DATA REDUCTION AND DATA EVALUATION

14.1 DATA REDUCTION

Instrumental printouts, terminal readings, chromatograms, strip chart recordings, and physical measurements provide raw analytical data that are reduced to concentrations of analytes through the application of appropriate equations. Equations are generally given within the analytical methods referenced in Section 9.0. Data reduction may be performed manually by scientists or automatically by computerized data systems on the instruments.

14.2 DATA VALIDATION

Data validation is an essential element of the QA evaluation component. Validation is the process of data review and subsequent acceptance or rejection based on established criteria. The following requirements are checked by Ceimic in the validation of data:

- Correct Methodologies Used
- Holding times
- Instrument Performance (Tunes, PEMs, etc.)
- Calibration (Initial & Continuing)
- ICP Interference Check Samples (for Metals)
- Blanks
- Lab Control Samples
- Surrogate Recoveries (organics only)
- Duplicate Sample Analyses (for inorganics)
- Matrix Spike/Matrix Spike Duplicates
- ICP Serial Dilution (for metals)
- Method of Std. Additions Used (for metals)
- Internal Standards Performance (GC/MS only)
- Compound Identification/Sample Result Verification
- Compound Quantitation and Reported Detection Limits
- Tentatively Identified Compounds (GC/MS only)

14.3 DATA REPORTING

Interpretation of raw data and calculation of results are performed by a scientist experienced in the analytical methodology. Upon completion of data reduction and self-review, the Lab Analyst initials for the reported results on the data report form. The Lab Supervisor or designee reviews and verifies the results,

laboratory, performs the technical review or may independently review data and completed report forms. The final report is certified and approved by the Lab Director. At a minimum, each data point is checked by two scientists experienced with the analytical methodology. The QA Officer reviews 10% of all complete data packages. Refer to SOP No. O35 for the procedures employed to assure thorough data review.

Records are maintained for all data, even for those results that are rejected as invalid, for a minimum of five (5) year, unless requested by the client to retain the data longer.

14.4 DATA DELIVERABLES

Depending on specific project requirements and data quality objectives (DQOs), different contents of analytical reports (deliverables) may be required. Contents of project deliverables may be specified in the applicable QAPP or, in the absence of a QAPP, discussed with the client prior to accepting analytical work. Ceimic deliverables can be tailored to contain different levels of information concerning analyzed field or QC samples. The routine contents of specific "levels" of analytical reports are briefly summarized below:

Level 2: the summary reports list concentrations of target analytes in tested environmental samples, associated method blanks and LCS along with applicable quantitation (reporting) limits and surrogate recovery summaries (for organic analyses).

Level 3: in addition to data provided in level 2 reports summary calibration data are also supplied.

Level 4: this level of reporting corresponds to the reporting requirements of the USEPA Contract Laboratory Program (CLP). Summary reports (forms) for field and QC samples and calibration standards are provided along with the raw data (i.e. instrument and QC printouts) to permit complete data validation. Internal chain-of-custody documentation is provided upon request.

In addition to hard copy reports Ceimic also produces electronic forms of sample results as Electronic Diskette Deliverables (EDD) in a variety of client-specified formats.

15.0 INTERNAL AUDITS AND APPROVALS FROM OTHER AGENCIES

As a participant in several certification programs and various contracts, Ceimic Corporation is frequently subjected to rigorous performance evaluations and on-site inspections by regulatory agencies and commercial clients. The QA/QC Officer performs routine internal audits of the laboratory as well. The audits ensure that all laboratory systems, including sample control, analytical procedures, data generation, and documentation, meet contractual requirements and comply with good laboratory practice standards.

16.1 SYSTEMS AUDITS

The Director of the Laboratory Approval Program for the Department of Environmental Management (DEM) in the State of Rhode Island has inspected the Ceimic laboratory facilities as part of the Rhode Island certification process. Ceimic passed this inspection and continues to maintain its certification by the State of Rhode Island for both potable and nonpotable water. Ceimic has also been successfully inspected by the U.S. EPA, the Air Force Center for Environmental Excellence (AFCEE), the Naval Facilities Engineering Support Center (NFESC), Army Corps of Engineers (ACOE), and the states of California, Florida, New Hampshire, New York and others.

The QA/QC Officer conducts annual internal audits in order to detect any problems in sample flow, analytical procedures, or documentation and to ensure adherence to the good laboratory practices as described in Ceimic's Standard Operating Procedures (SOPs).

An outline of the procedures employed during internal sustems audits is provided in SOP No. Q05. A three year inspecton cycle is employed to assure that the quality assurance and quality control procedures for all analytical and preparation methods are reviewed in detail by the QA/QC Officer.

16.2 PERFORMANCE AUDITS

Ceimic is also subject to frequent performance evaluations. The USEPA Contract Laboratory Program requires successful performance of pre-award Performance Evaluation samples prior to acceptance into the program. Once established in the program, a lab must continue to demonstrate performance capabilities by successfully analyzing blind samples sent by the EPA each quarter. Ceimic has averaged greater than 95% on these quarterly blind samples. Ceimic also participates in the Water Pollution (WP) and Water Supply (WS) Performance Evaluations sponsored by the Quality Assurance Branch of the EPA, and has averaged greater than 95% for the past four years. Successful analyses of these samples are required as part of the laboratory certification process for the environmental agencies of several states.

Table 15-1 CEIMIC PERFORMANCE EVALUATIONS

Agency/Program	Parameter(s)
USEPA-EMSL/Water Pollution Study	VOA, Pesticides/PCBs, Metals, Classical Chemistry
USEPA-EMSL/Water Supply Study	VOA, Pesticides, Metals, Classical Chemistry
USEPA CLP Organic Quarterly Blind	VOA, BNA, Pest/PCB

Performance is monitored internally on a daily basis at Ceimic through the use of surrogate standards and laboratory control samples. NIST/A2LA traceable second source calibration verification standards are analyzed after each new initial calibration in each of the Ceimic laboratories and ensure continuing high-level performance.

Figure 15-2. Laboratory Accreditations

STATE	Certification	Certification Parameters*		CERTIFICATION RENEWAL DATE
		Potable Water	Waste Water	
CALIFORNIA, Dept of Health Services	2309	No	Yes	September, 2000
COLORADO, Dept of Health	-	Yes	No Program	May, 1999
CONNECTICUT, Dept of Health Service	PH-0620	Yes	Yes	March, 2000
FLORIDA, Dept. of Health	87573	No	Yes	June, 1999
MAINE, Dept of Human Services	RI004	Yes	Yes	August, 1999
MARYLAND, Dept of Health & Mental Hygiene	245	Yes	No Program	September, 1999
MASSACHUSETTS, Dept of Env Protection	M-RI004	Yes	Yes	June, 1999
MICHIGAN, Dept of Health	-	Yes	No Program	June, 2000
NEW HAMPSHIRE, Dept of Env Service	201094-A/C	No	Yes	April, 1999
NEW YORK, Dept. of Health	11030	No	Yes	April,1999
PENNSYLVANIA, Dept of Environmental Resources & Energy	68-391	Yes	No Program	May, 1999
RHODE ISLAND, Dept of Health	0129	Yes	Yes	June, 2000
VIRGINIA, Dept of General Services	00052	Yes	No Program	June, 1999
GOVERNMENT	Contract #	Contract Parameters Organic	Inorganic	CONTRACT/APPROVAL EXPIRATION DATE
USEPA CLP	68-D5-0019	X		February, 1999
U.S. Army Corps of Engineers (USACE)	-	X	X	October, 1999
D.O.D. Naval Facilities Engineering Service Center (NFESC)	-	X	X	May, 2000
U.S. Air Force Center for Environmental Excellence (AFCEE)	-	X	X	February, 1999
OTHER	Approval #	Notes		EXPIRATION DATE
FLORIDA, Dept of Environmental Protection	900279	CompQAP Approval		April, 1999
U.S. Dept of Agriculture Animal & Plant Health Inspection Service Import License**	permit # S-3330	Approval to accept samples from Brazil, Guam, PR		December, 2002

*Refer to state-issued parameter list for complete list of certified parameters.
**Does not contract laboratories

16.0 DOCUMENT CONTROL

Ceimic Document Control Officer assembles documentation relating to each project. A central file is maintained for each project and is the repository for all documentation associated with the project. Projects are arranged by Ceimic project number. All project files are located in the central filing area located in the secure area. The documents are assembled as follows, where appropriate:

- Each project is assigned one file folder or file section.
- Filing order is according to Ceimic project number.
- All documents, including sample tags, client documents, and laboratory-generated data pertaining to a project, are placed in the central file folder or file section assigned to the project.
- Chain-of-custody records are held in the central storage facility at Ceimic until sample disposal; at that time, custody records are entered into the central file for the project.
- All project files are located in the central filing area. Custody is maintained by following procedures specified in SOP.
- Prior to the release of analytical results, the Document Control Officer or designee assembles and cross-checks information on sample tags, custody records, laboratory worksheets and notebook pages, instrument logs, and other relevant data to ensure that the data has been assembled following the procedures specified in SOP.
- The Ceimic Document Control Officer is responsible for ensuring that all documents for a specific project are accounted for and are present in the file when the project is completed.

The Ceimic Sample Custodian notifies the Laboratory Managers of the receipt of samples. The Lab Manager schedules analysis for timely completion. Following analysis of the samples, each laboratory provides the required data and documentation to the Document Control Officer so that the project records may be assembled, reviewed, corrected if necessary, and sent to the client.

The QA/QC Officer has the responsibility of assuring document control of the Laboratory Quality Assurance Plan (LQAP) and Standard Operating Procedures (SOPs). All internal LQAP and SOP copies are controlled documents. The QA/QC Officer distributes these to employees, who must sign for receipt of them. A document control record is maintained by the QA/QC Officer for each SOP and LQAP. Upon issuance of updated SOPs or LQAPs, employees must return their old copy to the QA/QC Officer, who then disposes of the old copy. The QA/QC Officer is responsible for establishing and maintaining control of the LQAP and SOPs. The QA/QC Officer distributes controlled copies of SOPs, documents the return of out-dated SOPs and archives the master copy of the out-dated SOP. The Lab Supervisor is responsible for notifying the QA/QC Officer when SOP revisions are needed.

The Lab Supervisor writes the revisions on a DRAFT copy of the SOP. The QA/QC Officer then updates the SOP, reviews it, has it reviewed by the Lab Supervisor and Lab Manager, distributes the new SOP, and catalogues receipt of all old copies of the SOP. SOPs are reviewed and revised annually (at a minimum) by the Lab Supervisor, Lab Manager, and QA/QC Officer. The LQAPs is reviewed and revised annually (at a minimum) by the QA/QC Officer.

17.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The QA/QC Officer submits a QA report quarterly to the Lab Director. The report contains detailed information on QA activities during the previous six months including:

- Summary of systems audits
- Performance evaluation samples analyzed and scores received
- Status of certifications
- Laboratory QA/QC review
- Problems and corrective actions
- Comments and recommendations

In addition, copies of all Performance Evaluation results, Systems Audit Reports, and resulting corrective actions are provided to the Lab Director throughout the year as they are received.

In the case of a severe problem or difficulty, a special report is prepared by the QA/QC Officer and submitted in a timely manner to the management.

18.0 SOFTWARE QUALITY ASSURANCE

Ceimic has written a DRAFT Software Quality Assurance Plan (SQAP) to describe the procedures and policies to be implemented in order to maintain an adequate level of software quality assurance. The design, testing, modification, verification, validation or reconfiguration of laboratory software systems/applications are covered by this document.

The SQAP describes policies and practices for software configuration control, policy and practices for electronic data security, and the process for documentation of validation and verification activities. The Systems Manager is responsible for maintaining software QA data files. It is expected that this DRAFT SQAP will be in FINAL form by May 30, 1999 following the implementationa and validation of new reporting software.

19. CLIENT SERVICES

19.1 INTERNAL COORDINATORS

The client satisfaction with the laboratory services is of foremost importance at Ceimic. To assure personal attention to the individual clients and/or projects, a Internal Coordinator is appointed to serve a a point of contact between the client and the laboratory. This system is designed to make sure that all client specific requirement are being met. Refer to SOP No. Q13 for detailed description of Internal Coordinator duties and responsibilities. In summary the following chain of events follows the acquisition of a new project:

19.1.1 Upon receipt of a new project, the Lab Director assigns an Internal Coordinator to oversee the project. The Internal Coordinator is chosen from among the Lab Managers and Lab Director.

19.1.2 The Internal Coordinator familiarizes himself with the project Quality Assurance Plan requirements, notes deviations from standard laboratory operations, and communicates the special requirements to the Lab Supervisors in the following way.

19.1.2.1 Minor requirements, such as analysis of an extra target analyte, are written on the Sample Log-In sheet and distributed to each Lab Supervisor.

19.1.2.2 Major requirements are communicated by issuance of a memorandum and a project startup meeting. At the beginning of a project the Internal Coordinator holds a meeting with Lab Supervisors and distributes a memo with all of the project specific requirements to the Lab Supervisors. The Lab Supervisors then disseminate this information to the Lab Analysts who will be analyzing samples for this project.

19.2 ADDRESSING COMPLAINTS

In the event a complaint regarding analytical data quality is submitted to the laboratory the following procedures are followed.

- Laboratory management will review the complaint and establish its validity and substance.
- The cause of complaint is determined.
- A corrective action will be implemented according to guidelines in section 13 of this document.
- The client will be notified in writing of the implemented corrective action and provided with revised data, if applicable.

19.3 PROTECTING CLIENT'S CONFIDENTIALITY

Ceimic regards all information relating to work for its clients to be confidential. Furthermore if its clients provide access to proprietary information belonging to the clients of a business or technical nature in order to accomplish the work, the information is regarded as confidential. Ceimic does not appropriate any information for its own use or disclose such information to third parties unless authorized in writing to do so by its clients.

Attachment A-2

Title Pages of Ceimic's SOPs for Various Project Analytical Methods

CEIMIC CORPORATION

Standard Operating Procedure

No. 8270C

TITLE:

SEMI-VOLATILE ANALYSIS BY SW846 METHOD 8270C

FINAL

Approved By:

Jane King
QA/QC Officer

Laboratory Manager

Jane King
Laboratory Supervisor

Previous Revision Date: 6/25/98

Date Revised: 2/29/00

DATE ISSUED
MAR 01 2000

Control No.: 1/1

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

CEIMIC CORPORATION

Standard Operating Procedure

No. 8260B

TITLE:

GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS BY SW846 METHOD 8260B

FINAL

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

DATE ISSUED

MAR 01 2000

Previous Revision Date: 2/11/99

Date Revised: 2/29/00

Control No.: M4

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

CEIMIC CORPORATION

Standard Operating Procedure

No. 6010B

TITLE:
INDUCTIVELY COUPLED PLASMA - ATOMIC EMISSION SPECTROSCOPY BY SW846 METHOD 6010B

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

Previous Revision Date: 1/17/97

DATE ISSUED

MAR 01 2000

Date Revised: 2/29/00

Control No.: N/A

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

Jeff

CEIMIC CORPORATION

Standard Operating Procedure

No. 300A

TITLE:

DETERMINATION OF INORGANIC ANIONS BY EPA METHOD 300.0 ION CHROMATOGRAPHY (REV. 2.1)

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

DATE ISSUED

JAN 1 5 1999

Previous Revision Date: 12/4/96

Date Revised: 1/14/99

Control No.: 300A.02

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

CEIMIC CORPORATION

Standard Operating Procedure

No. 3810

TITLE:

METHANE, ETHANE AND ETHENE GASES IN WATER SAMPLES BY GAS CHROMATOGRAPHY ANALYSIS OF SAMPLE HEADSPACE

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

FINAL

Previous Revision Date: 4/14/99

Date Revised: 3/27/00

Control No.: U/A

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

CEIMIC CORPORATION

Standard Operating Procedure

No. Method 5035

TITLE:
Closed-System Purge-and-Trap and Extraction for
Volatile Organics in soil and waste samples

Approved By:

QA/QC Officer

Laboratory Manager

Laboratory Supervisor

FINAL

Previous Revision Date: 05/04/00

Date Revised:

Control No.: 5035-01

Note: This document may not be copied. Controlled copies of this document are available from the QA/QC Officer. The original is stamped with a red stamp.

Attachment A-3

USACE's QA Sample Summary and Shipment Instructions

INSTRUCTIONS FOR SHIPMENT OF QUALITY ASSURANCE SAMPLES

Date: October 4, 1999 **(revised 11 May 2000)**

Name of Contractor: EA Engineering, Science, and Technology, Bedford, MA
James Schultz
Phone: (781-275-8846

Name of USACE Project: Former NIKE PR-58 and Adjacent Navy NCBC Davisville Site 03
Characterization of CVOC Contamination
Location of Project: North Kingstown, RI
Contract No.: DACA31-94-D-0025; task order 0181
QA Laboratory No: E0853
Name of Primary lab: CEIMIC Laboratory, Narragansett, RI

Quality Assurance (QA) samples for this project should be shipped to the following QA Laboratory:

Severn Trent Laboratories
55 South Park Drive
Colchester, VT 05446
Phone: (802)-655-1203
Fax: (802)-655-1248
Laboratory Point of Contact: Brian Blair

Instructions for EA Engineering, Science, and Technology, Inc.:

1. Fill out necessary documentation (i.e. Chain of Custody (COC) forms, etc), and ship samples in accordance with the procedure specified in the Work Plan/Quality Assurance Project Plan (QAPP) to the laboratory stated above. Include the project name and QA Laboratory project number on all documentation sent to the QA laboratory. Include specific method references on the COC forms for extraction and analysis of samples (in accordance with the method references stated in the approved QAPP).

2. Within 24 hours of shipment of samples to the QA Laboratory, fax copies of QA Chain of Custody forms to: Bill Saner, Fax number: (978)-318-8663

   Address: US Army Corps of Engineers, New England District, CENAE-EP-GE
   696 Virginia Road
   Concord, MA 01742-2751
   Phone: (978)-318-8734

3. Please direct questions regarding this procedure to Bill Saner (978)-318-8734 or Marie Wojtas at (978)-318-8175.

Project: NIKE PR-58 and Adjacent Navy NCBC Davisville Site 03, North Kingstown, RI; QA Lab No. E0853

date: 11 May 2000

QA SAMPLE SUMMARY

ANALYSIS	NUMBER OF SAMPLES	PREP METHOD	ANALYSIS METHOD	REPORTING LIMITS	COMMENTS
VOCs – Water Soil	10 + TBs 2 + TBs	5030B 5035	8260B 8260B	1-5 ppb 125-250 ppb	Soil samples will be preserved with methanol
SVOCs – Water Soil	1 1	3520C 3540C	8270C 8270C	10-15 ppb 330-1500 ppb	
TAL metals – Water Soil	2 1	3010A 3050A	6010B/7470A (Hg) 6010B/7471A (Hg)	standard	
Anions - Water (nitrate, sulfate, sulfide, chloride)	9	NA	300	standard	
Manganese - Water	9	3010A	6010B	standard	
Alkalinity - Water	9	NA	310.1	standard	

Note: Reporting limits should be lowest achievable for the referenced methods.
NA = Not Applicable.
Laboratory results turnaround time: standard (3-4 weeks from receipt of samples at the laboratory)

Send laboratory results report to the following address:

Bill Saner
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Cost code: L22102; funded work item number: **see Peter Hugh (x78452)**
Primary lab: CEIMIC Corporation, Narragansett, RI
QA Laboratory: Severn Trent Laboratory, Colchester, VT
Contractor: EA Engineering, Science, and Technology, Inc., Bedford, MA
Samples to be collected week of May 23 – August 15, 2000

Attachment A-4

Data Structure

ATTACHMENT A-4. (DATA STRUCTURE)

TABLE 1: SAMPLE LOCATION

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
LOCATION	C	15	The unique identifier for a specific sample location. (ie. well, boring,etc.) Examples: 01GW04 (site 01 groundwater well # 04), 01HP06 (site 01 hydropunch # 6), 01SED05 (site 01 sediment sample # 5), BGSED07 (background sediment sample # 7), 06SW05 (site 06 surface water sample/location # 5)
REF_ELEV	N	8.2	The elevation of this location.
TOT_DEPTH	N	6.2	Total depth below ground surface that this hole was drilled.
EASTING	N	10.2	The easting coordinate of this location.
NORTHING	N	10.2	The northing coordinate of this location.
TOP	N	5.1	The depth below ground surface to the top of the sampling point. For soil samples will be the Top of the split spoon depth. For groundwater, this will be the top of the screen.
BOTTOM	N	5.1	The depth below ground surface to the bottom of the sampling point. For soil samples will be the bottom of the split spoon depth. For groundwater, this will be the bottom of the screen.
TOP_CASING	N	8.2	The elevation of the top of the well casing.
SURVEYED	C	1	"Y" if the northing, easting, ref_elev, etc were surveyed. "N" if the coordinates "N" if the coordinates were digitized.
SURVEYOR	C	50	The name of the surveying company if the coordinates were surveyed.
SURV_DATE	I	8	The date the survey was conducted (i.e. 19970724 = 07/24/97)

TABLE 2: SAMPLE ATTRIBUTES

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
LOCATION	C	15	The unique identifier for a specific sample location. (ie. well, boring,etc.) Examples: 01GW04 (site 01 groundwater well # 04), 01HP06 (site 01 hydropunch # 6), 01SED05 (site 01 sediment sample # 5) BGSED07 (background sediment sample # 7), 06SW05 (site 06 surface water sample/location # 5)
SAMPLE_NO	C	30	The unique character string that identifies a specific sample specimen. If well names have been used instead of sample names, the sample date shall be appended to the sample name. For field duplicates, the sample number shall be identical to the original sample name plus "-D". Examples: 01GW07 07/24/97 - D (site 01 groundwater well # 7 collected July 24 1997 - Duplicate) duplicate.
MATRIX	C	7	The sample matrix. Examples: GW (groundwater), GWF (filtered groundwater), SOIL, SED, (sediment), PVMT (pavement) and TISS (tissue sample), TANKAQ (tank aqeuous), TANKSED (tank sediment).
TOP	N	5.1	The depth below ground surface to the top of the sampling point. For soil samples will be the Top of the split spoon depth. For groundwater, this will be the top of the screen.
BOTTOM	N	5.1	The depth below ground surface to the bottom of the sampling point. For soil samples will be the bottom of the split spoon depth. For groundwater, this will be the bottom of the screen.
TURB_NTU	N	5.2	Turbidity in well when sample was collected (measured in NTU's)
VALIDATED	C	1	This field will contain a "y" if the data has been validated and an "N" if the data has not been validated.
OUR_RESULT	C	15	A character string with the result and qual fields combined and separated by two spaces. The purpose of this field is for reporting and tag maps in the GIS.(ie. 16 J)
COMPOSITE	C	1	This field will contain a "Y" if this sample is a composite.
EXCAVATED	C	1	This field will contain a "Y" if this sample has been excavated.
SOURCE	C	80	This field describes the source document or file in which the information for this sample was taken. For historical data, the document title, author and date should be included. if the historical information was provided electronically, the title of the diskette and the name of the contractor who provided the diskette shall be included in this field.

C = Character string (everything shall be reported in capital letters)
I = Integer string
N = Numeric string (decimal places as indicated after period)

TABLE 3: LAB ANALYTIC RESULTS

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
SAMPLE_NO	C	30	Field sample ID as listed on the chain-of-custody. The sample number indicated in this field should never be truncated. The only exception for this field not matching the chain-of-custody is for reanalysis and matrix spike results in which a RE or MS suffix will be added to the sample number respectively
TRUNCATE	C	15	If the field sample ID listed on the Chain of Custody is truncated by the laboratory for use with the laboratory software, the truncated laboratory ID should appear in this field.
LAB_ID	C	15	Laboratory number for the given sample.
LABORATORY	C	25	Laboratory name.
BATCH_NO	I	10	Laboratory code for batch of samples in a given run.
ASSOC_BLNK	C	15	Laboratory name of the method blank associated with that particular batch of samples.
QC_TYPE	C	15	Normal, Duplicate, Matrix Spike, etc.
COLL_DATE	I	8	Date of sample collection as indicated on the Chain of Custody. Example: 19971107 = 11/07/97
REC_DATE	I	8	Date sample was recieved by the laboratory.
EXTR_DATE	I	8	Date sample was extracted or prepared by the laboratory.
ANAL_DATE	I	8	Date sample was analyzed by the Laboratory.
SDG	C	15	Sample delivery group identifier assigned by the laboratory.
PROJECT_NO	C	10	Identification of Project Number or CTO number.
PARAMETER	C	45	Chemical or analyte name as reported on Form 1.
CAS_NO	C	10	Chemical Abstract Service number for the parameter listed. This field should be left blank for those parameters not having CAS numbers(e.g. Total Organic Carbon)
FRACTION	C	5	Metals + 'M', Volatiles = 'OV', Semivolitiles/BNAs = 'OS', Pesticides = 'PEST', Polychlorinated Biphenyls = 'PCB', Radionuclide = 'RAD', Miscellaneous = 'MISC'.
METHOD	C	20	Analytical method used to quantitate parameter concentrations. SW846 method names should be used if applicable.
LAB_RESULT	N	15.4	Reported value in units specified in the UNITS field containing the proper number of significant digits. The % Recovery shall be placed in this field for matrix spike results.
UNITS	C	5	The units of measure as reported on the Form 1.
LAB_QUAL	C	2	The laboratory qualifier as reported on the Form 1. For example, a U qualifier should be used for all nondetected results.
IDL	N	10.4	Instrument detection limit in units specified in the UNITS field.
MDL	N	10.4	Method detection limit in units specified in the UNITS field and method specified in the METHOD field.
CRDL_CRQL	N	10.4	Contract Required Detection/Quantification Limit in the units specified in the UNITS field. RDL for non-CLP parameters.
DIL_FACTOR	I	5	Dilution factor.
PCT_MOIST	N	5	Percent moisture for soil samples; blank for water samples.
COMMENTS	C	20	Analytical result qualifier or comment other than that listed in the LAB-QUAL field. Example; "Reanalysis'

C = Character string (everything shall be reported in capital letters)
I = Integer string
N = Numeric string (decimal places as indicated after period)

Final

Characterization of CVOC Contamination
Former PR-58 Nike Site and NCBC Davisville Site 03
Site-Specific Health and Safety Plan

Prepared for

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

Under

Contract No.: DACA31-94-D-0025
Delivery Order No. 0181

Administered by

U.S. Army Corps of Engineers
Baltimore District
Baltimore, Maryland

Prepared by

EA Engineering, Science, and Technology
175 Middlesex Turnpike, Third Floor
Bedford, Massachusetts 01730
(781) 275-8846

April 2000

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1. INTRODUCTION

1.1 HEALTH AND SAFETY PLAN REQUIREMENTS

This Site-Specific Health and Safety Plan (SSHSP) has been developed by EA Engineering, Science, and Technology (EA) to establish the health and safety procedures required to mitigate potential risk to personnel who will oversee and/or perform investigative activities for the implementation of the Site Characterization. The purpose of this characterization is to target chlorinated volatile organic compound (CVOC) contamination at the former NIKE site PR-58 and the adjacent Site 03 at the Naval Construction Battalion Center (NCBC) Davisville. The investigation at the NIKE site is funded under the United States Army Corps of Engineers (USACE) Defense Environmental Restoration Program-Formerly Used Defense Sites (DERP-FUDS) Program. A Remedial Investigation (RI) will also be performed concurrently at Site 03, at NCBC Davisville under the Navy's Defense Base Realignment and Closure Act (BRAC). The field work for the entire joint USACE and Navy investigation will be performed in accordance with this SSHSP. The joint area will hereinafter, for the purposes of this SSHSP, be referred to as the Study Area.

The provisions of this SSHSP apply to all EA personnel and EA subcontractor personnel who will potentially be exposed to safety and/or health hazards related to activities described in Chapter 4 of this SSHSP. Prior to the beginning of the RI field activities, a copy of this document will be provided, as guidance, to all EA subcontractors. Although all site personnel must comply with the protocols listed in this SSHSP, it will be necessary for all subcontracting companies to develop an independent SSHSP that incorporates their specific responsibilities.

1.2 SCOPE AND APPLICABILITY OF THE HEALTH AND SAFETY PLAN

General health and safety protocols applicable to the field work under this Delivery Order and the RI at adjacent NCBC Davisville Site 03 are designated and defined in this SSHSP. Site employees will be familiar with this SSHSP for Study Area field activities in which they are involved. The scope of work covered by this SSHSP includes, but is not limited to, health and safety hazards anticipated from the evaluation of the potential for and existence of environmental contamination resulting from past or current activities within the Study Area.

Prior to initial entry onto the site, the Site Health and Safety Officer (SHSO) must make sure that the SSHSP is reviewed and an agreement to comply with the requirements must be signed by personnel, including contractors, subcontractors, and visitors (Attachment A). In signing this agreement, personnel, contractors, and subcontractors acknowledge their responsibility to comply with the SSHSP requirements as they apply to their work done under the Delivery Order. Personnel onsite shall be informed of the site emergency response procedures and potential safety or health hazards of the operations.

1.3 HEALTH AND SAFETY PLAN MODIFICATIONS

This SSHSP only pertains to the proposed tasks listed in Chapter 4 of this document. The procedures of this SSHSP have been developed based on current knowledge regarding the specific chemical and physical hazards that are known or anticipated for the operations that are to be conducted at this site.

Should additional information become available regarding site hazards; or should planned field sampling operations at the site change, it may be necessary to modify this SSHSP. All proposed modifications to this SSHSP must be reviewed and approved by the EA Health and Safety officers and Project Manager before such modifications are implemented.

1.4 ORGANIZATION OF DOCUMENT

This SSHSP includes health and safety planning for all anticipated site activities and meets the Occupational Safety and Health Administration (OSHA) requirements contained in 29 Code of Federal Regulations (CFR) Section 1910.120 and 29 CFR Part 1926 by including the following items:

- A description of the staff organization, qualifications, and responsibilities (Chapter 2)
- Site description and contamination characterization (Chapter 3)
- Field activities and hazard analysis (Chapters 4 and 5)
- Health hazard information (Sections 5.3 through 5.5)
- Environmental monitoring plan (Chapter 6)
- Personal protective equipment (PPE) (Chapter 7)
- Site control measures (Chapter 8)
- Decontamination procedures for personnel and equipment (Chapter 9)
- Medical monitoring (Section 10.1)
- Personnel training and standard operating safety procedures (Section 10.2)
- Emergency response and contingency procedures (Chapter 11)
- First aid, emergency, and safety equipment (Section 11.3).

Site-specific health and safety data and records to be used during the RI field activities are provided in the following attachments:

- Site Health and Safety Review Record (Attachment A)
- Material safety data sheets of chemicals used onsite (Attachment B)
- Potential hazardous substances (Attachment C)
- Physical and biological hazard information sheets (Attachment D)
- Monitoring instrument calibration procedures (Attachment E)
- Environmental Monitoring Record (Attachment F)
- Site Safety and Health Activity Report (Attachment G)
- Site Entry and Exit Log (Attachment H)

- Road map from the site to the hospital (Attachment I)
- Accident Investigation Report (Attachment J).

2. PERSONNEL

2.1 KEY PERSONNEL

Contract Task Order (CTO) Manager:	Jim Shultz,CPG	(781) 275-8846
Program Safety and Health Officer:	Barry Weissman	(732) 404-9370 Pager (888) 451-3578
Site/Task Manager*:	Jeff Norberg,	(781) 275-8846
Site Safety and Health Officer:	Jeff Norberg	
Field Personnel:	Jeff Norberg, Jim Shultz, Stella Kiras, Sam Whitin, Kevin Baum, Tom Biolsi, Jennifer Martin, Dan Bishuk, John Clark, Sue Chase, Mike Chase, Sandy Staigerwald, Steve Welzant, Stephanie D'jimas, James Gatherer, Bob Haras, Kim Shutty, Robert Wasserman	

* Certification of 8-Hour Supervisor's Training for Hazardous Waste Operations (HWO) is required for Site Manager.

2.2 RESPONSIBILITIES

The responsibilities for health and safety-related issues for program operations are as follows.

2.2.1 Project Manager

The responsibilities of the Project Manager include the following:

- Overseeing the preparation of the SSHSP
- Ensuring that the SSHSP is available onsite
- Assuring compliance with this SSHSP
- Coordinating with the designated USACE, Navy, and Rhode Island Economic Development Corporation (RIEDC) Technical Representatives
- Providing overall supervisory control for health and safety protocols in effect for the project
- Assigning the Site Manager and SHSO and assuring that the assigned onsite staff will enforce provisions of the approved SSHSP
- Assuring adequate resources are available for health and safety.

2.2.2 Program Health and Safety Officer

The Program Health and Safety Officer is responsible for the following:

- Providing senior review of this SSHSP
- Conducting audits of Delivery Orders for health and safety and stopping work if unacceptable health and safety risks exist
- Reviewing consultants' and subcontractors' health and safety programs, as they relate to work under the Delivery Order, to ensure consistency with EA's health and safety program.

Mr. Kris Hoiem, a Certified Industrial Hygienist, will be the substitute Program Health and Safety Officer in the event that Mr. Weissman is unavailable.

2.2.3 Site Health and Safety Officer

The SHSO will be onsite throughout the project and will be responsible for daily compliance with site health and safety requirements. The duties of the SHSO include the following:

- Stopping work, and directing shutdown of the work site if imminent safety or health risks exist or as outlined in this SSHSP
- Implementing usage of forms provided in attachments
- Implementing the SSHSP
- Providing an initial health and safety briefing to site workers and visitors
- Reviewing training and medical records (Table 2-1) prior to site work
- Evaluating reported hazardous conditions and recommending corrective action
- Conducting necessary monitoring
- Establishing and ensuring compliance with site control areas and procedures
- Ensuring decontamination of personnel, tools, and equipment
- Supervising the distribution, use, maintenance, and disposal of personal protective clothing and equipment
- Investigating and preparing incident reports as necessary.

2.2.4 Site Manager

The Site Manager (or the SHSO) during an emergency will be responsible for initiating and coordinating responses. The Site Manager will be responsible for the following:

- Work with the SHSO to identify and evaluate hazards
- Be responsible for initiating the evacuation of the work site when needed, or as directed by the SHSO, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders
- Determine if the abatement of hazardous conditions is sufficient prior to allowing resumption of work operations after an emergency.

2.2.5 Field Personnel and Subcontractors

Employees (including subcontractor and consultant employees) will be responsible for the following:

- Following this SSHSP and applicable health and safety rules, regulations, and procedures
- Using required controls and safety devices, including PPE
- Notifying his/her supervisor of suspected safety or health hazards
- Complying with training and medical requirements.

2.3 VISITORS

Visitors will be required to read and verify their understanding and willingness to comply with this SSHSP. Visitors will remain in an observation area and will not be allowed in the Exclusion Zone unless they have complied with the appropriate OSHA training and medical requirements (Table 2-1) and have the permission of the Project Manager or the SHSO.

3. SITE DESCRIPTION

3.1 BACKGROUND AND FACILITY DESCRIPTION

The former Nike PR-58 missile launch site (deactivated in 1962) property, located in North Kingstown, Rhode Island, is currently owned by RIEDC and has been the subject of environmental investigations by USACE under the FUDS Program.

The Nike area which is bounded by Perimeter Road, Seabee Avenue, and Babcock Road (Figure 1), was formerly part of Camp Thomas. Camp Thomas was not used after World War II until 1955-1956 when the Army constructed a Nike missile battery. The area between the Nike Site and Seabee Avenue has apparently not been used since World War II as evidenced by the mature forest which this area now supports. Aerial photographs from 1951 to 1976 show the area as vegetated and undeveloped.

The former Nike site included three underground missile silos (Buildings 347, 348 and 349), a refueling area located to the south of Building 347, a missile assembly and test building (Building 344) with an underground storage tank (UST), a generator building with a 4,000 gal UST (Building 345), and personnel quarters. The facility was constructed during the mid-1950s and was equipped with short-range, conventionally-armed Nike Ajax missiles. The facility was deactivated in 1962. In 1995, the Army drilled holes in the bottom of each silo, back-filled the missile silos with clean sand, and demolished the concrete pads around the silos.

Construction drawings of the Nike Site show a leaching field 250 ft east of Building 343 which was the Ready (personnel) Building. The building was later used by the Navy as a training classroom. The leaching field was used to dispose of sanitary wastewater. Each missile silo was equipped with a sump pit to collect liquids, which had accumulated in the bottom of each silo. The contents of the pit were pumped via pipe and discharged directly into a ditch, which ran along the eastern edge of the silos. The concrete pad, which surrounded the silos also, drained into this ditch. An acid neutralization pit and drainage sump was reportedly located at the missile refueling area, which was just south of the three former missile silos.

There is no site-specific documentation regarding the use, storage or disposal of hazardous material at this former Nike Site. However, for Nike sites in general, a variety of chlorinated organic solvents such as carbon tetrachloride, tetrachloroethene (PCE), trichloroethane (TCA) and trichloroethene (TCE) were reportedly used for parts cleaning, cleaning of grease spills and overall cleaning in preparation of painting. Typical quantities used ranged from 30 to 120 liters per month of TCE and 190 to 380 liters per month of other solvents.

The Navy reportedly used the area west of the missile silos as the Disaster Recovery Training Area between 1964 and 1974. The training consisted of classroom instruction and hands-on training. Reportedly, tear gas grenades, smoke pots and biological agent simulants were used. Detonation cord, blasting caps and plastic explosives were also used in small quantities. All

materials were considered to be consumed in use, and thus, no wastes were considered to have been generated. Although DANC [Decontaminating Agent - Non-Corrosive; a mixture of 1,1,2,2-tetrachloroethane (PCA) and 1,3-dichloro-5,5-dimethylhydantion] was reportedly stored at the Disaster Recovery Training Area, the available information does not indicate that there was training with DANC. Monitoring well EA-105D was installed in this area.

Thirty 6-in. diameter pipes, which rise about 4 ft above grade, are located east of the missile silos. This area is referred to as the "pipe structure area." On 7 June 1996, the Navy investigated this structure. Two of the southern pipes in the 'pipe structure' were pulled from the ground to assess their extent. Based upon the field observations and the two removed steel pipes, the pipes are arranged in six rows of five pipes each. Each pipe was approximately 6-in in diameter, 4.5 ft in length, extended into the ground approximately 12 in., and was partially filled with sand. No odor or staining of the soil was observed where the two pipes were pulled from the ground. Monitoring well EA-103D was installed adjacent to the east perimeter of the 'pipe structure'.

In 1974, the land west of Seabee Avenue was transferred to the General Services Administration (GSA). In 1978, the GSA transferred ownership to Rhode Island Port Authority (RIPA) (now RIEDC). RIPA leased 2.2 acres of land to Peabody Clean Industries (PCI) between 1980 and 1982 for use as a hazardous waste tank farm. At any one time, an estimated maximum of 50,000 gallons of oil/water waste, 10,000 gallons of waste solvents, waste oil and sludge and 20 drums of various hazardous materials were onsite. In 1983, the RIDEM directed PCI in a cleanup of soil impacted by the PCI activities at the site. RIPA removed the 4,000-gal UST at Building 345 and demolished many structures, including Building 345, as part of the cleanup/closure activities. Currently, RIEDC leases Building 344 to Marine Education Inc., who operates a marine repair training center.

The contamination of concern is the dissolved CVOC plume in the deep bedrock and groundwater. The plume in the overburden soil has been characterized; however, further work is needed to determine the extent of contamination in the deeper bedrock zone. The Rhode Island Department of Environmental Management (RIDEM) is the lead regulatory agency overseeing the activities within the NIKE area (DERP-FUDS funded). The U.S. Environmental Protection Agency - Region 1 (US EPA) is the lead agency overseeing activities within the Navy property (BRAC funded).

Based upon the findings presented in the Navy's Final "Nike Source Area and Offsite Investigation" Report, dated December 1998, the main source area for the deep CVOC groundwater plume was in the vicinity of monitoring well MW03-14D, located just east of the former Nike Site and west, up-gradient of Navy property. Based upon these findings and the comments from the US EPA and RIDEM, additional characterization of the plume is necessary to further assess the nature and extent of CVOC in the bedrock.

The Navy's past investigations at the NCBC identified dissolved CVOCs in the deep ground water. Continued activities undertaken by the Navy indicate that the "primary source" of the dissolved CVOC plume was from a location within the former NIKE site. Several other

secondary source areas are suspected and are located on the Navy's property.

3.2 MATERIAL USE

Former use of chemical and petroleum products have been identified at various locations within the Study Area. The historical usage or storage of the following materials were recorded during previous investigations:

- DANC [Decontamination Agent – Non-Corrosive; a mixture of 1,1,2,2-tetrachloroethane (PCA) and 1,3-dichloro-5,5-dimethylhydantoin];
- Tear gas grenades;
- Smoke pots;
- Simulated biological agents;
- Detonation cord;
- Blasting caps;
- Plastic explosives;
- Carbon tetrachloride;
- Tetrachloroethene (PCE);
- Trichloroethane (TCA); and
- Trichlorothene (TCE).

3.3 WASTE GENERATION

The following wastes have reportedly been generated within the Study Area:

- Neutralization Acid;
- Sanitary wastewater;
- Oil/water waste;
- Waste solvents;
- Waste oil; and
- Sludge.

3.4 STUDY AREA

The areas to be characterized during this investigation consist of the former Nike Site PR-58, and adjacent properties downgradient of the former Nike site. These downgradient locations include NCBC Davisville Site 03 and a residential area northeast of the former Nike site. The Study Area is depicted in Figure 2.

4. PURPOSE AND WORK SCOPE

General objectives of the additional characterization with the Nike site and the northern residential areas will be to:

- Further assess the nature and extent (lateral and vertical) of the potential primary CVOC source area in the competent bedrock in the vicinity of MW03-04.
- Assess the nature and extent (lateral and vertical) of the potential second CVOC source area in the sand and gravel / weathered rock and competent bedrock zones at the end of a 20-25 ft dirt road just east of former Building (silo) 349. This areas was alleged by recent information from RIDEM to have been an area of historical disposal of solvents and acids.
- Assess the nature and extent of the dissolved CVOC plume with specific focus on the northeast edge that extends off the former Nike site and Navy properties (impacting the GA aquifer).
- Further assess natural attenuation (develop isopleth plots).
- Assess, identify, and recommend remedial action alternatives. An elaborate and detailed level of effort is not the intent of this assessment. If required at a future date, a Phase III level Feasibility Study (Detailed Assessment of Remedial Alternatives) will be incorporated as a modification to this task order.

General objectives of the additional characterization within the Navy property shall be to:

- Document the direction of ground-water flow and assess the nature and extent in the competent bedrock of the dissolved CVOC plume that has extended east beneath the Navy property.
- Further assess natural attenuation within the Navy property.

The field tasks covered by this SSHSP include the following:

- **Site Reconnaissance**—A ground survey will be conducted to clear the site for proposed sampling locations and make necessary arrangements with USACE, NCBC Davisville Caretaker Site Office (CSO), and RIEDC personnel for set-up of investigative-derived waste (IDW) storage and decontamination areas.

- **Seismic Refraction**—Previous site investigations have shown that the configuration of the surface of competent bedrock appears to have influenced the migration of the CVOC plume. In general, seismic refraction interpretive data is available for the areas of the additional characterization except for the area of the northeast plume beyond EA-112D/R. Therefore, this task shall include up to 4000 ft of seismic refraction survey lines to aid in locating: (1) the northeast trending valley in the competent bedrock surface and (2) the two planned monitoring well clusters in that area.

- **Soil Sampling**—Subsurface soil samples will be collected from borings, specified in the Work Plan, using hollow-stem auger, rotary-wash, and/or air-rotary drilling methods.

- **Soil Gas Study**—Conduct a soil gas survey (up to 10 points) in the area east of Building #347 and west of Seabee Avenue. The purpose is to gather information to help determine the best locations for the new monitoring wells EA-114 (D, R, and R2) in the area alleged by RIDEM to have been a location where waste oils and solvent were dumped on the ground during the 1960s.

- **Monitoring Well Installation**—Monitoring wells will be installed using hollow-stem auger, rotary-wash, and/or air-rotary drilling methods.

- **Borehole Geophysics**—A subcontractor will be chosen to conduct geophysical logging of the open rock portions of selected boreholes after the completion of the drilling activities.

- **Ground-Water Sampling**—Collection of ground-water samples from newly installed and existing monitoring wells.

- **Sample Handling**—Soil and ground-water samples will be collected, containerized, labeled, logged, and shipped to the offsite analytical laboratory in accordance with the Work Plan. Additionally, bedrock core samples will be obtained and stored onsite in core boxes, in accordance with the Work Plan.

- **Water Level Measurement**—The depth to water will be measured in each monitoring well.

- **Decontamination Activities**—Drilling and sampling equipment will be decontaminated before and after use in accordance with the Work Plan. Procedures for personnel decontamination are provided in Chapter 9.

- **IDW Management**—IDW generated during field activities will be handled and disposed of in accordance with the Work Plan.

- **Professional Land Survey**—Survey newly installed monitoring well locations. In addition, survey existing deep and bedrock monitoring wells located on the adjacent NCBC Davisville property.

5. HAZARD ANALYSIS

The following chemical and physical hazard analysis applies only to the proposed activities covered by this SSHSP.

5.1 HAZARD COMMUNICATION

Material safety data sheets, specified with the volume, for each chemical provided by EA shall be kept with the SSHSP. The material safety data sheets are contained in Attachment B. EA employees and EA subcontractors shall be informed of the location of material safety data sheets. Subcontractors must inform EA about any hazardous substances that they bring to the site and provide the appropriate material safety data sheets and quantities. Chemicals brought on the site must be properly labeled in accordance with the OSHA Hazard Communication requirements (29 CFR 1910.1200).

Chemicals provided by EA for field investigation purposes include the following:

- Liquinox
- Isopropanol
- Isobutylene (calibration gas)
- Hydrochloric Acid
- Methanol
- Nitric Acid

5.2 CHEMICAL HAZARDS

Potential hazardous substances known or suspected to be present at this site include soil and water impacted with petroleum constituents and CVOCs. The highest concentration of chemical compounds detected during previous investigations is provided in Table 5-1. These substances were identified through record searches and previous investigations.

- **Soil Sampling**—Soil sampling will take place outside. Chemical hazards may involve the exposure to petroleum constituents and CVOCs. Possible routes of exposure include inhalation, ingestion, and skin absorption.

- **Ground-Water Sampling**—Ground-water sampling will take place outside. Chemical hazards may involve the exposure to petroleum constituents and CVOCs dissolved in ground water. Possible routes of exposure include ingestion, skin absorption, and inhalation of vapors volatilizing from the ground water.

Potential hazardous substances are outlined in Attachment C. The worker exposure limits including Permissible Exposure Limits/Threshold Limit Values and the Immediately Dangerous

to Life or Health values for these hazardous substances are also included. The expected exposure (e.g., inhalation, dermal contact, and ingestion) to these hazardous substances per field activity is summarized below.
During all phases of the field work, strict adherence to the monitoring procedure in Table 5-2 will be conducted to help protect against inhalation of vapors from potential or known chemicals of concern. The proper PPE will protect against other types of exposure to the chemical hazards.

Table 5-3 presents the Task-Specific Activity Hazard Analysis.

5.3 PHYSICAL AND BIOLOGICAL HAZARDS

Physical and Biological Hazard Information Sheets provide potential hazards and protective measures. If additional hazards are encountered on the site, they will be added to this SSHSP. The following hazard sheets are included in Attachment D:

- Underground utilities
- Electrical hazards
- Biological hazards
- General physical hazards
- Noise hazards
- Fire/explosion hazards
- Heat stress
- Materials handling/moving/lifting
- Cold stress
- Drum handling
- Lyme Disease and Encephalitis

5.4 UNDERGROUND UTILITY HAZARDS

Underground utility lines must be identified prior to drilling. It is important to keep in mind that sufficient information is not always available and that these lines do present possible hazards to site personnel. Buried lines may include the following:

- Communication cables
- Sewer, water, drainage and irrigation lines.

The following steps shall be taken prior to advancing borings:

- Notify DIG-SAFE (888-344-7233) at least 48 hours prior to any subsurface activities begin.
- Obtain digging clearance from RIEDC
- Have RIEDC personnel mark underground utilities relative to their plans.

5.5 OVERHEAD HAZARDS

The majority of overhead hazards that pose a threat during site investigations are overhead electric and telephone lines. All overhead hazards such as building canopies or trees should be identified before lifts or other equipment are extended. The most serious of these hazards is contact with high voltage electric lines causing electrical burns and shock.

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. Workers will take appropriate protective measures when working near live electrical parts, including inspection of work area, to identify potential spark sources, maintenance of a safe distance, proper illumination of work areas, provision of barriers to prevent inadvertent contact, and use of non-conductive equipment. If overhead lines cannot be de-energized prior to the start of work, a 10-ft distance must be maintained between overhead energized power lines with a voltage of 50 kV and elevated equipment parts. This distance will be increased 4 in. for every 10 kV greater than 50 kV. For example, workers must maintain a distance of 11.7 ft from energized power lines with a voltage of 100 kV.

6. ENVIRONMENTAL MONITORING

6.1 ENVIRONMENTAL MONITORING AND ACTION LEVELS

Task-specific environmental monitoring requirements are summarized in Table 5-2, including the type of monitoring to be performed, the frequency and location of monitoring, action levels, and required responses if action levels are detected. Only personnel trained in proper use and calibration may operate the monitoring instruments. Calibration procedures for the photoionization detector/flame ionization detector are contained in Attachment E.

Initial and detectable measurements will be logged on the Environmental Monitoring Record (Attachment F). Each exceedance of an action level will also be documented on this log, along with the corrective action taken. If no detectable levels are measured, this will be documented at least once every 30 minutes.

6.2 CALIBRATION OF MONITORING INSTRUMENTS

The calibration of each instrument must be performed at the beginning of each day of use and at least once during the day. The calibration of each instrument must be checked according to the manufacturer's recommendations. Calibration data will be logged into the field notebook to show the date, calibration material type, and concentrations and actual reading obtained.

7. PERSONAL PROTECTIVE EQUIPMENT

Based on evaluation of the potential health and safety hazards (Chapter 5), the required initial levels of PPE are presented in Table 7-1 for each work task. Attachment G will be completed by onsite personnel when changes in PPE are necessary due to changed site conditions not specifically addressed in the original plan. Upgrade and downgrade PPE levels are listed below:

- **Upgrade PPE Level C**— Components: steel toe/steel shank neoprene safety boots, polycoated tyvek coveralls, latex inner gloves, nitrile or neoprene outer gloves,hard hat, and full face air purifying respirator with Type P100 cartridges (and the use of organic volatile cartridges will be implemented).

- **Downgrade PPE Level**—None.

Only the SHSO can authorize an upgrade or downgrade in the PPE level worn onsite. All changes in PPE levels must be documented on Attachment G, along with the rationale for the PPE changes. When respirators are required, site workers must have been successfully fit-tested and part of a medical monitoring program within 1 year prior to the start of work operations.

Subcontractors are required to supply their workers with the appropriate PPE.

The SHSO will review appropriate procedures for donning and doffing PPE prior to the start of work tasks. All PPE must be inspected by site workers prior to use and regularly during use. If any site worker experiences a failure or alteration of PPE that affects the level of protection offered, that person will immediately leave. Re-entry will not be permitted until the equipment has been repaired or replaced.

Hearing protection will be made available by the contractor and must be worn whenever noise levels exceed 85 dBA (noise level at which a normal conversation cannot be understood at a 3-ft distance). The hearing protectors will have a noise reduction rating sufficient to reduce the sound level to below 85 dBA.

8. SITE CONTROL

8.1 WORK ZONES

Proposed work zone for soil boring and monitoring well installation is an approximately 20-ft radius from the drill rig (defined as the Hot or Exclusion Zone) and will be marked off with traffic cones or flagging, as deemed appropriate by the Site Manager. The proposed work zone for ground-water sampling is an approximate 10-ft radius around each sampled location (defined as the Hot or Exclusion Zone).

Personnel who enter the work zones shall sign the Site Entry and Exit Log, Attachment H.

8.2 SAFE WORK PRACTICES

Safe work practices for site workers include the following:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the work zone
- Hands and face must be thoroughly washed upon leaving the work area
- When respirators are required, facial hair that interferes with the face-to-face piece fit of the respirator will not be permitted
- Personnel onsite must use the buddy system; visual contact must be maintained between team members at all times
- If dust is being visually generated in the Work Zone, the SHSO will advise on procedures for misting or wetting the soil to prevent possible exposure from inhalation of soil contaminants
- Possessing, using, purchasing, distributing, selling, or having controlled substances on site during the work day, including meal or break periods onsite, is strictly prohibited.
- The use or possession of alcoholic beverages onsite is prohibited. Similarly, reporting to work or performing one's job assignments under the influence of any level of alcohol is not permitted
- Telephones—There will be a mobile telephone in the EA vehicle and at RIEDC Headquarters, located at 1330 Davisville Road (i.e., near the main Davisville exit)

9. DECONTAMINATION PROCEDURES

9.1 PERSONNEL DECONTAMINATION

Remove and discard boot covers, if worn. Wash boots with detergent and water; rinse. Wash outer gloves with detergent and water, rinse, and remove. Remove disposable coveralls, then respirator, if worn. Remove and discard inner gloves, if worn. Wash hands, face, and other exposed skin with soap and water. Shower and shampoo as soon as possible at the end of the work day, before dining or social activities. Place non-disposable coveralls in plastic bags prior to leaving the site and prior to entering any EA or personal vehicle.

9.2 EQUIPMENT DECONTAMINATION

Environmental monitoring instruments used onsite will be wet-wiped with clean water prior to removing them from the site. When respirators are used, wet-wipe exteriors upon exiting work areas and clean with a manufacturer-recommended sanitizer, then hang to drip dry, and place in plastic bags for protection. Change respirator cartridges at least daily, when breakthrough occurs, or when breathing resistance becomes high, whichever occurs first. Used cartridges shall be duct taped and disposed.

Sampling equipment must be decontaminated in accordance with the Work Plan. Discoloration, stains, corrosive effects, and substances adhering to objects may indicate that contaminants have not been removed.

9.3 IDW DISPOSAL PROCEDURES

Used PPE, drill cuttings/fluids, fluids from sampling procedures, and liquids from decontamination procedures will be collected for disposal in accordance with the Work Plan.

10. MEDICAL MONITORING/ TRAINING REQUIREMENTS

Dates of employee training are documented in Table 2-1. Any person who does not meet these training requirements is prohibited from engaging in site operations. Once the SSHSP has been signed by the Project Manager, no other personnel may be added to the project field work without prior written approval by the Project Manager or SHSO, who must review the proposed employee's training and medical status. The following training must be completed prior to the start of work operations.

10.1 MEDICAL MONITORING

Hazardous waste site workers must have satisfactorily completed a comprehensive medical examination by a licensed physician within 12 months prior to the start of site operations. Non-hazardous waste site workers will be medically examined and undergo an annual respirator fit test to meet OSHA requirements specific to their job. The date of medical examination and respirator clearance for each EA site worker will be recorded on Table 2-1. Subcontractors will provide this information in writing to the Project Manager for their workers onsite prior to startup of field activities. Medical surveillance protocols shall comply with 29 CFR 1910.120.

10.2 TRAINING

All personnel must be active participants in a medical monitoring program that complies with 29 CFR 1910.120(f). Only individuals that will be in the field greater than 30 days will need to have completed an annual surveillance examination. Each individual must have completed an initial baseline examination within the last year prior to performing any site work covered by this SSHSP.

10.2.1 All Site Workers

- Prior to project start-up, 40-hour initial OHSA training, and 3 days of onsite training under the direct supervision of a more experienced site worker

- 8-hour annual OHSA refresher training (if >12 months have passed since 40-hour initial training or previous 8-hour refresher).

10.2.2 Site Manager

- Above requirements for site workers, plus one-time OHSA 8-Hour Supervisor's Hazardous Waste Operations Training.

10.2.3 Subcontractor Training

Prior to the start of work operations, the Project Manager will obtain a written list of subcontractor personnel to be present onsite, and written certification from the subcontractor management that these workers meet the training requirements summarized above in Section 10.2.

Non-hazardous waste site workers will have been trained to meet applicable OSHA requirements specific to their work. Training records and certification letters will be managed and maintained per the EA's Safety and Health Program Management Plan.

10.3 PRE-ENTRY BRIEFING

All site workers will read the SSHSP and indicate their understanding of the requirements by signing Attachment A, Site Health and Safety Review Record. The SHSO must check the training status of all onsite personnel and then brief workers on the potential hazards at the site and protective measures to be implemented, both prior to entry and daily during the work. An evacuation location to be used in the event of an emergency must be designated and known to all personnel. This location should be an upwind point from site activities, in an area not expected to be affected by emergency situations onsite. Authorized visitors are not permitted to enter areas where they may be exposed to hazardous substances if they do not meet the training requirements summarized above in Section 10.2.

10.4 FIRST AID/CPR

At least two employees currently trained in first aid/CPR will be on site while work is being performed. Directions to the Kent County Memorial Hospital are given in Table 11-1 and shown on the map in Attachment I.

11. EMERGENCY RESPONSE PLAN

11.1 EMERGENCY RECOGNITION

Prior to work start-up, personnel must be familiar with this Emergency Response Plan. The Site Manager must make this SSHSP available for review and copying by all field personnel. Field personnel will sign the Health and Safety Review Record (Attachment A). The location of evacuation areas and exit routes will be reviewed regularly as part of the ongoing site safety program. The location of the nearest operating telephone for emergency use should be determined. Emergency telephone numbers are provided in Table 11-1.

Field personnel must immediately stop work, tend to injured personnel, evacuate the Work Zone, and report to the Site Manager any of the following potential emergency situations such as:

- Personal injury
- Fire
- Explosion
- Chemical release.

Onsite emergencies will be handled by offsite emergency support personnel upon their arrival. In case of a hazardous materials emergency, the Site Manager or SHSO onsite will take control and direct the emergency response until the arrival of the emergency responders. The Site Manager, the Program Health and Safety Officer, or the SHSO will work with the emergency responders to identify and evaluate hazards. Emergency responses and communications will be coordinated and controlled through the Onsite Incident Commander, designated by the emergency responders.

In addition, if during drilling there is any indication that underground tanks, drums, or other containers are being encountered, the drilling will be halted immediately and the SHSO shall notify the Project Manager and the Program Health and Safety Officer. Indications that a waste container may have been encountered include:

- Change in the momentum/resistance of the sampling probe
- Visual examination of the soil samples
- Odor noted in the samples
- The presence of airborne total volatile organic compounds as measured with a direct-reading instrument.

11.2 PROCEDURES FOR HANDLING EMERGENCY INCIDENTS

EA will coordinate with local emergency responders, prior to commencing with site activities. In the event of an emergency, the information available at that time must be properly evaluated and the appropriate steps taken to implement the Emergency Response Plan. The Site Manager (or SHSO if the Site Manager is part of the emergency) shall assume command of the situation.

He/she must call the appropriate emergency services, evacuate personnel to the predesignated evacuation location as needed, and take other steps necessary to gain control over the emergency. Emergency telephone numbers, directions to the nearest hospital, and the location of the nearest telephone and other site communication equipment are presented in Table 11-1. A road map showing highlighted directions to the Kent County Memorial Hospital is presented in Attachment I.

Give the following information when reporting an emergency:

1. Name and location of person reporting
2. Location of accident/incident
3. Name and affiliation of injured party
4. Description of injuries, fire, spill, or explosion
5. Status of medical aid and/or other emergency control efforts
6. Details of any chemicals involved
7. Summary of accident, including suspected cause and time it occurred
8. Temporary control measures taken to minimize further risk.

This information is not to be released under any circumstances to parties other than those listed in this section and emergency response team members.

Once emergency response agencies have been notified, the Project Manager, Program Health and Safety Manager must be notified immediately. In addition, the following personnel must be notified immediately if the incident occurs within their jurisdiction.

- USACE Technical Manager [if within the site boundaries for Nike Site PR-58 or (off-site) north of Perimeter Road]
- Navy Technical Manager (if within the site boundaries maintained by NCBC Davisville)

11.3 MEDICAL EMERGENCIES

Personnel should always be alert for signs and symptoms of illnesses related to chemical, physical, and disease factors onsite. Severe injuries resulting from accidents must be recognized as emergencies and treated as such. At least one employee currently trained in first aid/CPR will be on site while work is being performed.

In a medical emergency, the Site Manager (or the SHSO if the Site Manager is not available) must sound the emergency alarm, upon which all work must stop and personnel must move to the decontamination area:

- If the emergency situation cannot be conveyed by word of mouth, an air/car horn or other alarm device will be sounded.
- One continuous blast of the air/car horn will be used as the emergency signal.
- Personnel currently trained in first aid and CPR will evaluate the nature of the injury, decontaminate the victim if the victim can be moved safely, and initiate first aid assistance immediately.
- First aid will be administered only to limit further injury and stabilize the victim.
- The local Emergency Medical Services must be notified immediately if needed.
- Victims that are heavily contaminated with toxic or dangerous materials should be decontaminated before being transported from the site.
- No persons will re-enter the Work Zone until the cause of the injury or symptoms has been determined and controlled.
- A fellow EA worker must accompany injured workers to the hospital to inform the admitting clerk that the injury is work-related to assist in completing the insurance forms.

Personnel will not transport victims to emergency medical facilities unless:

- The site is so remote that timely response of medical professionals is not possible
- The injury does not pose immediate threat to life and transport to the emergency medical facility can be accomplished without the risk of further injury.

The Site Manager must complete an Accident Investigation Report (Attachment J) and submit it to the Project Manager and Program Health and Safety Officer. The Program Health and Safety Officer will submit the report to the appropriate Technical Manager (i.e., USACE or Navy) within 24 hours of the following types of incidents:

- Job-related injuries and illnesses
- Accidents resulting in loss or damage to property

- All accidents involving vehicles and/or vessels, whether or not they result in damage to property or personnel

- Accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property

- An accident which results in a fatality or the hospitalization of 3 or more employees must be reported within 8 hours to the U.S. Department of Labor via the EA Human Resources representative. Subcontractors are responsible for notification involving their employees.

First aid/emergency equipment is available at the following locations:

- First Aid Kit — Onsite in EA vehicle
- Eye Wash — Onsite in EA vehicle
- Fire Extinguisher — Onsite in EA vehicle
- Emergency Alarm — Onsite in EA vehicle

The eye wash kit must be portable and capable of supplying at least a 15-minute supply of potable water to the eyes. This will also be located onsite in EA vehicle.

11.4 FIRE/EXPLOSION EMERGENCIES

Fire and explosion must be immediately recognized as an emergency. The Site Manager (or SHSO if the Site Manager is not available) must order evacuation and sound the emergency signal. Personnel must decontaminate and be evacuated to the predesignated evacuation location. If the emergency situation cannot be conveyed by word of mouth, a vehicle horn will be sounded. One continuous blast of the vehicle horn will be used as the emergency signal. The local emergency services must be notified. Only persons properly trained in fire suppression, spill control, and other emergency response procedures should attempt to deal with these situations. Other than small fires or spills, local emergency response services must be notified to handle the emergency. The Site Manager should take measures to reduce injury, primarily by evacuating personnel as quickly as possible. He/she must then notify the Project Manager. Cleanup after such events may require specialized services. The Project Manager will determine proper cleanup actions. Site personnel will not resume work during or after a fire/explosion incident until the Site Manager has directed the incident is over and work may resume. During the incident, site personnel will remain outside the incident area and obey the instructions of the Site Manager.

11.5 EMERGENCY TELEPHONE NUMBERS

Telephone numbers are listed in Table 11-1

12. SPILL CONTAINMENT PROCEDURES

Small incidental spills, i.e., those that cause no injury to personnel or the public, should be cleaned up quickly. For large spills, i.e., those that contaminate personnel or the environment, attend to first aid measures first, stop the source of the spill if possible, then notify the Program Health and Safety Officer and the appropriate Technical Manager (i.e., USACE or Navy). The Site Manager (or the SHSO in his/her absence) will notify the Project Manager as soon as possible. Spills of hazardous materials or wastes that are listed by U.S. Environmental Protection Agency as having a reportable quantity value must be reported to appropriate federal, state, and local agencies if a reportable quantity or greater is released. It is the USACE, Navy, or RIEDC's responsibility, as deemed appropriate by the Project Manager, to contact other appropriate federal, state, and local agencies.

Emergency telephone numbers are provided in Table 11-1.

13. CONFINED SPACE ENTRY PROCEDURES

No confined space entry is permitted or anticipated under this Delivery Order.

TABLE 2-1 SITE WORKER TRAINING AND PHYSICAL EXAMINATION RECORD

SITE: NCBC Davisville Site 16

Name	HAZWOPER 40-Hour Initial	HAZWOPER Annual	Respirator Fit Test	First Aid[a]	CPR[a]	Supervisor[b]	Medical Exam
James Shultz	1984	3/00	---	12/91	11/93	2/93	4/99
Barry Weissman	1995	12/99	12/99	8/97	8/97	9/95	10/99*
Jeff Norberg	1994	3/00	3/00	10/99	10/99	2/99	4/99*
Kevin Baum	2000	1/00	1/00	5/00	5/00	---	3/00*
Stella Kiras	1997	3/00	3/00	11/97	10/98	---	1/99*
Sam Whitin	2000	2/00	3/00	2/00	2/00	---	2/00*
Tom Biolsi	1997	10/99	2/99	4/98	4/98	---	10/99*
Jennifer Martin	1999	3/00	---	5/99**	5/99**	---	5/00
Dan Bishuk	1991	3/91	---	5/99**	5/99**	3/97	11/98**
John Clark	1998	3/00	---	5/99**	5/99**	---	2/00
Sue Chase	1993	4/00	---	3/99	3/99	4/93	6/99
Mike Chase	1996	4/00	---	3/99	3/99	---	5/00
Sandy Staigerwald	1989	7/99	5/00	1/99	1/99	12/90	***
Steve Welzant	1997	10/99	5/00	1/99	3/00	7/98	10/98**
Stephanie D'jimas	1998	2/00	---	8/99	8/99	---	8/99
James Gatherer	1999	2/00	---	8/99	8/99	---	12/99
Bob Haras	1989	2/00	---	8/99	8/99	12/94	3/00
Kim Shutty	1989	2/00	---	8/99	8/99	12/94	4/00
Robert Wasserman	2000	4/00	---	8/99	8/99	---	4/00

(a) At least two persons onsite must have current certification in first aid/CPR for all tasks.
(b) At a minimum, the Site Manager must have had supervisor's training.
* respirator clearance was issued at time of medical exam
** planned to be taken 6/00
*** planned to be taken 7/00
NOTE: No employees other than those listed above are permitted to work onsite without prior written approval by the Project Manager or SHSO.

TABLE 5-1 REPORTED MAXIMUM CONCENTRATIONS OF PREVIOUSLY DETECTED ANALYTES AT THE NIKE SITE AND STUDY AREAS 01/04 AND SITES 02/03 NCBC DAVISVILLE, RI

Chemical Analyte	Soil mg/kg	Ground Water µg/L
4,4-DDE	0.006	—
4,4-DDT	0.067	—
Acetone	3.1	—
Aroclor 1254	0.170	—
Aroclor 1260	0.080	—
Benzene	164	—
Benzo(b)fluoroanthene	0.190	—
Bis(2-ethylhexyl)phthalate	3.3	570
Chloroform	0.002	320
Chromium	21.8	9.6
1,1-Dichloroethene	0.005	160
1,2-Dichloroethene (total)	0.057	32,000
1,2-Dichloroethane	—	120
Gamma-chlordane	0.005	—
Lead	628	21
Methylene chloride	0.009	—
Nickel		200
PAH	0.450	—
Petroleum Based Hydrocarbons	3,110	—
Pyrene	0.260	—
Trichloroethene	1.8	160,000
1,1,2,-Trichloroethane	0.150	8,000
Tetrachloroethene	814	2,000
1,1,2,2-Tetrachloroethane	1.2	330,000

Chemical Analyte	Soil mg/kg	Ground Water µg/L
TPH	57,000	—
Toluene	0.003	2.5
Total BTEX	—	2,350
Total chlorinated VOCs	—	546,480
Vinyl Chloride	—	17

Notes:

— = either datum was not available or analyte concentration was not detected above the laboratory method detection limit.

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

TABLE 5-2 ENVIRONMENTAL MONITORING REQUIREMENTS

SITE: Former PR-58 Nike Site and NCBC Davisville Site 03				
Step/Task	Instrument	Frequency and Location	Action Levels	Required Response
Drilling, Ground-Water Sampling, Soil Sampling	PID or FID	Initially and approximately every 10 to 15 minutes in the breathing zone	0-1 ppm above background in breathing zone for 5 minutes	Evacuate to a safe upwind location and wait for levels to dissipate; retest the area after 15 minutes. If levels have not dissipated, continue work in Level C PPE *.
			Sustained 1-5 ppm above background in breathing zone	Continue work in Level C PPE *. Monitor continuously.
			>5 ppm above background in breathing zone	Evacuate to a safe upwind location immediately. Retest the area after 15 minutes wearing Level C PPE *. If levels have not dissipated in 30 minutes, contact the EA Project Manager and Program Safety and Health Officer.
Drilling, Monitoring Well Sampling	CGI	Initially when well is opened; measure at opening. Initially and approximately every 10 to 15 minutes during drilling. Measure at surface of hole.	0-10% LEL	Monitor with caution.
			10-20% LEL	Prepare to shut down.
			>20% LEL	Shut down. Contact SHSO and EA Project Manager.

NOTE: PID = Photoionization detector; FID = Flame ionization detector.
CGI = Combustible gas indicator.
PPE = Personal protective equipment.
* = Change respirator cartridges at least daily, when breakthrough occurs, or when breathing resistance becomes high, whichever occurs first.

TABLE 5-3 TASK-SPECIFIC ACTIVITY HAZARD ANALYSIS

Task	Potential Hazards	Hazard Control Measures
MOBILIZATION / DEMOBILIZATION	Chemical Exposure	• Review summary of known and potential chemicals of concern, be familiar with potential routes of exposure, and symptoms. • Follow recommended procedures for implementing appropriate level of PPE • Review MSDS with workers before work begins and follow recommended procedures for handling and storage of acids, as per MSDS • Wear gloves, tyveks, and eye protection to avoid dermal and eye contact in case of leak or splash
	General Safety Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs
	Heavy Equipment Hazards	• Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Understand and review hand signals • Wear hard hats and steel-toe safety shoes to prevent injuries

Task	Potential Hazards	Hazard Control Measures
MOBILIZATION / DEMOBILIZATION (continued)	Noise	• Position equipment down wind and as far away as practical. • Wear hearing protection if it is difficult to hold a conversation at a distance of 3-ft.
	Material Handling, Moving, Lifting	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads • Use two or more persons for heavy bulk lifting
	Vehicle and Pedestrian Traffic	• Use orange traffic cones. • Use reflective warning vests if exposed to vehicular traffic • Locate staging areas in locations with minimal traffic
	Fire/Explosion	• Eliminate sources of ignition from the work area • Prohibit smoking in the work areas • Provide ABC (or equivalent) fire extinguishers in work areas • Store flammable liquids in well ventilated areas
	Electrical	• Identify electrical utility hazards prior to sampling • Inspect work areas for spark sources, maintain safe distances, properly illuminate work areas, and provide barriers to prevent inadvertent contact • Maintain minimum clearance distances for overhead energized electrical lines as specified in EM 385-11.E.

Task	Potential Hazards	Hazard Control Measures
MOBILIZATION / DEMOBILIZATION (continued)	Weather	• Monitor marine radio for up-to-date severe weather forecasts • Discontinue work during thunderstorms and severe weather events
	Cold Stress	• Monitor of cold stress as recommended in Section 5.3 and Attachment D
	Heat Stress	• Monitor for heat stress as recommended in Section 5.3 and Attachment D
	Insect Bites / Poisonous Plants	• Wear protective outer clothing and insect repellant • Workers with allergies should carry antidote kits, if necessary
SITE RECONNAISSANCE / GROUND SURVEY	General Safety Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs
	Vehicle and Pedestrian Traffic	• Use orange traffic cones. • Use reflective warning vests if exposed to vehicular traffic • Locate staging areas in locations with minimal traffic
	Weather	• Monitor marine radio for up-to-date severe weather forecasts • Discontinue work during thunderstorms and severe weather events

Task	Potential Hazards	Hazard Control Measures
SITE RECONNAISSANCE / GROUND SURVEY (continued)	Cold Stress	• Monitor for cold stress as recommended in Section 5.3 and Attachment D
	Heat Stress	• Monitor for heat stress as recommended in Section 5.3 and Attachment D
	Insect Bites / Poisonous Plants	• Wear protective outer clothing and insect repellant • Workers with allergies should carry antidote kits, if necessary
SOIL GAS STUDY/ DRILLING AND CORING	Chemical Exposure	• Wear appropriate PPE , including gloves to minimize dermal contact and eye protection to minimize splash hazards. • Monitor organic vapors using a FID (flame ionization detector) or PID (photoionization detector)
	Noise	• Position equipment down wind and as far away as practical. • Wear hearing protection if it is difficult to hold a conversation at a distance of 3-ft.
	General Safety Hazards (slips, trips, falls, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs

Task	Potential Hazards	Hazard Control Measures
SOIL GAS STUDY/ DRILLING AND CORING (continued)	Material Handling, Moving, Lifting	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads • Use two or more persons for heavy bulk lifting
	Heavy Equipment Hazards	• Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Understand and review hand signals • Wear hard hats and steel-toe safety shoes to prevent injuries
	Fire/Explosion	• Eliminate sources of ignition from the work area • Prohibit smoking in the work areas • Provide ABC (or equivalent) fire extinguishers in work areas • Store flammable liquids in well ventilated areas
	Weather	• Monitor marine radio for up-to-date severe weather forecasts • Discontinue work during thunderstorms and severe weather events
	Cold Stress	• Monitor for cold stress as recommended in Section 8.1.2.8 and Attachment B
	Heat Stress	• Monitor for heat stress as recommended in Section 5.3 and Attachment D

Task	Potential Hazards	Hazard Control Measures
SOIL GAS STUDY/ DRILLING AND CORING (continued)	Electrical	• Identify electrical utility hazards prior to sampling • Inspect work areas for spark sources, maintain safe distances, properly illuminate work areas, and provide barriers to prevent inadvertent contact • Maintain minimum clearance distances for overhead energized electrical lines as specified in EM 385-11.E.
	Utilities	• Contact local utility companies to identify utility right-of-ways prior to sampling • Be aware of unanticipated hazards
	Insect Bites / Poisonous Plants	• Wear protective outer clothing and insect repellant • Workers with allergies should carry antidote kits, if necessary
MONITORING WELL INSTALLATION / WATER-LEVEL MEASUREMENT / SOIL AND GROUND-WATER SAMPLING / WASTE MANAGEMENT / EQUIPMENT DECONTAMINATION	Chemical Exposure	• Review MSDS with workers before work begins and follow recommended procedures for handling and storage of nitric acid, hexane, and methanol as per MSDS • Wear appropriate PPE , including gloves to minimize dermal contact and eye protection to minimize splash hazards.
	General Safety Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs

Task	Potential Hazards	Hazard Control Measures
MONITORING WELL INSTALLATION / WATER-LEVEL MEASUREMENT / SOIL AND GROUND-WATER SAMPLING / WASTE MANAGEMENT / EQUIPMENT DECONTAMINATION (continued)	Material Handling, Moving, Lifting	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads • Use two or more persons for heavy bulk lifting
	Noise	• Position equipment down wind and as far away as practical. • Wear hearing protection if it is difficult to hold a conversation at a distance of 3-ft.
	Fire/Explosion	• Eliminate sources of ignition from the work area • Prohibit smoking in the work areas • Provide ABC (or equivalent) fire extinguishers in work areas • Store flammable liquids in well ventilated areas
	Weather	• Monitor marine radio for up-to-date severe weather forecasts • Discontinue work during thunderstorms and severe weather events
	Cold Stress	• Monitor for cold stress as recommended in Section 5.3 and in Attachment D
	Heat Stress	• Monitor for heat stress as recommended in Section 5.3 and Attachment D
	Insect Bites / Poisonous Plants	• Wear protective outer clothing and insect repellant • Workers with allergies should carry antidote kits, if necessary

Task	Potential Hazards	Hazard Control Measures
SEISMIC REFRACTION & PROFILING	General Safety Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs
	Material Handling, Moving, Lifting	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads • Use two or more persons for heavy bulk lifting
	Electrical	• Identify electrical utility hazards prior to sampling • Inspect work areas for spark sources, maintain safe distances, properly illuminate work areas, and provide barriers to prevent inadvertent contact • Maintain minimum clearance distances for overhead energized electrical lines as specified in EM 385-11.E.
	Weather	• Monitor marine radio for up-to-date severe weather forecasts • Discontinue work during thunderstorms and severe weather events
	Cold Stress	• Monitor for cold stress as recommended in Section 5.3 and in Attachment D

Task	Potential Hazards	Hazard Control Measures
SEISMIC REFRACTION & PROFILING (continued)	Heat Stress	• Monitor for heat stress as recommended in Section 5.3 and Attachment D
	Insect Bites / Poisonous Plants	• Wear protective outer clothing and insect repellant • Workers with allergies should carry antidote kits, if necessary
SAMPLE HANDLING	Chemical Exposure	• Review MSDS with workers before work begins and follow recommended procedures for handling and storage of nitric acid, hexane, and methanol as per MSDS • Wear appropriate PPE , including gloves to minimize dermal contact and eye protection to minimize splash hazards.
	General Safety Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways, work areas of equipment, tools, debris • Watch for accumulation of water on walkways and work surfaces • Mark, identify, or barricade obstructions • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs
	Material Handling, Moving, Lifting	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads • Use two or more persons for heavy bulk lifting

TABLE 7-1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

Equipment	Level D	Level C
Hard hat	X[a]	X
Safety glass/splash shield	X/O	X/O
Work clothes	X	O
Boots, safety with steel toe/steel shank	X	NR
Boots, chemical resistant with steel toe and shank, or boot covers to go over safety boots	NR	X
Gloves, inner and outer, chemical resistant (nitrile)	O	X
Air-purifying full-face or half-face respirator	NR	X[b]
Chemical-resistant clothing	NR	X
Disposable boot protectors	NR	O
Hearing protection	O	O
Two-way radio communication	NR	X*

(a) Hard hat will be required while within the Exclusion Zone of the drilling rig, due to overhead hazards.

(b) Must comply with OSHA respirator cartridge provisions.

NOTE: X = Required.
O = Optional.
NR = Not required.
X* = If permitted.

TABLE 11-1 EMERGENCY INFORMATION

SITE: Former PR-58 Nike Site and NCBC Davisville Site 03		
Nearest telephone (give location, directions, and telephone number): EA Vehicles and RIEDC Headquarters, 1330 Davisville Road, Exit Site by traveling west on Davisville Road, Proceed to entrance of NCBC Davisville, RIEDC headquarters building will be on north side of the road near exit.		
Other site communication equipment: Cellular telephone in EA vehicle		
	Name	Phone Number
Police:	8166 Post Road, North Kingstown, RI	911 or 401-294-3311
Fire:	8150 Post Road, North Kingstown, RI	911 or 401-294-3344
Ambulance:	8150 Post Road, North Kingstown, RI	911 or 401-294-3344
Hospital:	Kent County Memorial Hospital 445 Toll Gate Road, Warwick, RI	401-267-2541
Directions to Hospital: Exit NCBC Davisville by traveling west on Davisville Road. Proceed to entrance of NCBC Davisville. Proceed under Route 2 overpass onto Devil's Foot Road. Continue approximately 2 miles on Devil's Foot Road and turn right onto Route 4. Take Route 4 North to Route 95 North. Take the first exit off of Route 95 onto Route 117. Take a left onto Route 117. Proceed one block to a traffic light and turn right. Follow road and bear right at first intersection. Follow road to the end and take a left onto Toll Gate Road. Hospital will be on your right.		
NATIONAL RESPONSE CENTER: **1-800-424-8802**		
Project Manager: Jim Shultz		(781) 275-8846 (work)
Site Manager: Jeff Norberg		(781) 275-8846 (work) (401) 658-2398 (home)
Site Safety and Health Officer: TBD		(781) 275-8846 (work)
Program Manager: Brenda Herman		(410) 584-7000 (work)
Program Safety and Health Officer: Barry Weissman, CSP		(732) 404-9370 (work)
EA Medical Services: Dr. Elayne F. Theriault, Medical Director Continuum Healthcare 4360 Chamblee Dunwoody Road, Suite 202 Atlanta, Georgia 30341		(770) 455-0818
Poison Control Center		(800) 822-9761
In case of accident or exposure, contact EA Human Resources within 24 hours		(410) 584-7000
NOTE: The Project Manager will verify telephone numbers and check with the emergency responder to ensure coordination. The medical facility will be contacted to determine the ability and desire to treat potentially contaminated patients.		

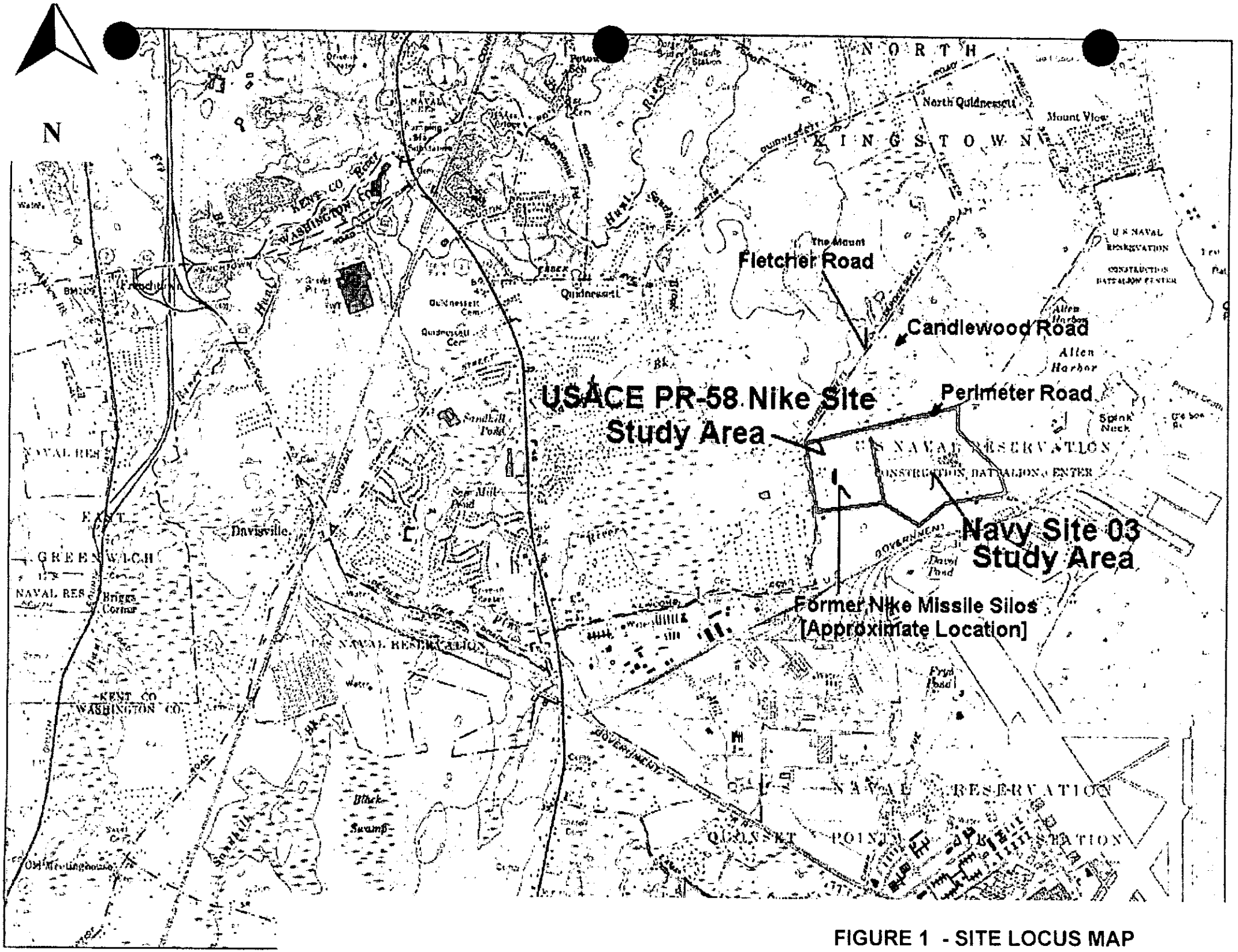

FIGURE 1 - SITE LOCUS MAP
USACE FORMER NIKE PR-58 SITE/ NCBC DAVISVILLE SITE 03 STUDY AREAS

LEGEND

- ● EXISITING MONITORING WELL
- ◉ LOCATION OF PROPERTY WITH PRIVATE-USE WELLS
- ○ PROPOSED MONITORING WELL FOR USACE
  - D – DEEP ZONE
  - R – SHALLOW COMPETENT BEDROCK ZONE
  - R2 – DEEPER COMPETENT BEDROCK ZONE
- △ PROPOSED MONITORING WELL FOR THE NAVY
- ------ SEISMIC REFRACTION SURVEY LINE

N

500 250 0 500 1000

GRAPHIC SCALE IN FEET

NOTES:

MONITORING WELL LOCATIONS ARE APPROXIMATE

BASE MAP (SOUTH OF PERIMETER RD) DIGITIZED FROM: NCBC CENTER DAVISVILLE RI STATION MAP, SEPT 1992, ADDITIONAL ROADS ADDED FROM AERIAL PHOTO DATED 4/95

OFFSITE AREA (NORTH OF PERIMETER RD) DIGITIZED FROM A DRAWING PROVIDED BY THE TOWN OF NORTH KINGSTOWN, RI.

G:\PROJECTS\60957.56\0001.WPS\FINAL\FIELDWP\FIGURES\FIG2.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

U.S. ARMY CORPS OF ENGINEERS
FORMER PR-58 NIKE SITE CHARACTERIZATION
NORTH KINGSTOWN, RHODE ISLAND

SITE MAP

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
JAS	JAS	JBN	JAS	04-19-00	AS SHOWN	60957.56	FIG.2	–	2

Attachment A

Site Health and Safety Review Record

ATTACHMENT A
SITE HEALTH AND SAFETY REVIEW RECORD

SITE: Former PR-58 Nike Site and NCBC Davisville Site 03
Project No. 60957.56.0003

I have read the Health and Safety Plan for this site and have been briefed on the nature, level, and degree of exposure anticipated as a result of participation in this project. I agree to conform to the requirements of this Plan.

Name	Signature	Affiliation	Date

Attachment B

Material Safety and Data Sheets

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response to Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ALCONOX(tm)

MSDS Number: A2052 --- ***Effective Date: 12/08/96***

1. Product Identification

Synonyms: Alkyl Aryl Sulfonates
CAS No.: Not applicable.
Molecular Weight: Not applicable.
Chemical Formula: Not applicable.
Product Codes: A461

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Alconox(tm)	N/A	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! CAUSES IRRITATION.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

--

Potential Health Effects

Inhalation:
None identified.

Ingestion:
May be harmful.

Skin Contact:
Irritation.

Eye Contact:
Irritation.

Chronic Exposure:
No information found.

Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes.

Eye Contact:
In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

---

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.

Explosion:
None identified.

Fire Extinguishing Media:
Use extinguishing media appropriate for surrounding fire.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

---

7. Handling and Storage

Keep container tightly closed. Suitable for any general chemical storage area. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a

full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
White Powder.

Odor:
No information found.

Solubility:
Appreciable (>10%)

Specific Gravity:
0.00

pH:
No information found.

% Volatiles by volume @ 21C (70F):
N/A

Boiling Point:
No information found.

Melting Point:
No information found.

Vapor Density (Air=1):
Not applicable.

Vapor Pressure (mm Hg):
Not applicable.

Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
No information found.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
No information found.

Conditions to Avoid:
No information found.

---

11. Toxicological Information

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Alconox(tm)	No	No	None

---

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Alconox(tm)	Yes	No	No	No

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Alconox(tm)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Alconox(tm)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Alconox(tm)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.

WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

Label Hazard Warning:
WARNING! CAUSES IRRITATION.

Label Precautions:
Keep in tightly closed container. Wash thoroughly after handling.

Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse.

Product Use:
Laboratory Reagent. Research and Development Use Only.

Revision Information:
Pure. New 16 section MSDS format, all sections have been revised.

Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

FISCHER & PORTER -- 141B079U03BT, PH 7 BUFFER SOLUTIONS
MATERIAL SAFETY DATA SHEET
NSN: 685000N033906
Manufacturer's CAGE: 22375
Part No. Indicator: A
Part Number/Trade Name: 141B079U03BT, PH 7 BUFFER SOLUTIONS

General Information

Company's Name: FISCHER & PORTER
Company's Street: 125 EAST COUNTY LINE RD
Company's City: WARRINGTON
Company's State: PA
Company's Country: US
Company's Zip Code: 18976
Company's Emerg Ph #: 215-674-6000
Company's Info Ph #: 215-674-6000
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 19SEP91
Safety Data Review Date: 05AUG92
MSDS Serial Number: BPQNS
Hazard Characteristic Code: NK

Ingredients/Identity Information

Proprietary: NO
Ingredient: NON HAZARDOUS INGREDIENTS
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: 1000314NH
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Physical/Chemical Characteristics

Appearance And Odor: WATER CLEAR LIQUID, CHARACTERISTIC ODOR.
Melting Point: N/A
Specific Gravity: 1
Solubility In Water: SOLUBLE
Percent Volatiles By Volume: 95

Fire and Explosion Hazard Data

Extinguishing Media: WATER, CO*2, DRY CHEMICAL POWDER, FOAM.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: USE WATER SPRAY TO DISPERSE VAPOR.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): HIGH TEMPERATURE
Materials To Avoid: NOT ESTABLISHED.
Hazardous Decomp Products: NOT ESTABLISHED.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): HIGH TEMPERATURE, FREE RADICAL SOURCES.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE/CHRONIC:UNKNOWN. EXPECTED TO BE HARMFUL BY ALL ROUTES. EXPECTED TO BE AN IRRITANT.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: CHEMICAL, PHYSICAL & TOXICOLOGICAL PROPERTIES ARE NOT ESTABLISHED FOR THIS MATERIAL. HANDLE WITH THE CARE REQUIRED BY GOOD LABORATORY TECHNIQUE.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: SKIN:WASH AFFECTED AREA W/COPIOUS AMOUNTS OF WATER. EYE:FLUSH W/WATER FOR AT LEAST 15 MINUTES. INHAL:REMOVE TO FRESH AIR. GIVE OXYGEN OR ARTIFICIAL RESPIRATION, AS NEEDED. INGEST:DRINK 1 OR 2 GLASSES OF WATER. CALL MD. SEEK MEDICAL TREATMENT IF DISCOMFORT PERSISTS.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: WEAR NIOSH/MSHA APPROVED SCBA, RUBBER BOOTS & GLOVES. ABSORB ON SAND, VERMICULITE, SAWDUST & PUT IN CONTAINER FOR FUTURE DISPOSAL. WASH & VENTILATE SPILL SITE AFTER PICKUP IS COMPLETE.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISSOLVE OR MIX MATERIAL W/COMBUSTIBLE. DISPOSE OF INSOLVENT & BURN IN EPA LICENSED CHEMICAL INCINERATOR EQUIPPED W/ AFTERBURNER & SCRUBBER. DISPOSE IN COMPLIANCE W/ALL LOCAL, STATE & FEDERAL REGULATIONS.
Precautions-Handling/Storing: STORE MATERIAL AT 4C. KEEP STORAGE CONTAINER TIGHTLY CLOSED. AVOID CONTACT W/SKIN & EYES. DO NOT INHALE.
Other Precautions: HANDLE WITH THE CARE REQUIRED BY GOOD LABORATORY TECHNIQUE.

Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR IF NEEDED.
Ventilation: MECHANICAL VENTILATION.
Protective Gloves: RUBBER GLOVES.
Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).
Other Protective Equipment: SAFETY SHOWER & EYE BATH.
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.

Transportation Data

Trans Data Review Date: 93019
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
Additional Trans Data: NOT REGULATED FOR TRANSPORTATION

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 20AUG92

Label Date: 05AUG92
Label Status: G
Common Name: 141B079U03BT, PH 7 BUFFER SOLUTIONS
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE:EXPECTED TO BE HARMFUL BY INHALATION, SWALLOWING AND SKIN ABSORPTION. AVOID CONTACT WITH SKIN AND EYES. DO NOT INHALE. WASH THOROUGHLY AFTER HANDLING. CHRONIC:NONE SPECIFIED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: FISCHER & PORTER
Label Street: 125 EAST COUNTY LINE RD
Label City: WARRINGTON
Label State: PA
Label Zip Code: 18976
Label Country: US
Label Emergency Number: 215-674-6000

LABCHEM -- LC12250, BUFFER SOLUTIONS PH 3.00-4.00-5.00,
MATERIAL SAFETY DATA SHEET
NSN: 681000N065235
Manufacturer's CAGE: 0MX47
Part No. Indicator: A
Part Number/Trade Name: LC12250, BUFFER SOLUTIONS PH 3.00-4.00-5.00,
(SUPDAT)

==========

General Information

==========

Company's Name: LABCHEM INC
Company's Street: 200 WILLIAM PITT WAY
Company's City: PITTSBURGH
Company's State: PA
Company's Country: US
Company's Zip Code: 15232
Company's Emerg Ph #: 412-626-5230
Company's Info Ph #: 412-626-5230
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 26MAY92
Safety Data Review Date: 24OCT95
MSDS Serial Number: BZQFR

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: POTASSIUM ACID PHTHALATE; (POTASSIUM HYDROGEN PHTHALATE)
Ingredient Sequence Number: 01
Percent: >1
NIOSH (RTECS) Number: 1000497PP
CAS Number: 877-24-7
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO
Ingredient: HYDROCHLORIC ACID (SARA 302/313) (CERCLA).
Ingredient Sequence Number: 02
Percent: 0-<0.1
NIOSH (RTECS) Number: MW4025000
CAS Number: 7647-01-0
OSHA PEL: C 5 PPM
ACGIH TLV: C 5 PPM; 9495

Proprietary: NO
Ingredient: SODIUM HYDROXIDE (CERCLA)
Ingredient Sequence Number: 03
Percent: 0-<0.1
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: C 2 MG/M3; 9495

Proprietary: NO
Ingredient: FORMALDEHYDE (SARA 302/313) (CERCLA)
Ingredient Sequence Number: 04
Percent: 0.04
NIOSH (RTECS) Number: LP8925000
CAS Number: 50-00-0
OSHA PEL: SEE 1910.1048
ACGIH TLV: C 0.3 PPM, A2; 9495

Proprietary: NO
Ingredient: WATER
Ingredient Sequence Number: 05
Percent: BALANCE
NIOSH (RTECS) Number: ZC0110000
CAS Number: 7732-18-5
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Physical/Chemical Characteristics

Appearance And Odor: CLEAR COLORLESS SOLUTION - MAY BE COLOR CODED (DYE) ACCORDING TO PH.
Boiling Point: 212F,100C
Melting Point: 32.0F,0.0C
Vapor Pressure (MM Hg/70 F): 14 @ 20C
Vapor Density (Air=1): 0.7 (H*2O)
Specific Gravity: 1.0
Evaporation Rate And Ref: >1 TTE (ETHER = 1)
Solubility In Water: COMPLETELY SOLUBLE

Fire and Explosion Hazard Data

Flash Point: NOT APPLICABLE
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM.
Special Fire Fighting Proc: USE NIOSH/MSHA APPRVD SCBA & FULL PROT EQUIP(FP N). NEGLIGIBLE FIRE & EXPLOSION HAZ WHEN EXPOS TO HEAT/FLAME. MOVE CNTNR IF POSS, AVOID BREATHING VAPORS/DUSTS.
Unusual Fire And Expl Hazrds: NO ACUTE HAZARD.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: INCOMPATIBLE WITH WATER REACTIVE SUBSTANCES (OLEUM, SODIUM,ETC.)
Hazardous Decomp Products: BYPRODUCTS: BOILING TO DRYNESS RELEASES A SMALL AMOUNT OF CHLORIDE GAS AND A TRACE OF FORMALDEHYDE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: POTASSIUM HYDROGEN PHTHALATE MAY CAUSE IRRITATION OF THE EYE, SKIN AND RESPIRATORY TRACT. REDNESS AND PAIN TO THE EYE CAN OCCUR. INGESTION CAN RESULT IN NAUSEA, VOMITING, AND DIARRHEA. CHRONIC: POTASSIUM HYDROGEN PHTHALATE MAY CAUSE RESPIRATORY IRRITATION, DERMATITIS, CONJUNCTIVITIS OF THE EYE. (EFTS OF OVEREXP)
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs/Symptoms Of Overexp: HLTH HAZ: TOXICITY: POTASSIUM HYDROGEN PHTHALATE IS AN EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: INHAL:MOVE VICTIM TO FRESH AIR, GIVE ARTF RESP

IF NEC. KEEP VICTIM WARM, AT REST. GET MED AID. SKIN:REMOVE CONTAMD CLTHG, WASH AREA W/SOAP & H*2O, FLUSH W/LARGE AMTS OF H*2O (15-20 MIN) UNTIL NO TRACE OF CHEM REMAINS. GET MED AID. EYES:FLUSH EYES W/LARGE AMTS OF H*2O, LIFTING UPPER/LOWER LIDS OCCASNLY FOR AT LEAST 15 MIN UNTIL CHEM IS GONE. GET MED AID. INGEST:GIVE CONSCIOUS VICTIM 2 TO 4(SUPDAT)

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: ABSORB WITH SUITABLE MATERIAL (VERMICULITE, DIATOMACCOUS EARTH, ETC.), PLACE IN SUITABLE CONTAINER AND LABEL FOR DISPOSAL. KEEP OUT OF SEWER AND WATER SOURCES.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISPOSE IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL LAWS.
Precautions-Handling/Storing: STORE AT ROOM TEMPERATURE, KEEP TIGHTLY CAPPED AND AWAY FROM WATER REACTIVE MATERIALS.
Other Precautions: WEAR SAFETY GOGGLES, DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

Control Measures

Respiratory Protection: PROVIDE GENERAL DILUTION VENTILATION. NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: NONE SPECIFIED BY MANUFACTURER.
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).
Other Protective Equipment: EYE WASH FOUNTAIN & DELUGE SHOWER WHICH MEET ANSI DESIGN CRITERIA (FP N).
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.
Suppl. Safety & Health Data: MFR'S TRADE NAME/PART #:CARBON STANDARD, 1000PPM (ORGANIC). FIRST AID PROC:GLASSES OF WATER, INDUCE VOMITING (TOUCH FINGER TO BACK OF THROAT). GET MEDICAL AID IMMEDIATELY.

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 25OCT95
Label Date: 25OCT95
Label Status: G
Common Name: LC12250, BUFFER SOLUTIONS PH 3.00-4.00-5.00, (SUPDAT)
Chronic Hazard: YES
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE: POTASSIUM HYDROGEN PHTHALATE MAY CAUSE IRRITATION OF THE EYE, SKIN AND RESPIRATORY TRACT. REDNESS AND PAIN TO THE EYE CAN OCCUR. INGESTION CAN RESULT IN NAUSEA, VOMITING, AND DIARRHEA. CHRONIC: POTASSIUM HYDROGEN PHTHALATE MAY CAUSE RESPIRATORY IRRITATION, DERMATITIS, CONJUNCTIVITIS OF THE EYE.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: LABCHEM INC
Label Street: 200 WILLIAM PITT WAY

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID (10%-33%)

MSDS Number: H3886 --- ***Effective Date: 11/17/99***

1. Product Identification

Synonyms: This MSDS applies to the concentrated standard used to make laboratory solutions and any solution that contains more than 10% but less than 33% Hydrochloric acid. For diluted product, see MSDS for Hydrochloric Acid (less than 10%). For saturated solution
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in H2O
Product Codes:
J.T. Baker: 4654, 4657, 4658, 5618, 5619
Mallinckrodt: 2608, 2609, 2625, H151, H168, V024, V035, V328

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	10 - 33%	Yes
Water	7732-18-5	67 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Water or water spray. Neutralize with soda ash or slaked lime.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

---

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage.

Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
5 ppm (STEL/Ceiling)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:

Pungent odor.
Solubility:
Infinitely soluble.
Density:
1.05 @ 15C (59F)
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
101 - 103C (214 - 217F)
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

---

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

```
--------\Cancer Lists\-----------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
```

Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia

Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Avoid breathing vapor or mist.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of

contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ISOPROPYL ALCOHOL (90 - 100%)

MSDS Number: I8840 --- *Effective Date: 09/08/97*

1. Product Identification

Synonyms: 2-Propanol; sec-propyl alcohol; isopropanol; sec-propanol; dimethylcarbinol
CAS No.: 67-63-0
Molecular Weight: 60.10
Chemical Formula: (CH3)2 CHOH
Product Codes:
J.T. Baker: 5082, 9037, 9080, U298
Mallinckrodt: 3027, 3031, 3032, 3035, 3037, 3043, 4359, 6569, H604, V073, V345, V555, V566

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Isopropyl Alcohol	67-63-0	90 - 100%	Yes
Water	7732-18-5	0 - 10%	No

3. Hazards Identification

Emergency Overview

WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND

RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

--
Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

--

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.
Ingestion:
Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (8 ounces).
Skin Contact:
May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Chronic Exposure:
Chronic exposure may cause skin effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Give large amounts of water to drink. Never give anything by mouth to an unconscious

person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Call a physician if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 399C (750F)
Flammable limits in air % by volume:
lel: 2.0; uel: 12.7
Listed fire data is for Pure Isopropyl Alcohol.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Isopropyl Alcohol (2-Propanol):
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
400 ppm (TWA), 500 ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with organic vapor cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene and nitrile rubber are recommended materials.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:

Rubbing alcohol.
Solubility:
Miscible in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
82C (180F)
Melting Point:
-89C (-128F)
Vapor Density (Air=1):
2.1
Vapor Pressure (mm Hg):
44 @ 25C (77F)
Evaporation Rate (BuAc=1):
2.83

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, aluminum, oleum and perchloric acid.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation rat LC50: 16,000 ppm/8-hour; investigated as a tumorigen, mutagen, reproductive effector.

```
--------\Cancer Lists\-----------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
```

Isopropyl Alcohol (67-63-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material may biodegrade to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ISOPROPANOL
Hazard Class: 3
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 355LB

International (Water, I.M.O.)

Proper Shipping Name: ISOPROPANOL

Hazard Class: 3.2
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 355LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Isopropyl Alcohol (67-63-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Isopropyl Alcohol (67-63-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Isopropyl Alcohol (67-63-0)	No	No	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Isopropyl Alcohol (67-63-0)	No	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2[S]2
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED

OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.

Label Precautions:

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.

Label First Aid:

If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 15.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

BACHARACH -- 51-1818 CALIBRATION GAS, METHANE 0.95% IN AIR
MATERIAL SAFETY DATA SHEET
NSN: 6630012826325
Manufacturer's CAGE: 05083
Part No. Indicator: A
Part Number/Trade Name: 51-1818 CALIBRATION GAS, METHANE 0.95% IN AIR

==========

General Information

==========

Company's Name: BACHARACH INC
Company's Street: 625 ALPHA DR
Company's City: PITTSBURGH
Company's State: PA
Company's Country: US
Company's Zip Code: 15238-5000
Company's Emerg Ph #: 412-963-2223
Company's Info Ph #: 412-963-2223
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SE
Date MSDS Prepared: 03MAR94
Safety Data Review Date: 29OCT96
Preparer's Company: BACHARACH INC
Preparer's St Or P. O. Box: 625 ALPHA DR
Preparer's City: PITTSBURGH
Preparer's State: PA
Preparer's Zip Code: 15238-5000
MSDS Serial Number: BRYGP

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: METHANE
Ingredient Sequence Number: 01
Percent: 0.95
NIOSH (RTECS) Number: PA1490000
CAS Number: 74-82-8
ACGIH TLV: SIMPLE ASPHYXIANT

Proprietary: NO
Ingredient: AIR
Ingredient Sequence Number: 02
Percent: 99.05
NIOSH (RTECS) Number: 1005486AI

==========

Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS, ODORLESS, TASTELESS COMPRESSED GAS IN CYLINDERS
Boiling Point: SEE SUPP
Melting Point: SEE SUPP
Vapor Density (Air=1): 0.991
Specific Gravity: 0.673
Solubility In Water: NEGLIGIBLE
Percent Volatiles By Volume: 100

==========

Fire and Explosion Hazard Data

==========

Flash Point: -306.4F METHANE
Flash Point Method: CC
Lower Explosive Limit: 5
Upper Explosive Limit: 15

Special Fire Fighting Proc: WEAR NIOSH APPROVED POSITIVE PRESSURE SCBA & FULL PROTECTIVE CLOTHING. USE SHIELDING TO PROTECT FROM CYLINDER EXPLOSION.
Unusual Fire And Expl Hazrds: COMPRESSED AIR/METHANE MIXTURES AT HIGH PRESSURE WILL ACCELERATE THE BURNING OF OTHER MATERIALS. GAS CYLINDERS EXPOSED TO HEAT/FLAME MAY VENT RAPIDLY/EXPLODE.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): HEAT, FLAMES, TEMP >130F.
Hazardous Poly Occur: NO

Health Hazard Data

Route Of Entry - Inhalation: NO
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: METHANE IS A NON-TOXIC SIMPLE ASPHYXIANT.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Emergency/First Aid Proc: OBTAIN MEDICAL ATTENTION IN ALL CASES.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: THIS MATERIAL IS NON TOXIC & NON-FLAMMABLE.
Waste Disposal Method: DON'T INCINERATE CYLINDER. DISPOSE OF IAW/FEDERAL, STATE & LOCAL REGULATIONS. NON-FLAMMABLE GAS. UN1956.
Precautions-Handling/Storing: DON'T STORE CYLINDERS NEAR HEAT/FLAME. EXPOSURE TO TEMP >130F MAY CAUSE RUPTURE. SECURE CYLINDERS. DON'T DROP/ DAMAGE CYLINDERS. DON'T PUNCTURE.
Other Precautions: CONTENTS UNDER HIGH PRESSURE. NEVER THROW CONTAINER INTO FIRE/INCINERATOR. USE W/EQUIPMENT OF PROPER PRESSURE RATING. DON'T TAMPER W/PRESSURE RELIEF VALVE. CLOSE CYLINDER VALVE WHEN NOT IN USE & WHEN EMPTY.

Control Measures

Respiratory Protection: NONE NEEDED.
Ventilation: NONE REQUIRED
Protective Gloves: LEATHER
Eye Protection: SAFETY GLASSES
Other Protective Equipment: NONE NEEDED
Suppl. Safety & Health Data: BOILING POINT: -259.6F (METHANE). MELTING POINT: -295.6F (METHANE). AUTOIGNITION TEMP: 1076F.

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 21SEP93
Label Date: 21SEP93
Label Status: F
Common Name: CALIBRATION GAS,METHANE 1% IN AIR
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-None: X

Contact Hazard-None: X
Fire Hazard-None: X
Reactivity Hazard-Slight: X
Special Hazard Precautions: THIS MATERIAL IS NON TOXIC. CAN BE FATAL IF SWALLOWED. HARMFUL IF ABSORBED THROUGH SKIN. INGESTION: DAMAGE TO KIDNEYS CAN LEAD TO BLOOD DISORDERS. SKIN & EYE IRRITANT. POISONOUS.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: BACHARACH INC
Label Street: 625 ALPHA DR
Label City: PITTSBURGH
Label State: PA
Label Zip Code: 15238
Label Country: US
Label Emergency Number: 800-424-9300
Year Procured: UNK

Please reduce your browser font size for better viewing and printing.

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MSDS Material Safety Data Sheet

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

NITRIC ACID 1.0 N AND 2.0 N VOLUMETRIC SOLUTIONS

MSDS Number: N3659 --- ***Effective Date: 10/15/99***

1. Product Identification

Synonyms: Azotic acid solution; nitric acid 6.3%; nitric acid 1.0 N volumetric solution; nitric acid 2.0 N volumetric solution; nitric acid 12.6%
CAS No.: 7697-37-2
Molecular Weight: 63.00
Chemical Formula: HNO3 in H2O
Product Codes:
J.T. Baker: 5639
Mallinckrodt: 3510

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	6 - 13%	Yes
Water	7732-18-5	> 87%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO

ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.
Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

---

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.
Explosion:
May react explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.
Fire Extinguishing Media:
If involved in a fire, use water spray.
Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Nitric Acid:
OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4 ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Suffocating, acrid.
Solubility:
Infinitely soluble.
Specific Gravity:
No information found.
pH:
No information found.

% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.
Conditions to Avoid:
Heat and incompatibles.

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11. Toxicological Information

For Nitric Acid: Investigated as a mutagen and reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Nitric Acid (7697-37-2)	No	No	None
Water (7732-18-5)	No	No	None

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12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: Yes (Mixture / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0** Other: **Oxidizer**
Label Hazard Warning:
POISON! DANGER! OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Store in a tightly closed container.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SULFURIC ACID, < 10%

MSDS Number: S8236 --- *Effective Date: 09/15/98*

1. Product Identification

Synonyms: Sulfuric acid solution; Sulfuric Acid Volumetric Solutions 2.0 Normal and below
CAS No.: 7664-93-9
Molecular Weight: 98.07
Chemical Formula: H2SO4 in H2O
Product Codes:
J.T. Baker: 4699, 4703, 4704, 5640, 5641, 5642, 5690, 5692, 5693, 5694
Mallinckrodt: 6843, 7610, H366, H372, H381, H389, H392, H641

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	0.1 - 10%	Yes
Water	7732-18-5	90 - 99%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED

WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive. Effects should be less severe than from exposure to higher concentrations of sulfuric acid. Symptoms may include irritation of the nose and throat, labored breathing, as well as lung edema, damage to the mucous membranes and upper respiratory tract.
Ingestion:
Corrosive. Effects should be less severe than from exposure to higher concentrations of sulfuric acid. Symptoms may include severe burns of the mouth, throat, and stomach. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death. May cause sore throat, vomiting, diarrhea.
Skin Contact:
Corrosive. Effects should be less severe than from exposure to higher concentrations of sulfuric acid. Symptoms may include redness, pain, and burns to the skin. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.
Eye Contact:
Corrosive. Effects should be less severe than from exposure to higher concentrations of sulfuric acid. Symptoms may include blurred vision, redness, pain, and burns to eye tissue. Concentrated solutions can cause blindness.
Chronic Exposure:
Long term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

First aid procedures given apply to concentrated solutions. Exposures to dilute solutions may not require these extensive first aid procedures.

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion:
DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.

Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

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5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

Explosion:
Contact with most metals causes formation of flammable and explosive hydrogen gas.

Fire Extinguishing Media:
Dry chemical, foam, water or carbon dioxide. Concentrated solutions are water reactive.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(tm) or TEAM(tm) 'Low Na+' acid neutralizers are recommended for spills of this product.

---

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Sulfuric Acid:
-OSHA Permissible Exposure Limit (PEL):
1 mg/m3 (TWA).
-ACGIH Threshold Limit Value (TLV):
1 mg/m3 (TWA), 3 mg/m3 (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge and dust/mist filter may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless solution.
Odor:
Odorless.
Solubility:
Miscible in water.
Specific Gravity:
ca. 1.0 (0.1%), 1.07 (10%)
pH:
1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.
% Volatiles by volume @ 21C (70F):
> 95
Boiling Point:
No information found.
Melting Point:
3C (100%), -32C (93%), -38C (78%), -64C (65%).
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
(The following information applies to concentrated solutions). Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.
Conditions to Avoid:
Heat, incompatibles.

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11. Toxicological Information

Toxicological Data:
Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.
Carcinogenicity:
Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sulfuric Acid (7664-93-9)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.
Environmental Toxicity:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SULFURIC ACID (WITH NOT MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN2796
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH NOT MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN2796
Packing Group: II
Information reported for product/size: 200L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Sulfuric Acid (7664-93-9)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sulfuric Acid (7664-93-9)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sulfuric Acid (7664-93-9)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sulfuric Acid (7664-93-9)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: No information found.
WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 14.
Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 800-659-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYDROXIDE SOLUTIONS AND CONCENTRATES

MSDS Number: S4040 --- ***Effective Date: 12/08/96***

1. Product Identification

Synonyms: Sodium hydroxide, 0.2 to 2.0 normal volumetric solutions; DILUT-IT(tm) analytical concentrates; Sodium Hydroxide Concentrate Solution StandARd(tm)
CAS No.: 1310-73-2
Molecular Weight: 40.00
Chemical Formula: NaOH in water
Product Codes:
J.T. Baker: 4687, 4691, 4715, 5633, 5634, 5635, 5636, 5638, 5665, 5667
Mallinckrodt: 4693, H361, H364, H377, H380, H635, V027

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	0.8 - 8%	Yes
Water	7732-18-5	92 - 99%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED.

CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

The health effects from exposure to diluted forms of this chemical are not well documented. They are expected to be less severe than those for concentrated forms which are referenced in the descriptions below.

Inhalation:
Severe irritant. Effects from inhalation of mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.
Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appears days after exposure.
Skin Contact:
Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.
Eye Contact:
Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

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6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRACIT(tm)-2 or BuCAIM(tm) caustic neutralizers are recommended for spills of this product.

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7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Protect from freezing. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Sodium hydroxide:
-OSHA Permissible Exposure Limit (PEL):
2 mg/m3 Ceiling
-ACGIH Threshold Limit Value (TLV):
2 mg/m3 Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Physical data is displayed for a 5% solution of sodium hydroxide.

Appearance:
Clear, colorless solution.
Odor:
Odorless.
Solubility:
Miscible in water.
Density:
5% solution: 1.05
pH:
14.0
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
102C (216F) (5% solution)
Melting Point:
-4C (25F) (5% solution)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No hazardous decomposition products.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acids, aluminum, tin and zinc metals
Conditions to Avoid:
Heat, moisture, incompatibles.

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11. Toxicological Information

Sodium hydroxide: irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe. Investigated as a mutagen.

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--------\Cancer Lists\-------------------------------------------------------
                                    ---NTP Carcinogen---
Ingredient                          Known    Anticipated    IARC Category
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Sodium Hydroxide (1310-73-2)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM HYDROXIDE SOLUTION
Hazard Class: 8
UN/NA: UN1824
Packing Group: II
Information reported for product/size: 208L

International (Water, I.M.O.)

Proper Shipping Name: SODIUM HYDROXIDE SOLUTION
Hazard Class: 8
UN/NA: UN1824
Packing Group: II
Information reported for product/size: 208L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia

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Sodium Hydroxide (1310-73-2)                        Yes  Yes   Yes      Yes
Water (7732-18-5)                                   Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\--------------------------------
                                                        --Canada--
Ingredient                                        Korea  DSL   NDSL  Phil.
----------------------------------------------    -----  ---   ----  -----
Sodium Hydroxide (1310-73-2)                       Yes   Yes   No     Yes
Water (7732-18-5)                                  Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                          -SARA 302-    ------SARA 313------
Ingredient                                RQ    TPQ     List  Chemical Catg.
----------------------------------------  ---   -----   ----  --------------
Sodium Hydroxide (1310-73-2)              No    No      Yes        No
Water (7732-18-5)                         No    No      No         No

--------\Federal, State & International Regulations - Part 2\----------------
                                                  -RCRA-    -TSCA-
Ingredient                                CERCLA  261.33     8(d)
----------------------------------------  ------  ------    ------
Sodium Hydroxide (1310-73-2)              1000    No         No
Water (7732-18-5)                         No      No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: No   Fire: No  Pressure: No
Reactivity: No          (Pure / Liquid)
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Australian Hazchem Code: 2R
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, give several glasses of water or milk to drink. Vomiting may occur spontaneously, but DO NOT INDUCE! Never give anything by mouth to an unconscious

person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

New 16 section MSDS format, all sections have been revised.

Disclaimer:

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Prepared by: Strategic Services Division
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Attachment C

Potential Hazardous Substances

ATTACHMENT C
POTENTIAL HAZARDOUS SUBSTANCES

Substance	Maximum Levels in Media	Exposure Limits PEL (O) or TWA(A), STEL(S)	IDLH	Route of Exposure	Symptoms
INORGANICS					
Chromium	21.8 (S) 9.6 (GW)	1 mg/m^3 (O) 0.5 mg/m^3 (A)	250 mg/m^3 (as Cr)	Inhalation Ingestion, Contact: skin, eyes	Irritates eyes, skin, upper respiratory system, burns; eyes, skin
Lead	628 (S) 21 (GW)	0.5 mg/m^3 (A) 0.05 mg/m^3 (O)	100 mg/m^3 Pb	Inhalation; Ingestion; Skin and/or eye Contact	Weak; insomnia; facial pallor; low-weight; constipation; abdominal pain; anemia; gingival lead line; tremor; encephalopathy; kidney disease; irritable eyes
Nickel	200 (S)	0.01 mg/m^3 (A) 1 mg/m^3 (O)	[10 mg/m^3 (as Ni)] Ca	Inhalation, Ingestion, Contact; skin, eyes	Sensitization of skin, allergic asthma, pneumonitis, carcinogen
VOLATILES					
Acetone	3.1 (S)	1000 ppm (O) 500 ppm (A)	2500 ppm [10%LEL)	Inhalation, Ingestion, Contact: skin, eyes	Irritant: eyes, nose, throat. Dizziness, CNS depression, dermatitis.
Benzene	164 (S)	1 ppm (O) [Ca] 5 ppm (S) 0.5 ppm (A), skin, [Ca]	[500 ppm] Ca	Inhalation, Absorption, Ingestion, Contact; skin, eyes	Irritant: eyes, skin, nose, respiratory system. Giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis, bone marrow depression, [carcinogen].
Chloroform	0.002 (S) 320 (GW)	2 ppm (S) 50 ppm (O), ceiling 10 ppm (A)	[500 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritant: eyes, skin. Dizziness, mental dullness, nausea, confusion, headache, fatigue, anesthesia, enlarged liver, [carcinogen].
1,1-Dichlorethene	0.005 (S) 160 (GW)	N.D.	[N.D.] Ca	Inhalation, skin absorption, Ingestion, Contact: skin, eyes	Irritant to eyes, skin, throat; dizziness, headache, nausea, dydpnea (breathing difficulty); liver kidney dysfunction; pneumonitis; [potential occupational carcinogen].
1,2-Dichlorethene (total)	0.057 (S) 32,000 (GW)	200 ppm (O, A)	1,000 ppm	Inhalation, Ingestion, Contact: skin, eyes	Irritation eyes, respiratory system; central nervous system depressant/depression
1,2-Dichlorethane	120 (GW)	10 ppm (A) 2 ppm (S) 50 ppm (O)	[50 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Eye Irritant, corneal opacity, CNS depression, nausea, vomiting, dermatitis, liver and kidney and CVS damage.
Methylene chloride	0.009 (S)	50 ppm (A) 25 ppm (O) 125 ppm (S)	[2,300 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritation eyes, skin; fatigue, weakness, somnolence (sleepiness, unnatural drowsiness), lightheadedness; numbness, tingle limbs; nausea; [Potential occupational carcinogen]

Substance	Maximum Levels in Media	Exposure Limits PEL (O) or TWA(A), STEL(S)	IDLH	Route of Exposure	Symptoms
Trichloroethene	1.8 (S) 160,000 (GW)	50 ppm (A) 100 ppm (O)	[1,000 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritation eyes, skin; headache, vertigo (an illusion of movement); visual disturbance, fatigue, giddiness, tremor, somnolence (sleepiness, unnatural drowsiness), nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [Potential occupational carcinogen]
1,1,2-Trichloroethane	0.150 (S) 8,000 (GW)	10 ppm (O, A)	[100 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritation eyes, nose; central nervous system depressant/depression; liver, kidney damage; dermatitis; [Potential occupational carcinogen]
Tetrachloroethene	814 (S) 2,000 (GW)	50 ppm (A) 100 ppm (O)	[150 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; vertigo (an illusion of movement); dizziness, incoordination; headache, somnolence (sleepiness, unnatural drowsiness); skin erythema (skin redness); liver damage; [Potential occupational carcinogen]
1,1,2,2-Tetrachloroethane	1.2 (S) 330,000 (GW)	1 ppm (A), skin 5 ppm (O), skin	[100 ppm] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Nausea, vomiting, abdominal pain, tremors in fingers, jaundice, hepatitis, liver tenderness, dermatitis, monocytosis, kidney damage. [carcinogen]
Toluene	0.003 (S) 2.5 (GW)	50 ppm (A), skin 150 ppm (S) 200 ppm (O)	500 ppm	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritant to eyes and nose. Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervous, muscle fatig, insom, paresthesia, dermatitis, liver and kidney damage.
Vinyl chloride	17 (GW)	1 ppm (O, A) 5 ppm (S)	[N.D.] Ca	Inhalation, Contact [liquid]: skin, eyes	Weakness, abdominal pain, GI bleeding, enlarged liver, cyanosis of extremities, [liquid]: frostbite. [carcinogen]
SEMI-VOLATILES					
Pyrene	0.260 (S)	0.2 mg/m3 (A,O)	[80 mg/m^3] Ca	Inhalation, Contact:skin, eyes	Dermatitis, bronchitis, [carcinogen]
PESTICIDES					
4,4-DDT	0.067 (S)	1.0 mg/m3 (A) 1.0 mg/m3 (O) skin	[500 mg/m3] Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Irritation eyes, skin; paresthesia tongue, lips, face; tremor; apprehension, dizziness, confusion, malaise (vague feeling of discomfort), headache, fatigue; convulsions; paresis hands; vomiting; [Potential occupational carcinogen]
Gamma-chlordane	0.005 (S)	0.5 mg/m3 (O, A), skin	100 mg/m3 Ca	Inhalation, Absorption, Ingestion, Contact: skin, eyes	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea, irritability, tremor, convulsions; anuria; in animals: lung, liver, kidney damage; [Potential occupational carcinogen]

Substance	Maximum Levels in Media	Exposure Limits PEL (O) or TWA(A), STEL(S)	IDLH	Route of Exposure	Symptoms

NOTE:
- IDLH = Immediately Dangerous to Life and Health.
- N.D. = Not Determined.
- O PEL = Permissible Exposure Limit.
- A TWA = American Conference of Governmental Industrial Hygienists –Threshold Limit Value - Time Weighted Average
- S STEL = Short-Term Exposure Limit (15 min)
- Ca = Carcinogen

Media Description:
- S Soil (mg/kg)
- GW Ground Water (ug/L)

Attachment D

Physical and Biological Information Sheets

ATTACHMENT D
PHYSICAL HAZARD INFORMATION SHEET: UNDERGROUND UTILITIES

Underground utilities pose hazardous to workers involved in drilling, excavation, soil vapor contaminant analysis, and other invasive operations. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, water, and/or irrigation lines.

The estimated location of underground installations, including sewer, telephone, fuel, electric, water lines, or other underground installations that reasonably may be expected to be encountered during invasive work shall be determined prior to the start of any invasive work. This may be determined by contacting appropriate utilities, contacting a utility clearance service, using site maps and prominent site features, using a pipe and cable locator, etc. Buried utilities encountered during invasive operations must be protected while digging to prevent risks to site personnel and damage to the utilities.

Site-Specific Hazards and Protective Measures: Drilling/trenching operations must be cleared prior to initiation.

PHYSICAL HAZARD INFORMATION SHEET: ELECTRICAL HAZARDS

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. In accordance with OSHA's standard for Electrical Safety-Related Work Practices (29 CFR 1910.331-.335), protective measures must be taken when working near live electrical parts, including but not limited to:

- Insulation and guarding of life parts
- Grounding
- De-energizing live parts followed by lockout/tagout to prevent inadvertent reactivation of the parts
- Electric protective devices (e.g., insulated tools)
- Safe work practices, including:
  - — Inspection of work area to identify potential spark sources
  - — Maintenance of a safe distance from all live electrical parts
  - — Proper illumination of work areas
  - — No "blind reaching" around live electrical equipment
  - — Provision of barriers, shields, or insulation to prevent inadvertent contact with live parts
  - — Use of non-conductive, intrinsically safe equipment near live parts.

Overhead lines pose electrical hazards at many sites, particularly for work involving the use of equipment with elevated parts (e.g., drill rigs, backhoes). If overhead lines cannot be de-energized prior to the start of work, the following minimum distances must be maintained between the lines and both site workers and the longest conductive object present (including vehicles with elevated structural parts:

- 10 ft from overhead lines with voltage of 50 kV or less.
- 10 ft plus 4 in. for every 10 kV over 50 kV for overhead lines with voltages greater than 50 kV. For example, the minimum distance that must be maintained from a 250 kV line is 16.5 ft.

PHYSICAL HAZARD INFORMATION SHEET: ELECTRICAL HAZARDS (Continued)

EA personnel are not permitted to work on electric parts of equipment that have not been de-energized, locked out, and tagged by personnel trained to work with electrical equipment. No EA employee may work near energized exposed live parts without the use of any protective measures. Personal protective equipment designed to protect against electrical hazards may be specified for certain work operations. The Project Manager is responsible for ensuring that appropriate safety measures are implemented to protect against electrical safety hazards on their sites.

Lightning is a hazard during outdoor operations, particularly for workers handling metal equipment. To eliminate this hazard, weather conditions should be monitored and work suspended at the discretion of the SHSO during electrical storms.

Site-Specific Hazards and Protective Measures:
Generator: Use proper precautions while working with electrical connections DO NOT USE wires if frayed or bare wires are exposed.
A ground fault interrupter (GFCI) is required on all electrical equipment used outside if run off a regular circuit or generator greater than 5,000 watts.

PHYSICAL HAZARD INFORMATION SHEET: HEAVY EQUIPMENT HAZARDS

The use of heavy equipment (e.g., backhoes, dump trucks, generators, compressors, etc.) may pose a variety of health and safety hazards to site workers.

All heavy equipment work must be conducted only by trained, experienced personnel. Equipment backing up, swinging loads, buckets, booms, and counter-weights pose serious hazards to ground personnel. If possible EA personnel must remain outside the turning radius of any large, moving equipment. At a minimum, EA personnel must maintain visual contact with the equipment operator when the equipment is active.

No EA personnel are permitted to work underneath heavy equipment, because this practice poses serious crushing hazards.

Belts, pulleys, sheaves, gears, chains, shafts, clutches, drums, flywheels, and other moving parts of equipment can pose injury hazards. No guard, safety appliance, or other device may be removed or made ineffective unless repairs or maintenance are required, and then only after power has been shut off and locked out. Safety devices must be replaced once repair/maintenance is complete.

Exhaust from all equipment powered by steam or combustion engines must be properly located so that release of exhaust does not endanger workers or obstruct the view of the operator. Gasoline-operated equipment must be re-fueled properly to prevent fire hazards; power must be off, no smoking allowed, and proper dispensing equipment must be used.

When not operational, equipment shall be set and locked so that it cannot be activated, released, dropped, etc. Backhoe buckets must be lowered to the ground.

Site-Specific Hazards and Protective Measures:

Heavy Equipment: Proper precautions as described above should be exercised while working in the vicinity of the MIP rig or drill rig. Make certain that you have eye contact with the driver if in the vicinity of heavy equipment to let him know you are in the area.

Generator: Use proper precautions when lifting or moving the generator or sampling equipment. Use at least two people to lift generator off of tail-gate and bend at the knees.

PHYSICAL HAZARD INFORMATION SHEET: VEHICLE AND PEDESTRIAN TRAFFIC

Traffic at certain sites, particularly active sites in busy areas, presents a hazard to site personnel. Equipment must be located in an area that does not present hazards to bystanders. Barriers must be used to separate the work areas from both vehicle and pedestrian traffic areas and to prevent inadvertent entry of either type of traffic into the work area. The demarcated area must include adequate buffer zones between the actual work area and traffic areas. Standard traffic cones are not considered adequate for these situations, due to their low vertical profile. Taller, 28-in. cones can be effectively modified with warning flags and barricade tape. Safety pennants and plastic or steel "A" frame type barricades may also be used in high traffic areas. Flashing warning lights may also be necessary. Barriers demarcating the work areas and buffer zone are required even if the site is inactive during work operations.

Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

In excavation areas, excavated soil materials may be placed between the hole and traffic areas to act as a barrier to both vehicle and pedestrian traffic. Such material must be placed in a manner which will not pose engulfment hazards to either site workers or bystanders.

Site-Specific Hazards and Protective Measures:

Traffic: At times there will be several sampling teams on-site. Use proper precautions and follow traffic laws applicable to the RI or Davisville. Speed limit 10 mph, in the field, or as otherwise posted.

PHYSICAL HAZARD INFORMATION SHEET: BIOLOGICAL HAZARDS

Insect Bites/Stings

Protective outer clothing such as gloves, hard hats, and coveralls can help reduce the potential for insect bites and stings. Insect bite symptoms include redness, rash, swelling, chills, fever, diarrhea, and vomiting. Any worker who has been bit or stung and shows symptoms of a severe reaction should seek medical assistance immediately. Workers who know of any allergies they may have to any insects must advise their employer prior to engaging in any field activities and may want to carry antidote kits.

To prevent contact with disease-carrying ticks, wear long-sleeved shirts, long pants, and boots that extend above the ankle with socks pulled over pants cuffs. Permanone insecticide may be used to kill disease-bearing ticks and may be sprayed only on the outside of clothing (not directly on skin). Frequently check clothing, skin, and hair for the presence of ticks at the end of the work day. If a tick attaches to the body, remove by gently tugging with tweezers where the mouth parts enter the skin. Do not kill the tick prior to removal.

Poisonous Plants

Poisonous plants such as poison ivy may be present on certain sites during part of the year. Know how to recognize these plants and avoid contact. If contact occurs, wash affected areas with soap and water immediately.

Snakes/Rodents

On occasion, field workers may come into contact with snakes and/or rodents (rats, gophers, etc.). In case of a snake bite, which can be fatal, workers must immediately seek medical assistance and report the incident to the Site Health and Safety Officer (SHSO) and Site Manager, according to the procedures delineated in the Health and Safety Plan (HASP). Prompt medical attention is also required for rodent bites since many rodents carry rabies and other diseases. Field workers must report rodent bites to the SHSO and Site Manager immediately according to HASP requirements.

Site-Specific Hazards and Protective Measures: Biological hazards will be present due to the time of the year for the planned activities. Workers should keep as much skin as possible covered to protect against bites, stings, etc.

PHYSICAL HAZARD INFORMATION SHEET: GENERAL PHYSICAL HAZARDS

Hazardous waste and other field operation sites include many basic safety hazards, such as:

- Holes, ditches, etc., posing fall, cave-in, and other hazards
- Precariously positioned objects, which may cause crushing or other injuries
- Sharp objects (e.g., nails, metal shards, glass), which may cause cuts, injection, or other injuries
- Slippery surfaces, posing slip and fall hazards
- Steep grades and/or uneven terrain, posing slip, trip, and fall hazards
- Unstable surfaces (e.g., walls that may cave-in, unstable underground structures) which may pose fall, crushing, or other injuries.

Basic safety hazards can directly injure workers and create additional hazards. For example, a person may trip due to uneven terrain, fall and be cut on rusty metal shards, and become inoculated with contaminants adhering to the metal.

Site personnel should look constantly, closely, and carefully for these basic safety hazards and immediately inform the SHSO of any conditions that they feel may be hazardous.

Site-Specific Hazards and Protective Measures:

Exert extra precaution while working around vehicle sampling rigs and wet surfaces while collecting samples. Keep work area neat and orderly to prevent trip hazards.

PHYSICAL HAZARD INFORMATION SHEET: DRILLING

The selection of locations for each drilling activity site will take into account buried utility pipes, wires, conduits, and tanks, or other potentially dangerous structures. Overhead power lines and obstructions will also be surveyed. Prior to raising the mast, the area overhead and surrounding the rig will be checked by the drilling foreman and the SHSO. The longest conductive object on the drill rig will be located with a minimum of 10-ft clearance from overhead lines with voltages less than or equal to 50 kV. For lines with voltages exceeding 50 kV, the longest drill rig object must be at least 10 ft plus 4 in. for every 10 kV over 50 kV (e.g., for 250 kV line, clearance must be at least 16.7 ft). The client will inform EA of the voltages of any overhead lines in the vicinity of drilling operations.

When rotary drilling/sampling, drill rods will not be racked more than 1.5 times the height of the mast. During drilling operations and rig setup and takedown, all persons who enter the Exclusion Zone will wear hard hats, safety shoes/boots, and safety glasses/face shields to protect personnel from the physical hazards.

If during drilling there is any indication that underground tanks, drums, or other containers are being encountered, the drilling will be halted immediately and the SHSO shall notify the Program Safety and Health Officer. Indications that a waste container may have been encountered include: (1) change in the speed or momentum of the auger, (2) visual examination of auger cuttings, (3) odor noted in the cuttings, and/or (4) the presence of airborne total volatile organics as measured with a direct-reading instrument.

Work around drilling equipment also involves basic safety hazards (e.g., snapping cables, slings, ropes, moving heavy equipment, slip and trip hazards, etc.). Accidents may include head injuries from falling tools and equipment, hand and feet injuries due to moving equipment, and crushing injuries from unstable equipment or careless moving of equipment. If possible, EA personnel must remain outside the turning radius of any large moving equipment. If this is not feasible then, at a minimum, EA personnel must maintain visual contact with the equipment operator at all times when equipment is active.

PHYSICAL HAZARD INFORMATION SHEET: FIRE/EXPLOSION HAZARDS

Explosion and fire hazards may be present at various sites due to ignition of chemicals, agitation of shock-sensitive compounds, the sudden release of materials under pressure, etc. All site operations must be conducted in accordance with local fire codes and regulations. Continuous monitoring for combustible gases is required at sites where such gases may be present during spark-generating operations. Fire extinguishers and other fire-fighting provisions may also be necessary. Site personnel must be trained in the use of such fire-fighting equipment prior to the start of work operations. Site-specific requirements for monitoring and fire emergency equipment must be specified in the HASP.

Site-Specific Hazards and Protective Measures:
Gasoline for generators: Use proper precautions while in the vicinity of or handling gasoline for generators. If there is a spill wipe it up immediately and discard the absorbent material appropriately.
Fire caused by running vehicles: While parked on grass, turn off your engine. Grass touching the HOT under carriage of the vehicle could cause a fire.
Drums: If abandoned drums are encountered DO NOT OPEN. Notify the CTO Manager.

PHYSICAL HAZARD INFORMATION SHEET
NOISE HAZARDS

Work around large equipment often creates excessive noise. The effects of noise can include:

- Workers being startled, annoyed, or distracted
- Physical damage to the ear, pain, and temporary and/or permanent hearing loss
- Communication interference that may increase potential hazards due to the inability to warn of danger and provide for proper safety precautions to be taken.

If workers are subjected to noise exceeding an 8-hour time-weighted average sound level of 85 decibels on the A-weighted scale (dBA), feasible administrative or engineering controls shall be instituted to reduce noise levels to or below the permissible values. All personnel exposed to excessive noise levels shall be provided with and shall wear a hearing protection device which effectively protects the workers. OSHA regulations on noise can be found in 29 CFR Part 1910.95.

Site-Specific Hazards and Protective Measures:
Drill Rig: If you can not hold a conversation with someone at a distance of 3-ft use hearing protection.
Generators: If possible position the generator a safe distance downwind of the sampling location. This will allow workers to proceed without hearing protection because the wind will carry sound away from work area. Regardless, if you can not hold a conversation with someone at a distance of 3-ft use hearing protection.

PHYSICAL HAZARD INFORMATION SHEET: MATERIAL HANDLING/MOVING/LIFTING

Improper materials handling accounts for a large number of occupational injuries. Materials handling at hazardous waste sites can vary from heavy equipment handling to manually handling items. Hazards associated with materials handling include physical injury, detonation, fire, explosion, and vapor generation.

When using equipment to move materials, proper work practices must be followed. Equipment used must be designed for the task to be performed. Equipment must be inspected regularly by the SHSO and the Site Manager, and damaged or defective equipment must be removed from service. Planning is critical when handling materials. The Site Manager, in conjunction with the CTO Manager, must plan where the materials are to be moved, taking into consideration the current location of such materials and hazards associated with moving them. Routes for moving materials must be clearly outlined, with paths cleaned of all obstructions so materials may be transported.

Injuries to the back and abdominal muscles from improper lifting of loads is one of the most common occupational injuries reported. Such injuries can range from relatively mild strains to major permanently disabling injuries. Before lifting any load, personnel should consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Loads should be inspected for slivers, sharp edges, slippery surfaces, etc. prior to lifting.

Loads should be lifted using the power of the leg muscles rather than the back, stomach, or arm muscles. Approach the item to balance the load evenly. Never bend over when lifting. The back should be kept straight and the arms nearly parallel with the body. The knees should be bent to grasp the load. Lifting should be done by straightening the legs, holding the load as close to the body as possible, and the back remaining as straight as possible.

Bulky, heavy loads should be handled by at least two people, ensuring that the load is level and evenly distributed between all personnel helping to carry it. All carriers should know the destination and path for the load.

Site-Specific Hazards and Protective Measures:
Generator
Gasoline
Acid Preservatives
and Keep Work Area Neat and Orderly
As mentioned in the previous sections exercise proper precautions and always work in a safe manner.

PHYSICAL HAZARD INFORMATION SHEET: COLD STRESS

Cold stress hazards are most likely to occur at low temperatures or low wind chill factors, with wet, windy conditions also contributing to risks. All personnel should be familiar with cold stress symptoms, which include:

- **Hypothermia**—Cold-induced decreasing of the core body temperature that produces shivering, numbness, drowsiness, and muscular weakness. If severe enough, it can lead to unconsciousness and death.

- **Frostbite**—Constriction of blood vessels in the extremities, decreasing the supply of warming blood. May result in formation of ice crystals in the tissues, causing tissue damage. Condition may range from frostnip which is a numbing of extremities, to deep-freezing tissue beneath the skin. Symptoms include white or grayish skin, blisters, numbness, mental confusion, failing eyesight, fainting, shock, and cessation of breathing. Death may occur from heart failure.

Pain in the extremities may be the first warning of cold stress, and precautions (see below) should be taken to reduce exposure. Maximum severe shivering must be taken as a sign of immediate danger to the worker, and exposure to cold must be immediately terminated. Personnel exhibiting signs and symptoms of cold stress must be removed from the site, decontaminated, and given appropriate first aid. Emergency medical services must be contacted if symptoms are severe (e.g., more than numbness of the extremities or shivering). When air temperatures are less than 36 degrees F (including wind chill), workers who become immersed in water or whose clothing becomes wet must be immediately provided a change of clothing and be treated for hypothermia.

To prevent cold stress when air temperature is less than 40 degrees F (including wind chill), personnel should wear layers of loose-fitting clothing including insulated coveralls, head covering, and boots. Protection of the hands, feet, and head is particularly important because these are likely to be injured first by cold. However, actual injury to hands, feet, and head is not likely to occur without prior development of early signs of hypothermia such as numbing and shivering. Bare skin contact with cold surfaces (below 20 degrees F) must be avoided. Personnel should wear wind-resistant outer shell to decrease wind chill effects. No continuous exposure to cold is permitted when the air speed and temperature results in an equivalent chill temperature of 26 degrees F or less.

A temperature-dependent work regimen limiting lengthy periods of outdoor activity may be necessary. Workers entering heated shelters should remove the outer layer of clothing and loosen remaining clothing to permit sweat evaporation. Dehydration must be avoided by drinking warm drinks or soups.

PHYSICAL HAZARD INFORMATION SHEET: HEAT STRESS

Personnel working under high-temperature conditions or wearing protective clothing while working in warm temperatures are subject to heat stress. Symptoms of heat stress may include:

- **Heat Cramps**—Muscle spasms in the abdomen or limbs. Frequent rest periods and fluid intake are appropriate measures to prevent or reduce heat cramps.

- **Heat Exhaustion**—Severe dehydration; pale, clammy skin; profuse sweating; dizziness, light-headedness; slurred speech; rapid pulse; confusion; fainting; fatigue; cool skin; nausea. Affected personnel should be escorted from the site, decontaminated promptly, set in cool, shaded area, and given fluids slowly.

- **Heat Stroke**—Life-threatening condition occurring when the body's temperature-regulating system improperly functions. Hot dry skin; rapid, deep breathing; lack of perspiration; delirium; high fever (often 106 degrees F or more), nausea; unconsciousness. Brain damage and/or death may occur, if body temperature is not reduced. Provide fluids, use cooling devices (hose-down or shower), call emergency medical services or transport to hospital immediately.

Prevent heat stress by resting frequently in a shaded area and consuming large quantities of fresh potable water (more than amount needed to simply "quench thirst"). Drink at least 8 oz of water or Gatorade every 2 hours when temperatures exceed 75 degrees F.

If heat stress symptoms are wide-spread among workers or observed frequently, the SHSO should implement an appropriate work-rest period so that after 1 minute of rest, a person's heart rate (HR) does not exceed 110 beats per minute (bpm) based on pulse. If the HR exceeds 110 bpm, the next work period should be shortened by 33 percent, while the length of the rest period remains the same. If the HR is 110 bpm at the beginning of the next rest period, the following work cycle should be reduced by 33 percent. A healthy individual's resting HR is usually 60-72 bpm.

Attachment E

Monitoring Instrument Calibration Procedures

PERKIN ELMER PHOTOVAC

761 Main Avenue, M/S 219
Norwalk, CT 06859-0219
(203) 761-5330

FACSIMILE MESSAGE

TO: JEFF ADRAB ENG	FROM: Peter Ebersold
COMPANY: EA ENG	Technical Specialist
PHONE: 781 275-8896	Photovac Applications
FAX: 781 275-7253	(203) 761-2616
DATE:	Fax: (203) 761-2892

2020 CALIBRATION INFORMATION.

Peter

14. Remove the adapter tubing from the inlet and close the regulator.

If you turn off 2020 in the middle of zeroing or spanning, the next time you turn it on it will display a Cal status. This indicates that you need to calibrate 2020.

Note:	While the Cal status is active, all alarms are deactivated.

3.3. Calibration Using a Gas Bag

3.3.1. Preparing the Calibration Gas Bag and the Zero Air Bag

Use the calibration kit (Photovac Part No. 390033) as follows:

Warning:	Observe proper handling techniques for all gases! See Section 1.2.2.

1. Connect the regulator to the calibration gas cylinder.

   If you are using a portable tank of calibration gas, connect the regulator (Photovac Part No. 600649) directly to the tank.

   If you are using a large cylinder of calibration gas, you must obtain a high purity regulator as specified in Section 1.4. Isobutylene in air is usually supplied with a standard CGA 590 cylinder valve outlet. Obtain a regulator with the matching fitting. Connect the regulator to the tank of calibration gas. Tighten the regulator onto the tank with a wrench. Do not over-tighten.

Note:	Do not force the connection. Do not use Teflon tape with CGA fittings. In general, these fittings are designed for metal to metal sealing. Do not use adapters to connect one CGA fitting to another type of CGA fitting. If the regulator does not match the outlet on your calibration tank, contact your specialty gas supplier.

2. Attach the knurled nut on the gas bag adapter to the regulator. Finger-tighten the fitting.

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Zero Air Bag

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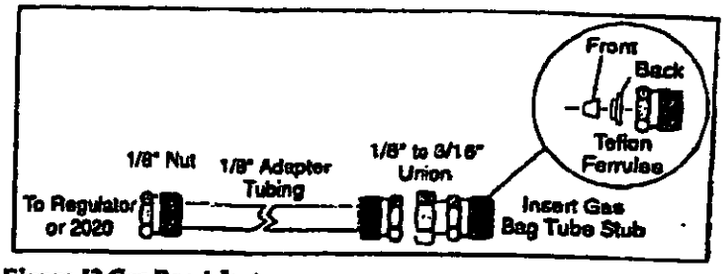

Figure 12 Gas Bag Adapter

3. Loosen the knurled nut on the reducing union of the gas bag adapter.

Note:	Do not remove the nut from the union as the Teflon ferrules contained inside the nut may be lost. See Figure 12.

4. Insert the tube stub from the gas bag into the knurled nut. Tighten the knurled nut and ensure the tube stub is secure. If the gas bag is not secure, ensure you have inserted the tube stub far enough into the knurled nut. Do not over-tighten the fitting.

Note:	Over-tightening the Teflon ferrules will result in damage to the ferrules!

5. The union should be connected to the gas bag adapter. If it is not, then tighten the nut on the adapter tube to the union.
6. Flush and fill the gas bag. See Appendix 8.5 for instructions.
7. Remove the knurled nut on the adapter tube from the regulator.
8. Repeat this procedure, if necessary, to prepare a bag of zero air.

Note:	Do not use the same gas bag or gas bag adapter for the bag of zero air. You will contaminate the bag of zero air.

3.3.2. Calibrating 2020 with a Gas Bag

1. Disconnect the probe from the 2020.
2. Press the ENTER key.

3. Select "Set", "Cal" and then "Mem".
4. Select the desired Cal Memory. 2020 has 15 Cal Memories and can be calibrated with 15 different span gases or response factors if required. Only one Cal Memory can be used at a time. Each Cal Memory stores a different response factor, zero point, sensitivity, and alarm levels.
5. Select "Chng" and then "User". Enter a name for the calibration memory.
6. Press the ENTER key and enter a response factor.
7. Press the ENTER key and enter an alarm level for each mode.
8. Press the ENTER key and enter a response factor. Refer to Appendix 8.6 for a list of Response Factors.

   If the compound is not listed in Appendix 8.6 or you are measuring gas mixtures, then enter a value of 1.0. The concentration detected by 2020 will be multiplied by the response factor before it is displayed and logged.
9. Connect the supply of zero air. If you are using a gas bag with zero air, open the bag and connect the gas bag adapter to the inlet.
10. Select "Set", "Cal" and "Zero". The 2020 sets its zero point.
11. Select "Set", "Cal" and "Span". The 2020 asks for the span gas concentration. Enter the known span gas concentration, without pressing the ENTER key to confirm it.
12. Open the bag and then connect the gas bag adapter to the inlet. Press ENTER. 2020 sets its response factor.

Note:	Readings may fluctuate slightly as the gas bag empties. Do not allow 2020 to evacuate the bag completely.

13. When the display reverts to the default display, 2020 is calibrated and ready for use. Remove the span gas bag from the inlet.

If the 2020 is powered off in the middle of zeroing or spanning, it will power on displaying a Cal status. This indicates that you need to calibrate 2020. While the Cal status is active, all alarms are inactive.

3.4. Pr

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3.4. Programming the Cal Memories

2020 has 15 Cal Memories and can be calibrated with 15 different span gases or response factors if desired. To program the Cal Memories:

1. If you will be calibrating directly from the portable cylinder, connect a flow-match regulator (Photovac Part No. 350006) to each tank. You must use a separate regulator for each compound to prevent cross contamination.

   If you are using gas bags, prepare the bags of calibration gas as outlined in Section 3.3. Use a different gas bag and gas bag adapter for each concentration and for each type of calibration gas. You can use the same gas bag to zero all the Cal Memories, however, you must refill the bag for each Cal Memory.

2. Select "Set", "Cal" and "Mem".

3. Select the desired Cal Memory (1 to 15) with the "Next" and "Prev" keys.

4. Press "Chng" to change the parameters of the Cal Memory. Select "User" or "Lib".

5. If you selected "User", enter the name, response factor and alarm levels.

6. If you entered "Lib", use the "Next" and "Prev" keys to select the required library. See Appendix 8.7 for a list of Library entries.

> **Note:** It does not matter which Cal Memory is selected or which response factor is entered, 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

7. Calibrate the instrument as described in Section 3.2.2 or 3.3.2. When the calibration is completed, the calibration information is automatically stored in the selected Cal Memory.

8. Repeat this procedure for each Cal Memory you need.

Whenever the instrument is calibrated, 2020 updates the selected Cal Memory only. Each Cal Memory must be calibrated at least once a day. Frequency of calibration will depend on ambient

conditions and instrument response. If ambient conditions change or the response has drifted, a calibration must be performed for each Cal Memory to ensure reliable operation.

3.5. Response Factors for Gases and Vapors

3.5.1. General Information

In situations where only a single pure compound is present in air, 2020 should be calibrated with a standard of that specific compound as span gas. 2020's 15 Cal Memories can be used to store calibration information for 15 different span gases.

The displayed reading will always be influenced by any other photoionizable compounds present in the air sample.

Note:	Even if 2020 has been calibrated with a specific compound, its response is not specific and the presence of another ionizable impurity may render the numerical result invalid.

It is often impractical to carry a range of different standards into the field. Approximate results can be obtained by calibrating 2020 with the recommended span gas and entering the appropriate response factor. The response factor is based on the ratio of the response of the specific compound to the response of the span gas. The response factor multiplies 2020's reading then displays and records it.

Appendix 8.6 provides response factors from which approximations can be made for guidance purposes. Data extrapolated from the use of response factors must be regarded as interim and approximate only. Appendix 8.6 should be used only for concentrations up to 500 ppm of the specific compound, as response factors change with concentration.

3.5.2. Using Response Factors

1. Select "Set", "Cal" and "Mem".
2. Select the desired Cal Memory (1 to 15) with the "Next" and "Prev" keys.
3. Press "Set", "Cal" and "Mem" and "Chng" to change the parameters of the Cal Memory. Select "User" or "Lib".

4. If you selected "User", enter the name, response factor and alarm levels.

5. If you entered "Lib", use the "Next" and "Prev" keys to select the required library. See Appendix 8.7 for a list of Library entries.

6. Calibrate 2020 with zero air and 100 ppm isobutylene as described in Section 3.2.2 or 3.3.2.

7. Expose 2020 to the sample. The displayed reading is the approximate concentration of the specific compound.

The response factors in Appendix 8.6 serve only as a guide to concentrations measured by 2020.

Results are expected to be accurate to within +/-10 ppm or +/-25% of the displayed result, whichever is greater. Accuracy of response factors to other gases and vapors may differ from those listed in Appendix 8.6.

3.6. Manual Operation

As part of manual operation, you setup 2020 to monitor various locations. Since each location may contain different compounds and concentration ranges you can program a Cal Memory and the associated response factor and alarm level for up to 15 different applications. In this way you can sample numerous locations without having to re-calibrate 2020 at each location.

Prepare a monitoring schedule for you application. Your schedule should contain a list of sites that must be monitored and the Cal Memory that must be used when monitoring the site. Also include any reference information that will help you define the site and the monitoring application. If you create your schedule using spreadsheet software, you can later download 2020 data to a computer and then copy it into the spreadsheet for further calculations.

Once you have programmed 2020, and prepared a list of sites to be monitored, you will move around to each location and manually log data at each site.

1. You must determine the number of calibration standards that will be required to perform manual monitoring for your application. Program and calibrate all the calibration memories that you need. See Section 3.2 and 3.4.

Note:	It does not matter which Cal Memory is selected or which response factor is entered, 2020's response is not specific to any one compound. The reading displayed always represents the total concentration of all ionizable compounds in the sample.

2. Ensure the 2020 is in PEAK mode. To change the mode, press ENTER and select "Disp". Press "Mode" and select PEAK.

3. Switch to manual operation. Press ENTER and then "Log". Select "Mode". Use the "Next" and "Prev" keys to scroll through the list. When Manual is displayed press ENTER. When you switch between interval and manual operation, the datalogger will be cleared. Press "YES" to confirm your selection and clear the datalogger. If you do not want to lose your previously recorded data, press "NO", then print or save the data to disk before changing to manual operation. See Sections 2.7.3 and 4.2 for printing and saving logged data.

4. The instrument status will change to "Loc".

5. Select the required Cal Memory for this location. Press ENTER and select "Set", "Cal" and then "Mem". Use the "Next" and "Prev" keys to select the desired Cal Memory.

6. Press the ENTER key and locate the first site on your schedule. The middle soft key is used to advance to the next measurement when you are operating in manual mode. Press the "Next" key. If you are not using manual operation, the "Next" key is not shown.

7. The instrument status will change to "BkGd". A background measurement must be made. When you have an accurate background, press "Next". 2020 will record the displayed concentration when you press the "Next" key.

8. The instrument status will now be "Samp". Take a sample measurement. When you have an accurate sample, press "Next". 2020 will record the displayed concentration when you press the "Next" key.

9. The instrument status will again be "Loc". Go to the next site on your schedule.

When you have completed your monitoring you can download the contents of the datalogger to a computer and then add the 2020 data to your spreadsheet.

Attachment F

Environmental Monitoring Record

ATTACHMENT F
ENVIRONMENTAL MONITORING RECORD

SITE: Former PR-58 Nike Site and NCBC Davisville Site 03 Project No. 60957.56.0003

INSTRUMENT: _____

CALIBRATION: Gas: _____ Conc: _____ Span: _____

Time	Monitoring Location	Reading	Corrective Action Taken[a]

Comments:

(a) Corrective actions taken must be documented whenever readings at or above action levels are reached.

Recorded By: _____

Site Health and Safety Officer Date

Attachment G

Site Safety and Health Activity Report

ATTACHMENT G
SITE SAFETY AND HEALTH ACTIVITY REPORT

SITE: Former PR-58 Nike Site and NCBC Davisville Site 03
Project No. 60957.56.0003

Weather Cond.: | Onsite Hours: From To

Changes in PPE Levels[a]	Work Operations	Reasons for Change

Site Safety and Health Plan Violations	Corrective Action Specified	Corrective Action Taken (Yes/No)

Observations and Comments:

Completed by: _____
Site Health and Safety Officer Date

(a) Only the Site Health and Safety Officer may change personal protective equipment levels, using only criteria specified in Health and Safety Plan.

Attachment H

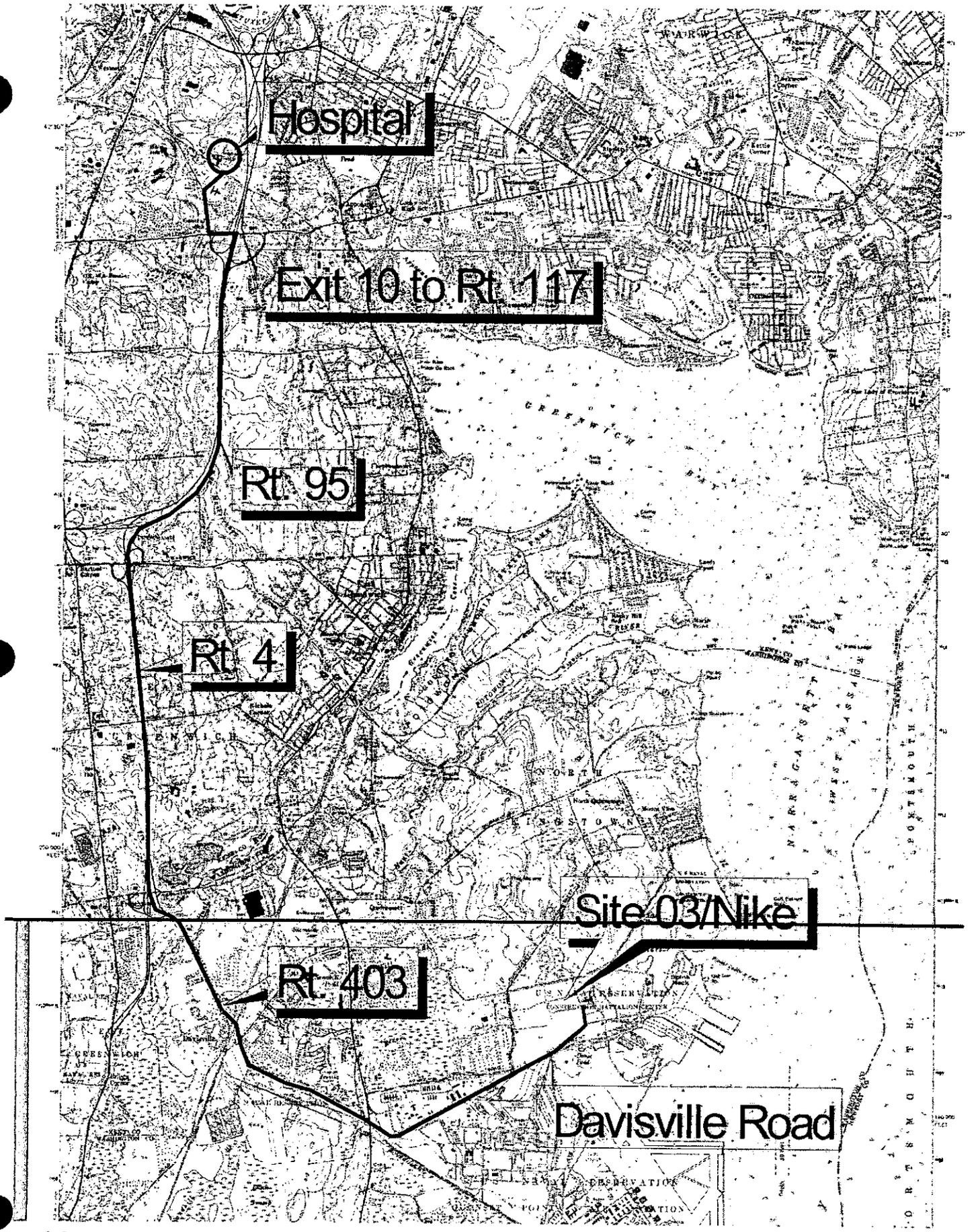
Site Entry and Exit Log

ATTACHMENT H
SITE ENTRY AND EXIT LOG

Date	Name	Representing	Time	
			In	Out

Attachment I

Road Map from the Site to the Hospital



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Hospital Location Map

Attachment J

Accident Investigation Report

ACCIDENT/LOSS REPORT

THIS REPORT MUST BE COMPLETED BY THE INJURED EMPLOYEE'S SUPERVISOR AND FAXED TO EA CORPORATE HUMAN RESOURCES WITHIN 24 HOURS OF ANY ACCIDENT. THE FAX NUMBER IS (410) 771-1780.

NOTE: WHENEVER AN EMPLOYEE IS SENT FOR MEDICAL TREATMENT FOR A WORK RELATED INJURY OR ILLNESS, PAGE 4 OF THIS REPORT MUST ACCOMPANY THAT INDIVIDUAL TO ENSURE THAT ALL INVOICES/BILLS/CORRESPONDENCE ARE SENT TO CORPORATE CENTER FOR TIMELY RESPONSE.

DATE OF ACCIDENT: _____ TIME OF ACCIDENT: _____

EXACT LOCATION WHERE ACCIDENT OCCURRED (including street, city, and state): ___

_____

_____

_____

NAME OF INJURED EMPLOYEE: _____

HOME ADDRESS: _____

HOME PHONE: _____ DATE OF BIRTH: _____ AGE: _____ SEX: ☐ MALE ☐ FEMALE MARITAL STATUS: _____

SOCIAL SECURITY NUMBER: _____ DATE OF HIRE: _____

NUMBER OF DEPENDENTS: _____

EMPLOYEE JOB TITLE: _____

DEPARTMENT IN WHICH REGULARLY EMPLOYED: _____

EXPLAIN WHAT HAPPENED (include what the employee was doing at the time of the accident and how the accident occurred): _____

_____

_____

_____

_____

_____

_____

DESCRIBE THE INJURY AND THE SPECIFIC PART OF THE BODY AFFECTED (i.e., laceration, right hand, third finger, second joint): _____

_____

_____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE: _____

_____

NAME AND ADDRESS OF THE PHYSICIAN (if medical attention was administered): _____

_____

_____

* PLEASE ATTACH THE PHYSICIAN'S WRITTEN RETURN TO WORK SLIP *

NOTE: A PHYSICIAN'S RETURN TO WORK SLIP IS REQUIRED PRIOR TO ALLOWING THE WORKER TO RETURN TO WORK.

IS THE EMPLOYEE EXPECTED TO LOSE AT LEAST ONE FULL DAY OF WORK? ____
WAS THE EMPLOYEE ASSIGNED TO RESTRICTED DUTY? _____
NUMBER OF DAYS AND HOURS EMPLOYEE USUALLY WORKS PER WEEK: _____
LIST ALL PPE EMPLOYEE WAS WEARING AND ALL SAFETY DEVICES IN USE AT THE TIME OF THE ACCIDENT: _____

_____

_____

_____

DESCRIBE THE PREVENTIVE MEASURES TAKEN TO AVERT A RECURRENCE OF THIS TYPE OF INCIDENT: _____

_____

_____

_____

_____

_____

DATE WHEN MEASURES WERE IMPLEMENTED AND BY WHOM: _____

_____

AUTOMOBILE ACCIDENT INFORMATION

AUTHORITY CONTACTED AND REPORT NO.: _____
EA EMPLOYEE VEHICLE YEAR, MAKE, AND MODEL: _____
V.I.N.: _____ PLATE/TAG NO: _____
OWNER'S NAME AND ADDRESS: _____

_____

_____

DRIVER'S NAME AND ADDRESS: _____

_____

_____

RELATION TO INSURED: _____ DRIVER'S LICENSE NO.: _____
DESCRIBE DAMAGE TO YOUR PROPERTY: _____

_____

_____

DESCRIBE DAMAGE TO OTHER VEHICLE OR PROPERTY: _____

_____
_____
_____
_____
_____

OTHER DRIVER'S NAME AND ADDRESS: _____
_____
_____

OTHER DRIVER'S PHONE: _____
OTHER DRIVER'S INSURANCE COMPANY AND PHONE: _____
_____
_____

LOCATION OF OTHER VEHICLE: _____
_____

NAME, ADDRESS, AND PHONE OF OTHER INJURED PARTIES: _____
_____
_____
_____

WITNESS

NAME: _____ PHONE: _____
ADDRESS: _____
STATEMENT: _____
_____
_____
_____
_____
SIGNATURE: _____

NAME: _____ PHONE: _____
ADDRESS: _____
STATEMENT: _____
_____
_____
_____
_____
SIGNATURE: _____

DATE OF THIS REPORT: _____ REPORT PREPARED BY: _____

I have read this report and the contents as to how the accident/loss occurred are accurate to the best of my knowledge.

Signature: _____ Date: _____
Injured Employee

I am seeking medical treatment for a work related injury/illness.

Please forward all bills/invoices/correspondence to:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

CORPORATE OFFICE

11019 MCCORMICK ROAD

HUNT VALLEY, MD 21031

ATTENTION: Ann Geisinger

(410) 771-1625

Revised 04\26\94

INCIDENT REPORT

THIS REPORT IS TO BE COMPLETED WHEN A NEAR MISS OCCURS THAT COULD HAVE POTENTIALLY RESULTED IN SERIOUS PHYSICAL HARM. PLEASE FAX THIS FORM TO EA CORPORATE SAFETY AND HEALTH DEPARTMENT AT (630) 574-3060, ATTN: CLAY BOCK.

EXPLAIN WHAT HAPPENED (include what the employee was doing at the time of the near miss and how it occurred): _____

REPORT PREPARED BY: _____ DATE: _____

Revised 04\26\94

Jim Shultz
06/15/2000 08:58 AM

To: peter.hugh@usace.army.mil
cc: mayhewjs@exchange.efdnorth.navfac.navy.mil, williams.christine@epamail.epa.gov, gjablons@dem.state.ri.us, hcohen@riedc.com, Jim Shultz/Boston/EAEST@EA, Jeffrey Norberg/Boston/EAEST@EA, wldavis@efdnorth.navfac.navy.mil

Subject: PR-58 Nike Site Field Progress Summary thru 14 June 2000

Hi Peter,

MW03-14R2
The 4-in. ID casing became wedged in the borehole in the rock about 18 ft above the depth it was to be set and could not be installed. The casing was recovered and the boring abandoned with cement bentonite grout.
The installation method for "R2" wells was modified to mitigate future such problems.
The modified method includes rotary drill 8.75-in. diameter boring to about 3 ft into competent bedrock, place and grout 6-in. ID steel casing (grout to set for min. of 24-hrs), drill 5.75-in diameter boring approximately 25 ft below the 6-in. ID casing and set/grout 4-in. ID steel casing (grout to set for min. of 24-hrs), then drill 3.875-in. diameter bore/core approximately 25 ft below the bottom of the 4-in. ID casing. Using this modified method, the 6-in. ID steel casing has been set to 43 ft bg and grouted. The 4-in. ID casing is planned to be set and grouted by Friday.

Revised 'R2' MW drilling method

EA-112R2
Water loss at about 92 ft bg. Bentonite pellets placed to mitigate water loss.
The 6-in. ID steel casing has been set and grouted to 105 ft bg. Competent rock at approx 102 ft bg.

EA-114R
Located approximately 10 ft east of the asphalt path.
No stained soil observed. No PID soil headspace detections except 6.6 for the 9-10.7 ft bg sample.
The 4-in. ID steel casing has been set and grouted to 17 ft bg (competent rock at approx 14 ft bg).
Soil samples collected for chemeical analysis from 0-2 ft bg and 9-10.7 ft bg (incl USACE QA sample to STL).

EA-116D
0 - about 62 ft bg -- Sand with varying amounts of sand and gravel
62- 66 -- Silty Clay
66- 76 -- Sandy gravel
76- 83.5 -- gravelly sandy silty clay
83.5 - 86 -- sand (flowed about 30 ft up into HSA) -- thus, could not perform slug test of that interval.
Competent rock at approx. 86 ft bg (86-89 ft bg slug tested). Cored 89-94 ft bg. (packer tested)
Screen set 75.2 - 85.2 (sand heavied into the auger as screen was being placed).
No PID headspace detections of soil samples from this boring.
Soil sample sent for chem analysis -- 83-85 ft bg

EA-116R
Boulder and HSA refusal encountered about 12 ft bg. Moved 7-10 ft north.
4-in. ID steel casing set and grouted to 90.5 ft bg.

EA-116R2
6-in. ID steel casing set and grouted to 91 ft bg.

---------- Forwarded by Jim Shultz/Boston/EAEST on 06/15/2000 08:02 AM ----------

Jim Shultz
06/02/2000 07:21 PM

To: peter.hugh@usace.army.mil
cc: Jim Shultz/Boston/EAEST@EA, mayhewjs@exchange.efdnorth.navfac.navy.mil, Jeffrey Norberg/Boston/EAEST@EA

Subject: PR-58 Nike Site Field Progress Summary for W/E 2 June 2000

Hi Peter,

31 May -- Mobilization
1 & 2 June -- begin drilling activity

EA-114D
was drilled and installed about 20 ft east (downgradient) of the asphalt pathway. Here is a summary of the preliminary field data.
The anticipated depth to competent bedrock was 32 ft bg.

00.0 - 10.6 ft bg Sand, silt
10.6 - 14.5 ft bg Weath &/or fractured rock
14.5 - Competent bedrock (14.5 - 17.5 ft bg roller bitted; 17.5 - 23.8 ft bg cored -- quartzite)

11.5 - 14.5 ft bg --- slug tested
14.5 - 17.5 ft bg --- slug tested
18.8 - 23.8 ft bg --- packer tested (about 0.5 gpm)

PVC screen set from 4.5 - 14.5 ft bg

No elevated soil sample headspace PID measurements.

Soil sample obtained was 'dry' (above water table). Weathered rock samples were of very small volume (too small for chem analysis) and too angular for packing in sample containers. We could consider collecting soil samples at EA-114R for chemical analysis.

MW03-14R2 --- was augered to a depth of 33 ft bg. Will complete on Monday (5 June).

The EA-116 well cluster will be the next location for next week.