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CNC CHARLESTON
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CORRECTIVE MEASURES STUDY TECHNICAL MEMORANDUM ZONE A SOLID WASTE MANAGEMENT UNIT 39 (SWMU 39) VOLUME I OF II CNC CHARLESTON SC
12/22/1999
ENSAFE

**COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA**

# ZONE A, SWMU 39 CORRECTIVE MEASURES STUDY TECHNICAL MEMORANDUM

**Volume I of II**

**CTO-029**
**Contract Number: N62467-89-D-0318**

**Prepared for:**

**Department of the Navy**
**Southern Division**
**Naval Facilities Engineering Command**
**North Charleston, South Carolina**

**Prepared by:**

**EnSafe, Inc.**
**5724 Summer Trees Drive**
**Memphis, Tennessee 38134**
**(901) 372-7962**

**December 22, 1999**
**Revision: 0**

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# 1.0 INTRODUCTION

This technical memorandum is provided to document the current status of the Corrective Measure Study (CMS) being performed under the Resource Conservation and Recovery Act (RCRA) of 1976, based on findings reported in the *Zone A RCRA Facility Investigation Report, NAVBASE Charleston, North Charleston, South Carolina* (EnSafe, 1998). The purpose of the CMS is to propose a remedial alternative for chlorinated solvents in groundwater. This report includes the results to date of data collection and evaluation activities at solid waste management unit (SWMU) 39 and a recommendation for continued evaluation.

SWMU 39 is located near the northernmost boundary of the former naval base, south of the Hess Oil, Inc., tank farm. SWMU 38 is to the east and a wetland is approximately 500 feet downgradient to the west. The area of SWMU 39 north of Building 1604 and approximately 300 feet south of the Hess Oil, Inc., tank farm was used for storage of petroleum, oil, and lubricant (POL) drums. Figure 1.1 shows RFI soil borings and geoprobe locations for the SWMU 39 site and its location within Zone A.

The site is currently used by Carolina Marine Handling for storage of miscellaneous items. This reuse tenant occupies Building 1605 as well as other buildings at the former naval base. According to the Charleston Naval Complex Redevelopment Authority (CNCRDA), the site will continue to be used for industrial/maritime purposes.

Section 2 of this report is a summary of the CMS field work that has been performed as well other data collection activities associated with SWMU 39. A description of the continued geologic and hydrogeologic assessment is in Section 3.0, and Section 4.0 provides the results of the monitored natural attenuation results. Section 5.0 is the results of fate and transport modeling and Section 6 is a conclusion and recommendation for continued activities. References are provided in Section 7.

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# 2.0 CMS FIELD WORK

## 2.1 Soil borings Sample Results

Site historical data suggests that the area north of Building 1604 is the source area for solvent contamination based upon its previous usage as a storage area of petroleum, oil, and lubricant drums. Conventional soil borings (46) and DPT soil samples (21) were collected around Building 1604 through its foundation, and as far north as the Hess Property line during the RFI. As summarized in the *Zone A RCRA Facility Investigation Report* (EnSafe, 1998), detections of PCE and TCE in soil were scattered and not definitive of a coherent source area.

During CMS activities, fifteen additional conventional soil borings (039SB047 through 061) were collected only from the upper interval (0 - 1 ft surface interval) in the near vicinity of Building 1604 and analyzed for VOCs, SVOCs, and metals. VOC results are summarized in Table 2.1. SVOC and metals data from these soil borings are included in Attachment A.

**Table 2.1**
**VOCs detected in surface soil**
**10/12/98**

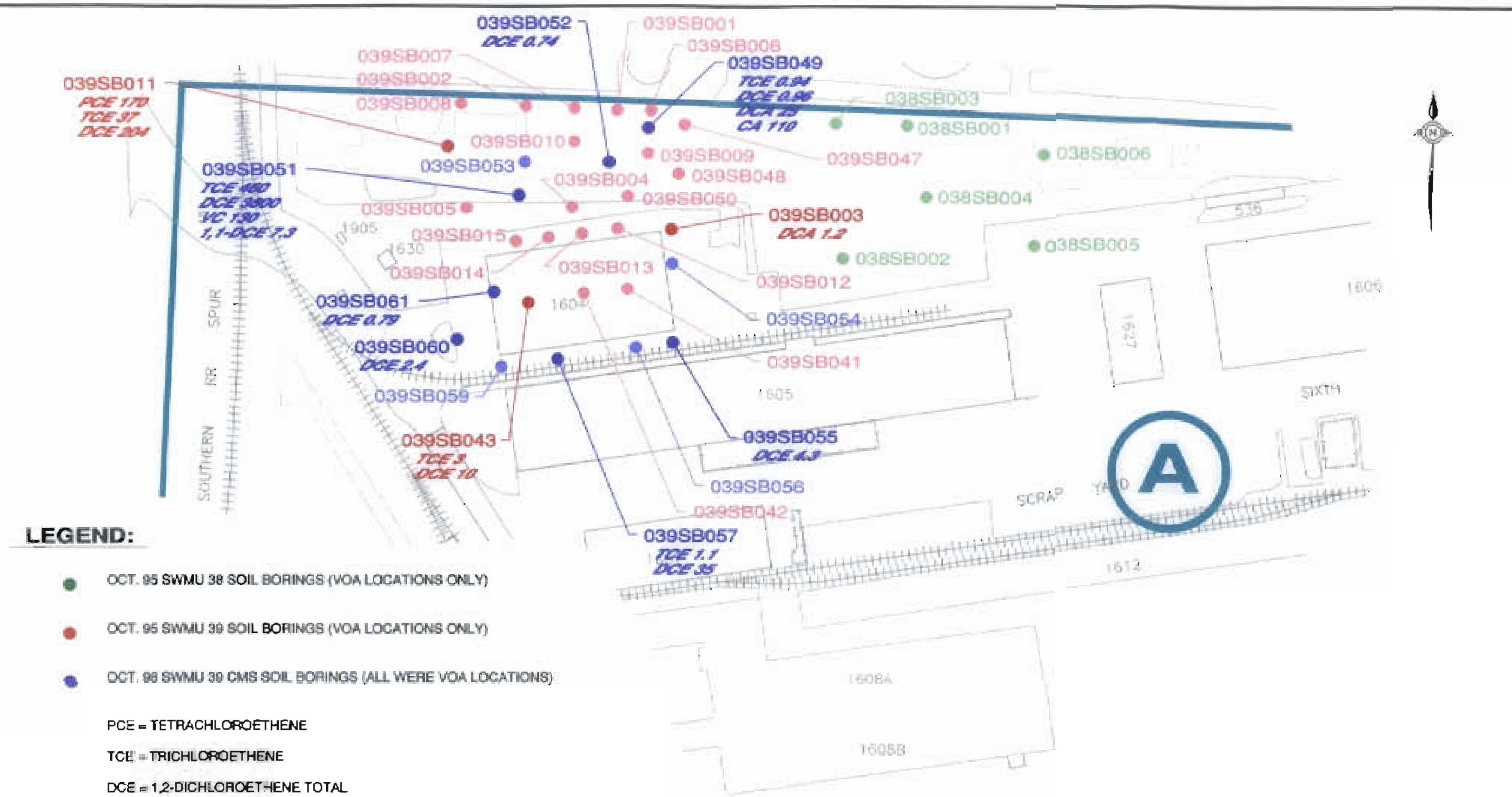
| Sample ID | Concentration ($\mu$g/kg) | Qualifier | Compound |
|---|---|---|---|
| 039SB04701 | 18 | J | 2-Butanone (MEK) |
| | 1.3 | J | Xylene (Total) |
| 039SB04801 | 39.0 | | Methylene chloride |
| | 3.0 | J | Toluene |
| | 1.3 | J | Ethylbenzene |
| | 4.8 | J | Xylene (Total) |
| 039SB04901 | 110 | | Chloroethane |
| | [illegible] | | Acetone |
| | 25 | | Methylene chloride |
| | 25 | | 1,1-Dichloroethane |
| | 81 | | 2-Butanone (MEK) |
| | 0.94 | | Trichloroethene |
| | 3.8 | J | Toluene |
| | 2.0 | J | Ethylbenzene |
| | 5.4 | J | Xylene (Total) |
| | 0.96 | J | 1,2-Dichloroethene (total) |

**Table 2.1**
**VOCs detected in surface soil**
**10/12/98**

| Sample ID | Concentration ($\mu$g/kg) | Qualifier | Compound |
|---|---|---|---|
| 039SB05001 | 150 | J | Acetone |
| | 46 | J | Methylene chloride |
| | 24 | J | 2-Butanone (MEK) |
| | 3.1 | J | Toluene |
| | 2.5 | J | Xylene (Total) |
| 039SB05101 | 130 | J | Vinyl chloride |
| | 130 | J | Acetone |
| | 7.3 | J | 1,1-Dichloroethene |
| | 460 | J | Trichloroethene |
| | 5.5 | J | Xylene (Total) |
| | 3800 | J | 1,2-Dichloroethene (total) |
| 039SB05201 | 150 | | Acetone |
| | 14 | J | 2-Butanone (MEK) |
| | 0.74 | J | 1,2-Dichloroethene (total) |
| 039SB05401 | 1.4 | J | Methylene chloride |
| | 2.1 | J | Ethylbenzene |
| | 3.2 | J | Xylene (Total) |
| 039SB05501 | 36 | | Methylene chloride |
| | 0.91 | J | Ethylbenzene |
| | 3.4 | J | Xylene (Total) |
| | 4.3 | J | 1,2-Dichloroethene (total) |
| 039SB05701 | 1.1 | J | Trichloroethene |
| | 35 | | 1,2-Dichloroethene (total) |
| 039SB06001 | 2.4 | J | 1,2-Dichloroethene (total) |
| 039SB06101 | 0.79 | J | 1,2-Dichloroethene (total) |

***Notes:***
J estimated concentration

In order to depict the magnitude of soil contamination at SWMU 39, all the soil VOC data was presented together in Figures 2.1 (surface soil) and 2.2 (subsurface soil) regardless of sampling method. DPT samples were included in Figure 2.2 since they were taken over a 2 - 4 ft bgs interval, which closely matches the subsurface soil sampling interval. SWMU 38 data was included in these figures to further delineate the extent of VOC contamination. As a result, the soil results represent several years of data.




## LEGEND:

- OCT. 95 SWMU 38 SOIL BORINGS (VOA LOCATIONS ONLY)
- OCT. 95 SWMU 39 SOIL BORINGS (VOA LOCATIONS ONLY)
- OCT. 98 SWMU 39 CMS SOIL BORINGS (ALL WERE VOA LOCATIONS)

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

DCE = 1,2-DICHLOROETHENE TOTAL

VC = VINYL CHLORIDE

1,1-DCE = 1,1-DICHLOROETHENE

DCA = 1,1-DICHLOROETHANE

CA = CHLOROETHANE

NOTE:
ALL CONCENTRATIONS <5 µg/Kg WERE ESTIMATED.
FADED SYMBOLS AND TEXT WERE NON-DETECT.

0 50 100 200 300
SCALE IN FEET

ZONE A – SWMU 39
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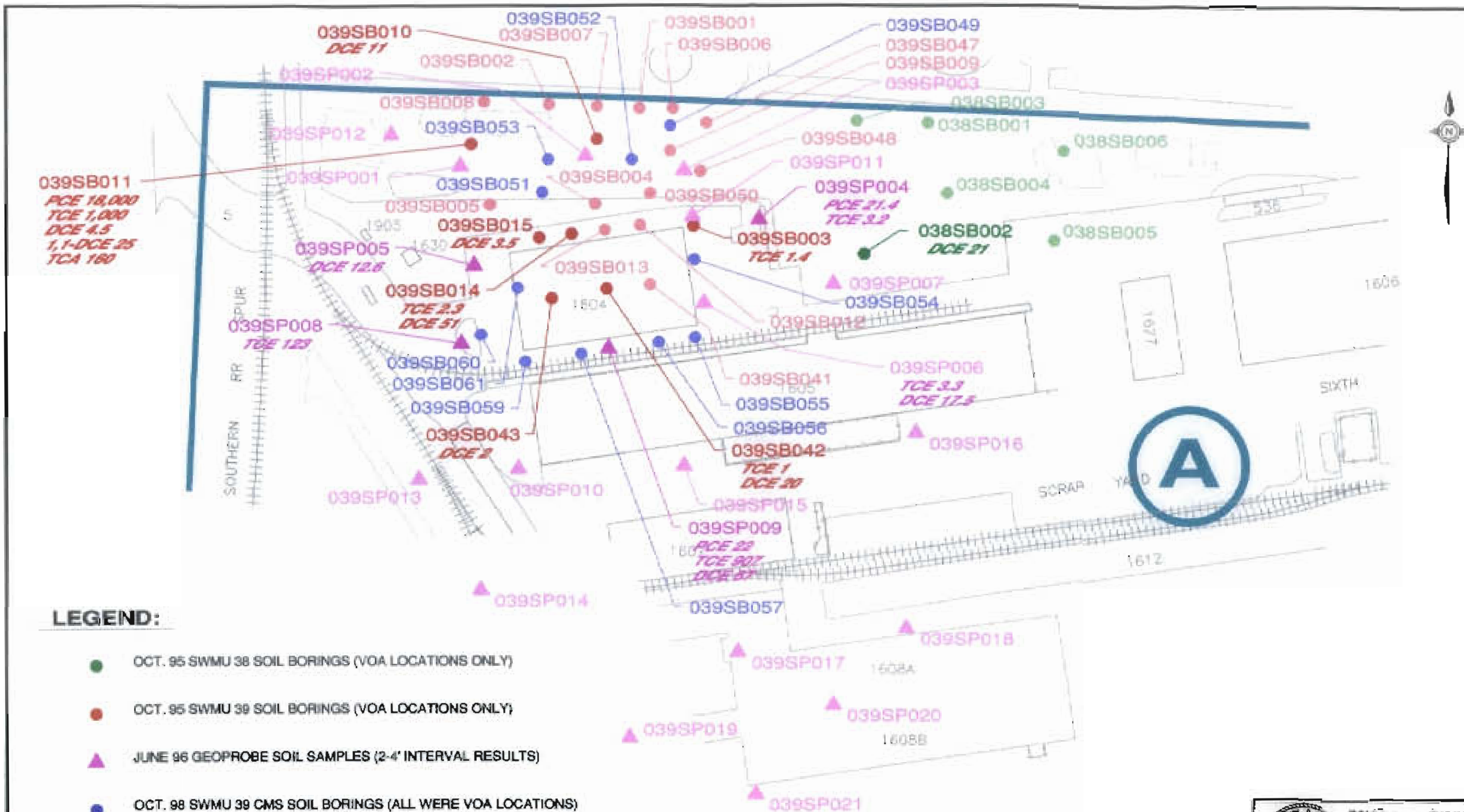
CHARLESTON, SC

FIGURE 2.1
COMPREHENSIVE
SURFACE SOIL (0–1') RESULTS
CHLORINATED
SOLVENT CONCENTRATIONS (µg/Kg)

Date: 11/21/99 | DWG Name: 2901M224




## LEGEND:

- OCT. 95 SWMU 38 SOIL BORINGS (VOA LOCATIONS ONLY)
- OCT. 95 SWMU 39 SOIL BORINGS (VOA LOCATIONS ONLY)
- JUNE 96 GEOPROBE SOIL SAMPLES (2-4' INTERVAL RESULTS)
- OCT. 98 SWMU 39 CMS SOIL BORINGS (ALL WERE VOA LOCATIONS)

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

DCE = 1,2-DICHLOROETHENE TOTAL

1,1-DCE = 1,1-DICHLOROETHENE

TCA = 1,1,1-TRICHLOROETHANE

NOTE:
ALL CONCENTRATIONS <5 µg/Kg WERE ESTIMATED.
FADED SYMBOLS AND TEXT WERE NON-DETECT.

0 50 100 200 300
SCALE IN FEET

ZONE A – SWMU 39
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FIGURE 2.2
COMPREHENSIVE SUBSURFACE SOIL (3–5') RESULTS CHLORINATED SOLVENT CONCENTRATIONS (µg/Kg)

Date: 11/21/99 | DWG Name: 2901M225

Chlorinated solvents were detected in seven of fifteen borings and were primarily encountered along the perimeter and to the north of Building 1604. PCE was detected in three distinctly separate locations (039SB011, 039SP009, and 039SP004), whereas TCE and 1,2-DCE was more uniformly grouped around Building 1604.

Since no reported release was ever documented at the site, it is unknown whether the parent compound was PCE or TCE. Furthermore, it is unclear whether TCE in soil represents a separate release or is simply the result of in-situ PCE biodegradation. Based on the seemingly isolated PCE soil detections and the more frequent TCE detections, it is reasonable to assume that several small releases, probably in the form of drum leaks, occurred in the vicinity of Building 1604.

## 2.2 Well Installation and Groundwater Sampling History

As part of SWMU 39 CMS activities, several well clusters were installed subsequent to the submittal of the *Zone A RFI Report* (EnSafe, 1998). Rotasonic drilling was used for all well installation events. Four well clusters (016-019) were installed in August 1998 and targeted data gaps within the heart of the plume to assist in the MNA evaluation. Based on the second round of MNA groundwater data and updated groundwater flow maps, two additional well clusters (020 and 021) were installed at newly-determined downgradient locations. In July 1999, two well pairs (022 and 023) were installed between the western CNC property boundary/Norfolk Southern Rail spur and the apartment complex to the west to address groundwater quality off-site. A deep monitoring well was paired with shallow well 042002 as a downgradient monitoring point along the western edge of the property. Boring logs for these additional wells are included in Attachment B.

As part of the RFI, a monitoring well sampling program was implemented at SWMU 39. Sixteen groundwater sampling events were performed at SWMU 39, largely as the result of multiple well installation phases. Figure 2.3 illustrates the Zone A monitoring well locations and includes CPT locations where groundwater samples were taken in 1996. Table 3.2 is an updated version of Table 10.4.4 presented in the *Zone A RCRA Facility Ivestigation Report* (EnSafe, 1998) revealing the additional groundwater evaluations and sampling events conducted at SWMU 39 since submittal of the RFI report.

**Table 2.2**
**SWMU 39 Groundwater Investigation**
**Time line of Events**

| Date | Event | # of wells installed | | | # of wells sampled | | | Comments |
|---|---|---|---|---|---|---|---|---|
| | | S | I | D | S | I | D | |
| Oct. 95 | MW Installation (Round 1) | 5 | 0 | 1 | 0 | 0 | 0 | Initial wells installed per RFI Work Plan |
| Dec. 95 | GW Sampling | 0 | 0 | 0 | 5 | 0 | 1 | First quarter sampling event |
| Apr. 96 | GW Sampling | 0 | 0 | 0 | 5 | 0 | 0 | "Interim" sampling event to verify VOC detections prior to geoprobe investigation. |
| Apr. 96 | GW Sampling | 0 | 0 | 0 | 5 | 0 | 1 | Second quarter sampling event |
| Jun. 96 | Geoprobe Invest. | 21[a] | 0 | 0 | 28[a] | 0 | 1 | Data identified a suspected plume of chlorinated solvent contamination in the vicinity of Bldgs. 1604,1605, & 1607. |
| Jun. 96 | GW Sampling | 0 | 0 | 0 | 5 | 0 | 1 | Third quarter sampling event. |
| Jul. 96 | MW Installation (Round 2) | 7 | 1 | 2 | 0 | 0 | 0 | Based upon the geoprobe investigation, wells were installed to further delineate the suspected plume. |
| Aug. 96 | GW Sampling | 0 | 0 | 0 | 7 | 1 | 2 | "Interim" sampling of Round 2 wells for VOCs. |
| Sept. 96 | CPT Invest. | 0 | 0 | 29[b] | 13[b] | 8[b] | 0 | Investigation both on and off base to further define stratigraphy and sample the off-base region for VOCs. |
| Sept. 96 | MW Installation (Round 3) | 0 | 4 | 3 | 0 | 0 | 0 | Based upon the CPT investigation, additional intermediate and deep wells were installed for vertical delineation. |

**Table 2.2**
**SWMU 39 Groundwater Investigation**
**Time line of Events**

| Date | Event | # of wells installed | | | # of wells sampled | | | Comments |
|---|---|---|---|---|---|---|---|---|
| | | S | I | D | S | I | D | |
| Sept. 96 | GW Sampling | 0 | 0 | 0 | 0 | 4 | 3 | "Interim" sampling of Round 3 wells for VOCs. |
| Oct. 96 | GW Sampling | 0 | 0 | 0 | 12 | 1 | 3 | Fourth quarter event for initial wells, first quarter event for Round 2 wells. |
| Nov. 96 | GW Sampling | 0 | 0 | 0 | 0 | 4 | 3 | First quarter event for Round 3 wells. |
| Jan. 97 | MW Installation (Round 4) | 3 | 0 | 2 | 0 | 0 | 0 | Final data gaps, both horizontal and vertical. |
| Feb. 97 | GW Sampling | 0 | 0 | 0 | 3 | 0 | 2 | First quarter event for Round 4 wells. |
| Mar. 97 | GW Sampling | 0 | 0 | 0 | 7 | 4 | 7 | Second quarter event for Round 3 and 4 wells. |
| Jul. 97 | GW Sampling | 0 | 0 | 0 | 10 | 5 | 7 | Third quarter event for Round 2, 3, and 4 wells. |
| Oct. 97 | GW Sampling | 0 | 0 | 0 | 10 | 5 | 7 | Fourth quarter event for Round 2, 3, and 4 wells. |
| Feb. 98 | GW Sampling (MNA) | 0 | 0 | 0 | 15 | 5 | 8 | First round of MNA sampling |
| Aug. 98 | MW Installation (Round 5) | 4 | 4 | 4 | 0 | 0 | 0 | Four well clusters addressing suspected plume hot spots to assist in MNA eval. |
| Oct. 98 | GW Sampling (MNA) | 0 | 0 | 0 | 24 | 9 | 12 | Second round of MNA sampling |
| Jan. 99 | MW Installation (Round 6) | 2 | 2 | 2 | 0 | 0 | 0 | Downgradient data gaps based on second round MNA data |
| Feb. 99 | GW Sampling (MNA) | 0 | 0 | 0 | 7 | 7 | 7 | Confirmation of second round MNA data |
| Jul. 99 | MW Installation (Round 7) | 2 | 0 | 3 | 0 | 0 | 0 | Two well pairs drilled west of property boundary for offsite migration concerns; downgradient deep well at SWMU 42. |

**Table 2.2**
**SWMU 39 Groundwater Investigation**
**Time line of Events**

| Date | Event | # of wells installed | | | # of wells sampled | | | Comments |
|---|---|---|---|---|---|---|---|---|
| | | S | I | D | S | I | D | |
| Aug. 99 | GW Sampling (MNA) | 0 | 0 | 0 | 26 | 11 | 17 | Third round of MNA sampling |
| Aug. 99 | GW Vertical Profile | – | – | – | – | – | – | Demonstration of profiling techniques at location 039GP038. |
| Oct. 99 | MW Installation (Round 8) | 0 | 0 | 1 | 0 | 0 | 0 | Multi-level well 03924M installed with 7 separate sampling intervals |
| Oct. 99 | GW Sampling | 0 | 0 | 0 | 0 | 0 | 1 | Multi-level well 03924M sampled. |

*Notes:*
*S* *Shallow monitoring well*
*I* *Intermediate monitoring well*
*D* *Deep monitoring well*
*a* *During the geoprobe investigation, 21 borings were installed for collection of a shallow groundwater sample. Seven samples from monitoring wells were also collected for analysis by the onsite laboratory during this investigation.*
*b* *During the CPT investigation, 13 borings were pushed on base to further define the stratigraphic relationship between the shallow aquifer and the discontinuous clay layers that overlie the intermediate sand unit. Also, 16 borings were pushed in the neighborhood streets off-base. In 13 of these locations, shallow groundwater samples were collected; and in 8 of these locations, intermediate groundwater samples were collected.*

Spatial VOC plots for each event shown in Table 2.2 are presented in Attachment B (Figures B-1 through B-24). These figures assist in depicting the extent of the BTEX and chlorinated solvent plume. Note that shallow, intermediate, and deep wells were separated for clarity beginning with the February 1998 MNA sampling event. Temporal plots of each well's VOC history are also presented in Attachment B (Figures B-25 through B-34). BTEX and chlorinated VOC results were presented in separate plots for some well locations for clarity. These figures are discussed in greater detail as they pertain to the MNA discussion in Attachment H.

## 2.3 Soil Gas Survey

A soil gas survey was conducted in the vicinity of Building 1607, which lies downgradient from Buildings 1604 and 1605. The purpose of this survey was to delineate any additional PCE sources downgradient from the primary source area. This possibility was based upon shallow groundwater data that indicates PCE in wells north of Building 1604 (039003 and 039005) but none downgradient at 039012 (south) despite the presence of PCE in soil within a few feet of this location (039SP009) (see Figures B-12 through B-18 in Attachment B). The reappearance of PCE in shallow groundwater approximately 350 feet downgradient at 039013 suggested that a separate PCE source area in soil may exist to the south.

Soil gas was sampled using a 700 foot long by 300 foot wide grid, with grid nodes spaced at 50 foot by 50 foot intervals (Figure 2.4) using a portable, calibrated vacuum assembly consisting of a calibrated stainless steel syringe assembly and purge assembly. A total of 74 of 84 possible grid nodes were sampled; those not sampled were inaccessible due to building foundations, loading ramps, or shallow depth to water which restricted soil gas sampling. Nodes were offset based on other obstructions such as railroad tracks. At each node, the soil gas sampled was obtain four feet below ground surface (grass, asphalt, or concrete). Soil gas was analyzed on-site using a portable gas chromatograph.

Based on the results of this initial grid, supplementary nodes were added to further characterize the locale. As such, the grid was extended to the northeast and southwest to address detections in those areas whereas to the northwest, samples were taken at inter-node locations (approximately 25 feet) for greater definition of the detections. Five confirmatory surface (0 - 1 foot) and subsurface (3 - 5 foot) soil samples (039SGP16 through 20) were obtained near the major soil gas detections. The only solvent detected in any of the samples was an estimated 1,2-DCE (total) concentration of 2.0 $\mu$g/L (5.0 $\mu$g/L detection level) in the second interval of 039SGP17. Full analytical data packages of the soil gas samples and confirmation soil samples are provided in Attachment C.

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As depicted in Figure 2.4, soil gas detections were generally sporadic with only two general groupings in the northwest and southwest. Only one detection of PCE (1.33 $\mu$g/L at grid node 350 W 200 N) occurred in close proximity to Building 1607, although no solvents were detected in its corresponding soil sample. The greatest detection was of PCE at grid node 0 W 250 N (12.2 $\mu$g/L); however, no solvents were detected in its corresponding soil sample nor any neighboring grid nodes suggesting an isolated occurrence. PCE at this location may be associated with TCE and 1,2-DCE found in shallow groundwater at 039018 approximately 70 feet southeast. The second highest PCE detections occurred to the northwest, but again no detections were found in the confirmation soil sample taken at grid node 200 N 650 W.

## 2.4 Storm Sewer Investigation

### 2.4.1 Surveying

Three primary west-east storm sewer lines cross SWMU 39. The first begins just northwest of Building 1604 and runs east to Outfall #1 on the Cooper River. The second line begins just north of 1614 (Former Propeller Yard) at the eastern edge of a westward trending drainage ditch and runs east along Sixth St North to Outfall #2 on the Cooper River. The third line runs westward from Outfall #3 on the Cooper River and bifurcates into three minor spurs between 1612, 1608A, and 1608B.

Twenty-one catch basins or drop-in basins along these three lines were surveyed to determine approximate invert elevations (Figure 2.5). Groundwater infiltration into the sewer system is possible due to the shallow water table conditions throughout SWMU 39. This potential was documented during the Zone E RFI through the use of permanent pressure transducers (*Draft Zone E RCRA Facility Investigation Report*, (EnSafe 1997). Schematic diagrams of each of these inlets are provided in Attachment D.

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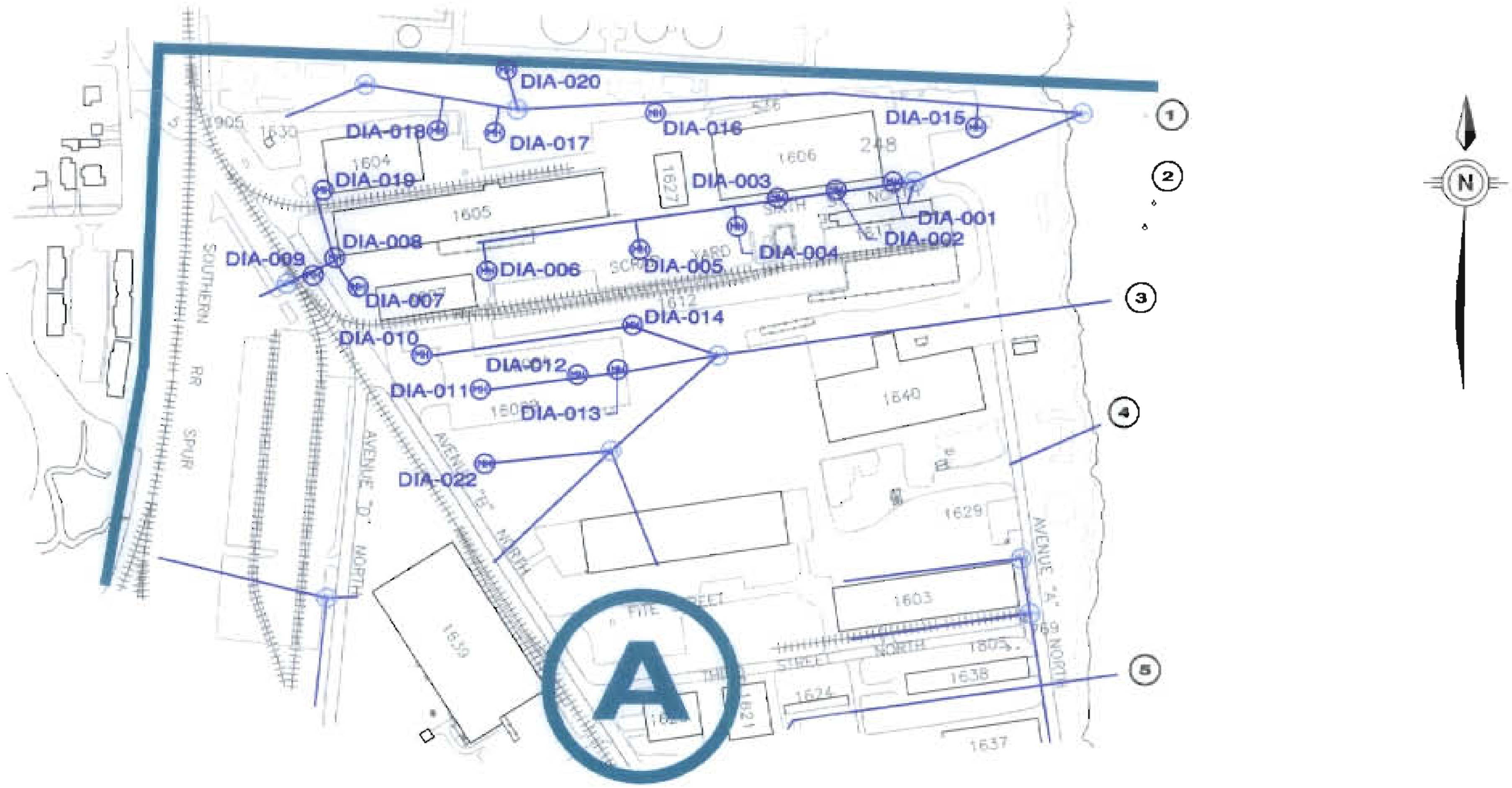


LEGEND:

DIA-022 STORM SEWER INVERT W/ ID NUMBER

NON-SURVEYED MANHOLE

(1) OUTFALL

0 100 200 400 600

SCALE IN FEET

ZONE A - SWMU 39
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FIGURE 2.5

STORM SEWER INVERTS SURVEYED AT SWMU 39

Date: 11/22/99 | DWG Name: 2901M223

### 2.4.2 Sewer Water Sampling

In conjunction with the surveying, surface water samples were taken at selected catch basins, ditches, and culverts within the immediate vicinity of SWMU 39. Sampling was conducted on January 20, 1999, after field reconnaissance two days earlier during a brief rainstorm. Water levels at all sampling points were noticeably lower on January 20th and no inverts were flowing at the time of sampling. As a result, it may be reasonably assumed that storm water was not the major component of water in the basins at the time of sampling. Samples were taken using teflon tubing and a peristaltic pump and were decanted directly into sample containers for VOA analyses only.

The locations of the storm water samples are shown in Figure 2.6. Duplicate samples were taken at each location and were denoted with 1A or 1B in the last two digits of the sample ID. The continuation of the second east-west trending storm sewer forms a bar ditch that extends to the western property boundary. This bar ditch is heavily overgrown with shrubs and trees. Sample 039W00001 was taken at the culvert entering the bar ditch and 039W00002 was taken at the culvert beneath the western property fence. Sample 039W00004 was taken opposite a culvert leaving CNC property south of well cluster 20. This culvert was not shown on any storm sewer diagrams, so it is unclear if the culvert is merely for controlling run-off or if it is attached for any storm sewer lines. Opposite this culvert and beneath the Norfolk Southern railroad tracks lies a second culvert which connects to the marshy area formed by the tributaries to Noisette Creek. A small depression has formed between the railroad culvert and the CNC culvert and becomes filled with tidal water during extreme high tides. At the time of sampling, the depression was full of water but the sample was taken as close as possible to the CNC culvert. Samples 039W00005 and 039W00006 were taken at catch basins DIA-009 and DIA-010, respectively. Sample 039W00003 was taken from a presumed isolated concrete basin in a grassy area just south of the east-west trending bar ditch.

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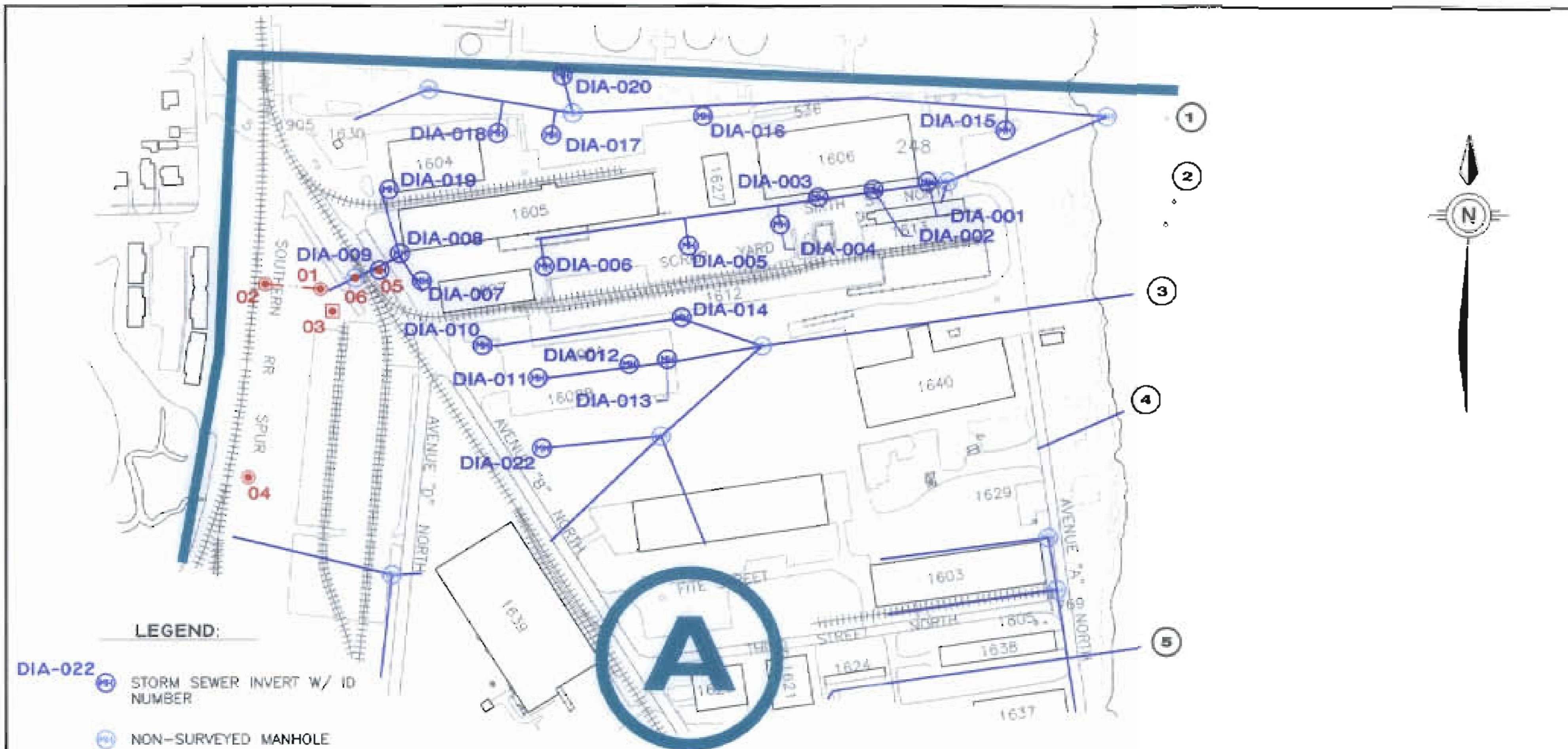


LEGEND:

DIA-022 STORM SEWER INVERT W/ ID NUMBER

NON-SURVEYED MANHOLE

1 OUTFALL

BAR DITCH

SAMPLE FROM CONCRETE BASIN OF UNKNOWN ORIGIN

STORM RUNOFF CULVERT SAMPLE

STORM SEWER SAMPLE

NOTE:
ALL LOCATIONS HAVE SUFFIX 039W000__

0 100 200 400 600
SCALE IN FEET

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FIGURE 2.6

STORM WATER SAMPLE LOCATIONS
JANUARY 20, 1999

Date: 12/10/99 | DWG Name: 2901M230

No VOCs were detected in any storm sewer samples. Full analytical data packages from these samples are provided in Attachment D.

## 2.5 Groundwater Vertical Profiling

Groundwater vertical profiling provides a means to collect water quality data at discrete vertical intervals within an aquifer to determine the vertical stratification of dissolved contaminants and other geochemical parameters. By obtaining discrete vertical samples, a detailed look at plume morphology and composition may be made, leading to the identification of preferred hydrologic flowpaths, which is especially advantageous in seemingly homogenous aquifers. This method works best in permeable geological formations, such as the large, very fine grained sand body which extends from ground surface to the top of the Ashley Formation, downgradient from SWMU 39. Figure 2.7 depicts the location of the vertical profile, 039GP038, in the central portion of Zone A. Besides geologic considerations, this location was chosen to fill a data gap in the chlorinated solvent plume: chlorinated solvents have been detected in surrounding deep wells 03913D, 17D, and 16D in August 1999 (3rd round MNA sampling) while no solvents have ever been detected at 03908D further downgradient. Thus, it was hoped that a vertical profile in this location would further pinpoint the leading edge of the plume as well as some insight regarding the plume thickness and vertical stratification of PCE, TCE, DCE, and VC.

Several methodologies may be employed to obtain vertical profile data either by conventional drilling techniques or DPT. The vertical profile at SWMU 39 was obtained using DPT and three groundwater sampling techniques: the innovative Waterloo Profiler™ (Solinst Drive-Point Profiler™), the Solinst Stainless Steel Drive point Piezometer™, and the more traditional steel casing and PVC screen. These techniques were employed to determine the feasibility of each in this geologic setting as well as determining the ease of operation and optimal field sampling protocol.

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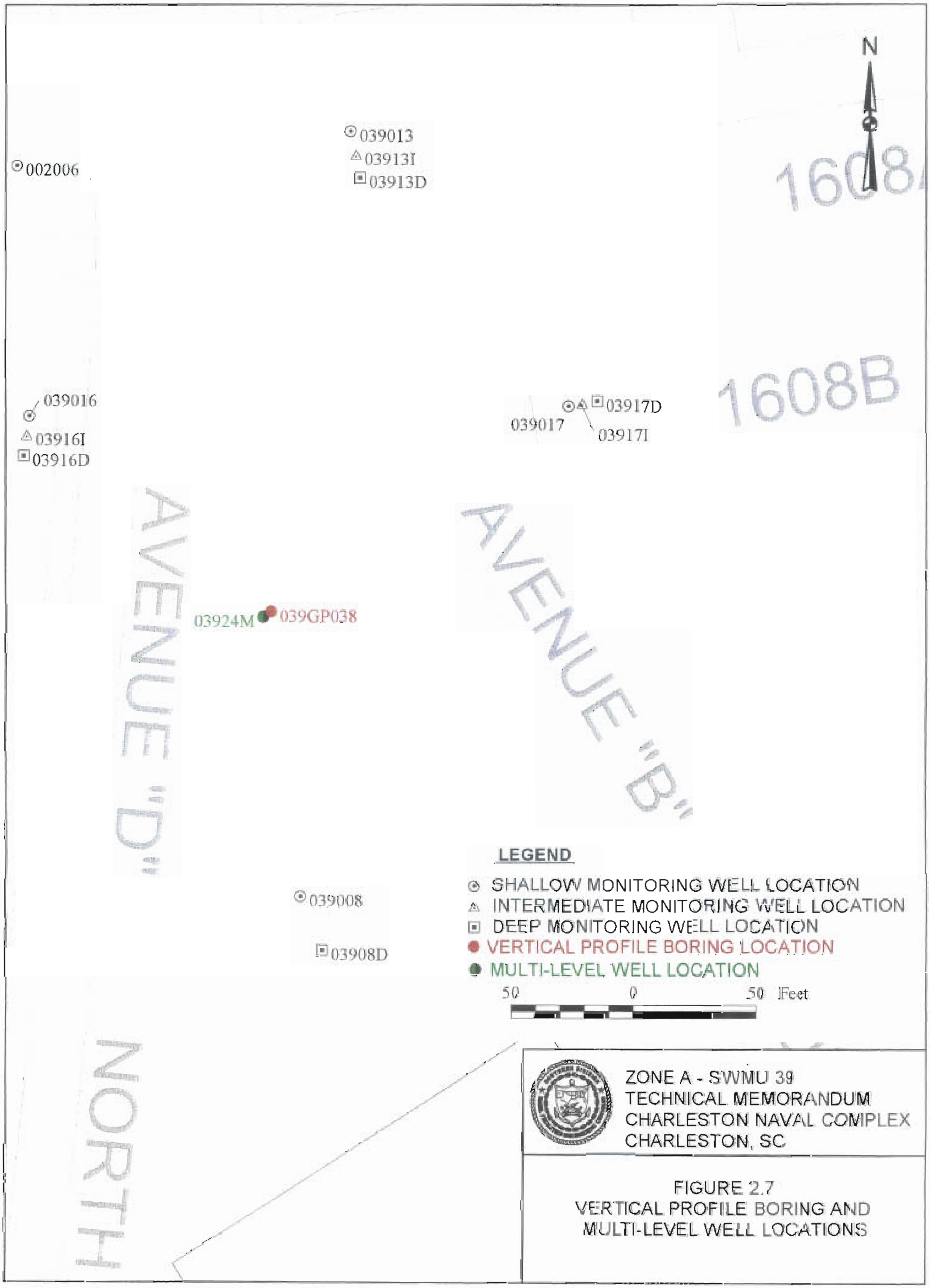


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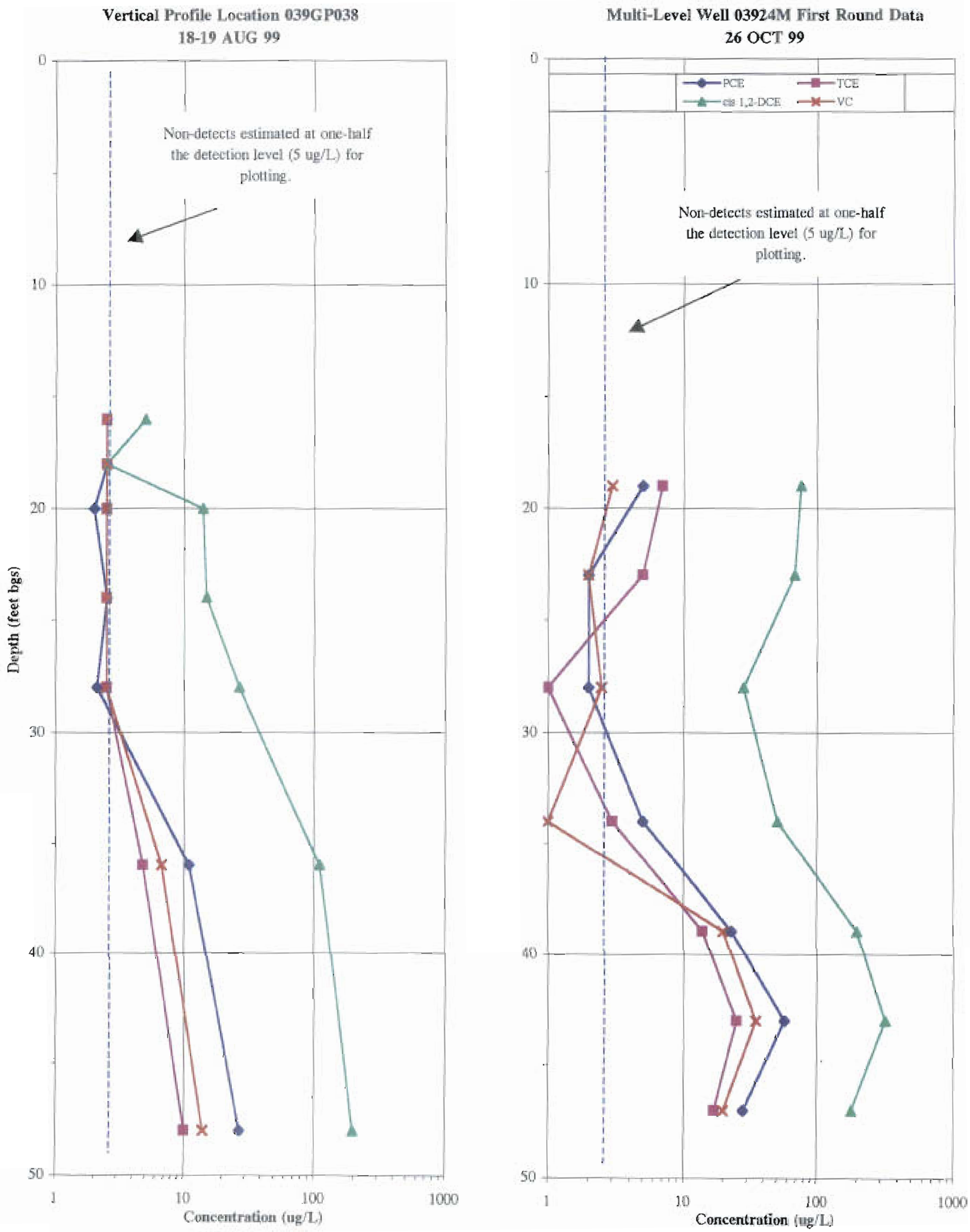
FIGURE 2.7
VERTICAL PROFILE BORING AND MULTI-LEVEL WELL LOCATIONS

Figure 2.8
Comparison of Vertical Profiling and Multi-Level Well VOC Data



The vertical profile was sampled in August 1999 at depths of 16, 18, 20, 24, 28, 36, and 48 feet below ground surface (bgs). The parameters pH, ORP, specific conductivity, and DO were obtained in the field using a flow through cell and direct readings meter while iron (II), chloride, and alkalinity were determined via field titration kits. VOCs were analyzed by an off-site lab using EPA Method 8260 (GC-MS). A summary table of the analytical results is presented in Table 2.3. The full analytical results and data summary package from the DPT subcontractor (Columbia Technologies, LLC) are provided in Attachment E.

**Table 2.3**
**Analytical Data Summary**
**Vertical Profile 039GP038**

| Date | Time | Depth (ft bgs) | Flow Rate (ml/min) | Temp (C) | pH | ORP (mV) | Cond (mmho/cm) | DO (mg/L) | Iron II (mg/L) | Cl (mg/L) | Alk (mg/L) | PCE ($\mu$g/L) | TCE ($\mu$g/L) | cis 1,2-DCE ($\mu$g/L) | 1,1-DCA ($\mu$g/L) | VC ($\mu$g/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/18/99 | 1350 | 16** | 87 | 34.2 | 6.1 | -15 | NT | 2.4 | NT | 30 | 115 | 5.0 U | 5.0 U | 5 | 5.0 U | 5.0 U |
| 8/18/99 | 1425 | 18** | 50 | 36.4 | 5.9 | -5 | 0.030 | 4.4 | NT | 60 | 60 | 5.0 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| 8/19/99 | 0920 | 20* | 170 | 24.5 | 5.1 | 94 | 0.059 | 3.4 | > 2.5 | 45 | 0 | 2 | 5.0 U | 14 | 5.0 U | 5.0 U |
| 8/19/99 | 1250 | 20*** | 200 | 31.9 | 4.5 | 104 | 0.060 | 2.6 | 1.87 | 27 | 0 | 5.0 U | 5.0 U | 12 | 5.0 U | 5.0 U |
| 8/18/99 | 1545 | 24** | 100 | 34.4 | 4.5 | 140 | 0.030 | 5.4 | NT | 16 | 0 | 5.0 U | 5.0 U | 15 | 5.0 U | 5.0 U |
| 8/19/99 | 1034 | 28* | -- | 25.3 | 5.2 | 68 | 0.023 | 2.5 | > 2.5 | 13 | 24 | 2.1 | 5.0 U | 27 | 5.0 U | 5.0 U |
| 8/19/99 | 1134 | 36* | -- | 30.7 | 6.0 | 10 | 0.032 | 2.2 | > 2.5 | 30 | 62 | 11 | 4.8 | 110 | 3.5 | 6.7 |
| 8/19/99 | 1310 | 48* | -- | 27.1 | 5.4 | 80 | 0.030 | 3.0 | 2.38 | NT | 20 | 27 | 10 | 196 | 6.6 | 14 |

**Notes:**

NT = Not taken
* = Samples obtained using 2" diameter steel casing and PVC screen (3/4" diameter, 0.010' slot, 12" length)
** = Samples obtained using Solinst Drive Point Profiler™
*** = Samples obtained using Solinst Stainless Steel Drive-point Piezometer™

As Table 3.3 reveals, the plume was encountered at 039GP038. Of note is that concentrations of each chlorinated solvent compound increase with depth with the highest concentrations measured at 48 ft bgs. Encouraging is the fact that cis-1,2-DCE, a TCE breakdown product, had the highest concentrations of all compounds.

### 2.5.1 Future Profiling

Vertical profiling is a viable option to be pursued should additional delineation data be required at SWMU 39. Of particular interest is the area downgradient of the clay aquitards where the geology becomes primarily sand and the ultimate endpoint for solvent migration. Very little is understood in this area regarding flow direction since deep well heads vary on the order of tenths to hundredths of a foot. Additional vertical profiles oriented in a grid perpendicular to the predominant intermediate and deep groundwater flow direction would enable the calculation of contaminant fluxes within the sand aquifer, which would provide critical data for any future contaminant transport modeling. EnSafe endorses the use of the Waterloo Profiler™ technology in which the samples are taken in a single borehole without retracting the drill rods or requiring decon between sample intervals. At other CNC sites with lithologies similar to that in central Zone A, the Waterloo Profiler™ technology has been shown to be an extremely efficient and consistent tool to collect delineation data for chlorinated solvent plumes.

### 2.5.2 Multi-level Well Installation and Sampling

A multi-level monitoring well, 03924M, was installed adjacent to the vertical profile location, 039GP038, to monitor the various intervals shown to have chlorinated solvent contamination (see Figure 2.7 earlier). The multi-level monitoring well technology has been developed by Precision Sampling, Inc., a DPT contractor based in Richmond, California. The specifications, construction, and installation information is documented in Attachment E and only briefly summarized here.

The multi-level monitoring well consists of 1.7" OD polyethylene tubing that has seven separate internal chambers. Ports are drilled into each chamber at the desired depths and fitted with 4" stainless steel 0.01 foot slotted screen meshes. Filter pack sleeves of FX-50 sand may be placed over the screened interval and bentonite packer sleeves are fitted above and below the screened interval to allow for discrete sampling intervals. In cases of flowing sands, filter packs are often not used since the native sediments will collapse directly onto the screened interval. No filter packs were used in 03924M. The screened intervals are approximately 6" in length including the filter pack sleeve. Bentonite packers average 1 foot in length. The wells are pre-built aboveground and installed through a 5" diameter borehole. The borehole is advanced using DPT, 5" steel casing, and an expendable stainless steel point. The casing is retracted once the well is in place and completed at the surface with either an aboveground riser or flush mount manhole.

The boring log for 03924M is included in Attachment E. All seven intervals were used for monitoring and were set at depths of 19, 23, 28, 34, 39, 43, and 47 ft bgs. Groundwater samples were collected from 03924M in October 1999, approximately 2 weeks after installation. Sample identifications were constructed from the site name, 039, matrix sampled (groundwater) - GW, well location (24) and port number (1-7), and sampling event (C2 in this case). For example, the sample from Port 3 was identified as 039GW243C2. Approximately three chamber volumes were evacuated prior to sampling using the calculations presented in the groundwater sampling form presented in Attachment E.

Table 2.4 presents the results of the multi-level well sampling event. Full analytical data packages for this sampling are provided in Attachment E.

**Table 2.4**
**Groundwater VOC Results from**
**Multi-Level Well 03924M**

| Sample ID | Compound | Qualifier | Concentration (ug/L) |
|---|---|---|---|
| 039GW241C2 | Tetrachloroethene | | 5 |
| | Trichloroethene | | 7 |
| | cis-1,2-Dichloroethene | | 75 |
| | Vinyl Chloride | J | 3 |
| | 1,1-Dichloroethane | J | 1 |
| | Acetone | | 7 |
| 039GW242C2 | Tetrachloroethene | J | 2 |
| | Trichloroethene | | 5 |
| | cis-1,2-Dichloroethene | | 67 |
| | Vinyl Chloride | J | 2 |
| | Toluene | J | 2 |
| 039GW243C2 | Tetrachloroethene | J | 2 |
| | Trichloroethene | J | 1 |
| | cis-1,2-Dichloroethene | | 28 |
| | Toluene | J | 2 |
| 039GW244C2 | Tetrachloroethene | J | 5 |
| | Trichloroethene | J | 3 |
| | cis-1,2-Dichloroethene | | 50 |
| | Vinyl Chloride | J | 1 |
| | 1,1-Dichloroethene | J | 2 |
| | Toluene | J | 2 |
| | Acetone | | 6 |
| 039GW245C2 | Tetrachloroethene | | 23 |
| | Trichloroethene | | 14 |
| | cis-1,2-Dichloroethene | | 200 |
| | Vinyl Chloride | | 20 |
| | 1,1-Dichloroethene | J | 3 |
| | 1,1-Dichloroethane | | 6 |
| | Acetone | | 10 |
| | Bromoform | J | 3 |
| 039GW246C2 | Tetrachloroethene | | 57 |
| | Trichloroethene | | 25 |
| | cis-1,2-Dichloroethene | DL | 320 |
| | Vinyl Chloride | | 35 |
| | 1,1-Dichloroethene | | 5 |
| | 1,1-Dichloroethane | | 5 |
| | Benzene | J | 2 |
| 039GW247C2 | Tetrachloroethene | | 28 |
| | Trichloroethene | | 17 |
| | cis-1,2-Dichloroethene | | 180 |
| | Vinyl Chloride | | 20 |
| | 1,1-Dichloroethene | J | 3 |
| | 1,1-Dichloroethane | J | 8 |
| | Methylene Chloride | | 7 |

***Notes:***
*J* *estimated concentration*
*DL* *diluted result reported*

Figure 2.8 illustrates the vertical distribution of PCE, TCE, cis-1,2-DCE, and VC at 039GP038 and the adjacent multi-level well 03924M. Although the cis-1,2-DCE data is slightly higher in 03924M samples, the multi-level well and vertical profile data compare favorably regardless of the several methods used in obtaining samples at 039GP038. The profiles indicate that solvents are pervasive from 16 - 47 ft bgs at the locale and also suggest that higher concentrations at 03924M from 20 - 25 feet and 39 - 42 feet interval may be the result of preferred contaminant migration pathways through the aquifer. No lithology data is available at the locale to determine if varying sand grain sizes or compositions might be the cause of this variability.

## 2.6 Navy Environmental Detachment Diffusion Sampling

In July 1999, the Navy Environmental Detachment Charleston (DET) conducted passive volatile organic compound (VOC) sampling in the marsh area west of SWMU 39 to determine if chlorinated solvents were being transported beyond the Charleston Naval Complex (CNC) property line and into the surrounding marsh area. The DET Completion Report was published on August 19, 1999, including a methodology description and results. This section summarizes the information provided in the DET's report.

To gather analytical data, the DET used the diffusion sampling method. This method uses polyethylene as semi-permeable membranes to allow for the passive diffusion of VOCs into the sampling container. Theoretically, as VOCs in ground water pass through the area, volatile compounds diffuse through the polyethylene sheet until an equilibrium state is reached. At this stage the samples are retrieved for analysis.

In the marsh area west of SWMU 39, twenty-six sample locations at 50 foot intervals contained twenty-six vapor samples and ten liquid samples. The samples were sent to a certified laboratory for Appendix IX volatile analysis and results are in Appendix F (provided by DET). No chlorinated solvents were detected above their respective USEPA surface water screening values and groundwater maximum contaminant levels (MCLs) in the liquid samples. Based on these results, the chlorinated solvent plume does appear to have migrated beyond the CNC property line and into the marsh area. However, since there were three detections in the liquid samples, continued sampling is recommended to monitor VOC transport.

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# 3.0 CONTINUED GEOLOGIC AND HYDROGEOLOGIC ASSESSMENT

## 3.1 Lithologic Unit Distribution

This section is an update to the Zone A / SWMU 39 geologic setting as presented in the *Zone A RCRA Facility Investigation Report* (EnSafe, 1998). Additional deep borings, completed as part of CMS activities, addressed geologic, chemical, and hydrogeologic data gaps. The additional geologic information provided data needed to refine previous delineations of the subsurface geologic units.

Two major geologic groups, Quaternary age sediments and the Tertiary age Ashley Formation, have been identified at SWMU 39. As discussed in the *Zone A RCRA Facility Investigation Report* (EnSafe, 1998), several marine transgression-regression episodes since deposition of the Ashley Formation have resulted in erosion and deposition of several Quaternary and upper-Tertiary age units in the Charleston area. The one persistent lithologic unit beneath CNC and this portion of the Charleston peninsula is the Ashley Formation. Above the Ashley may lie any assortment of younger Tertiary or Quaternary sediments. Anthropogenic fill materials overlay the entire SWMU 39 area of CNC.

Figure 3.1A depicts the locations of well borings, cone penetrometer (CPT) locations, and geologic cross section orientations in SWMU 39. Lithologic information from selected well borings and CPT locations has been correlated and presented as geologic cross-sections in Figures 3.1B and 3.1C. Quaternary age sediments have been grouped into a series of three depositional assemblages for these correlations. Each depositional assemblage consists of several associated units.

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Each of the lithologic units, identified at SWMU 39, have been given informal names for purposes of discussion. The following lithologic units have been identified at SWMU 39. They are presented in ascending order with respect to the primary depositional series.

**Tertiary Age Sediments**

Ta: Typically an olive-brown, calcareous, clayey silt. Areally extensive, it is the basal confining unit for the Charleston area. Ashley Formation

**Quaternary Age Sediments**

$Q_1$ Series

$Qs_1$: A dark grey to black, fine to coarse loose sand. It typically contains shell fragments and often phosphatic nodules. The basal portion of this unit may contain considerable fines and a pebble lag.

$Qcs_1$: Interbedded organic rich clay and dark grey sand.

Qdm: A dark grey to black, with a greenish cast; stiff, organic-rich silty clay/clayey silt. This unit is considered to be a compacted and dewatered Marsh Clay and occasionally may contain some thin sandy laminae.

$Q_2$ Series

$Qs_2$ : A grey to dark grey, very fine to fine and at times silty sand. This sand may have some shell fragments.

$Qcs_2$: Interbedded organic-rich clay and dark grey sand.

Qm : A dark grey to black, soft, organic-rich silty clay/clayey silt deposited as Marsh Clay.

$Q_3$ Series

$Qs_3$ : Typically an olive-brown to orange-brown, and occasionally a light grey or tan, predominantly very fine to fine grained sand with some grading to coarse.

$Qcs_3$: Interbedded clay and sand - at times clayey .

Qc : Inorganic clays of variable coloration, but typically orange-brown or blue- green.

Qp : Brown, peat consisting primarily of decaying vegetation/marsh grasses.

**Recent**

Qpm: A dark grey to black, very soft, organic rich clayey-silt associated with current Noisette Creek deposition. This material is essentially marsh clay but is labeled here as Pluff Mud in order to segregate these sediments from older marsh clay deposited as part of the $Q_2$ Series.

**Anthropogenic**

Fill: Predominantly sand but may contain clay.

Figure 3.2 illustrates subsurface topographic features of the Ashley Formation (Ta) contact with the overlying Quaternary age sediments in Zone A. Collectively, Figures 3.1B, 3.1C, and 3.2 depict the Ashley Formation and subsequent relationship with the overlying Quaternary sand and clay deposits. The episodic nature of shallow marine deposition is clear from the cross sections based on the overlapping sand and clay deposits of varied age, thickness, and extent.

Despite the complex geologic relationships illustrated in the cross sections, it is possible to reduce most of Zone A and SWMU 39 into two generalized regions as shown in Figure 3.3. The northwestern region of Zone A, which includes the primary SWMU 39 source area, consists of multiple interbedded units and the southeastern region which consists of very simple geologic conditions.

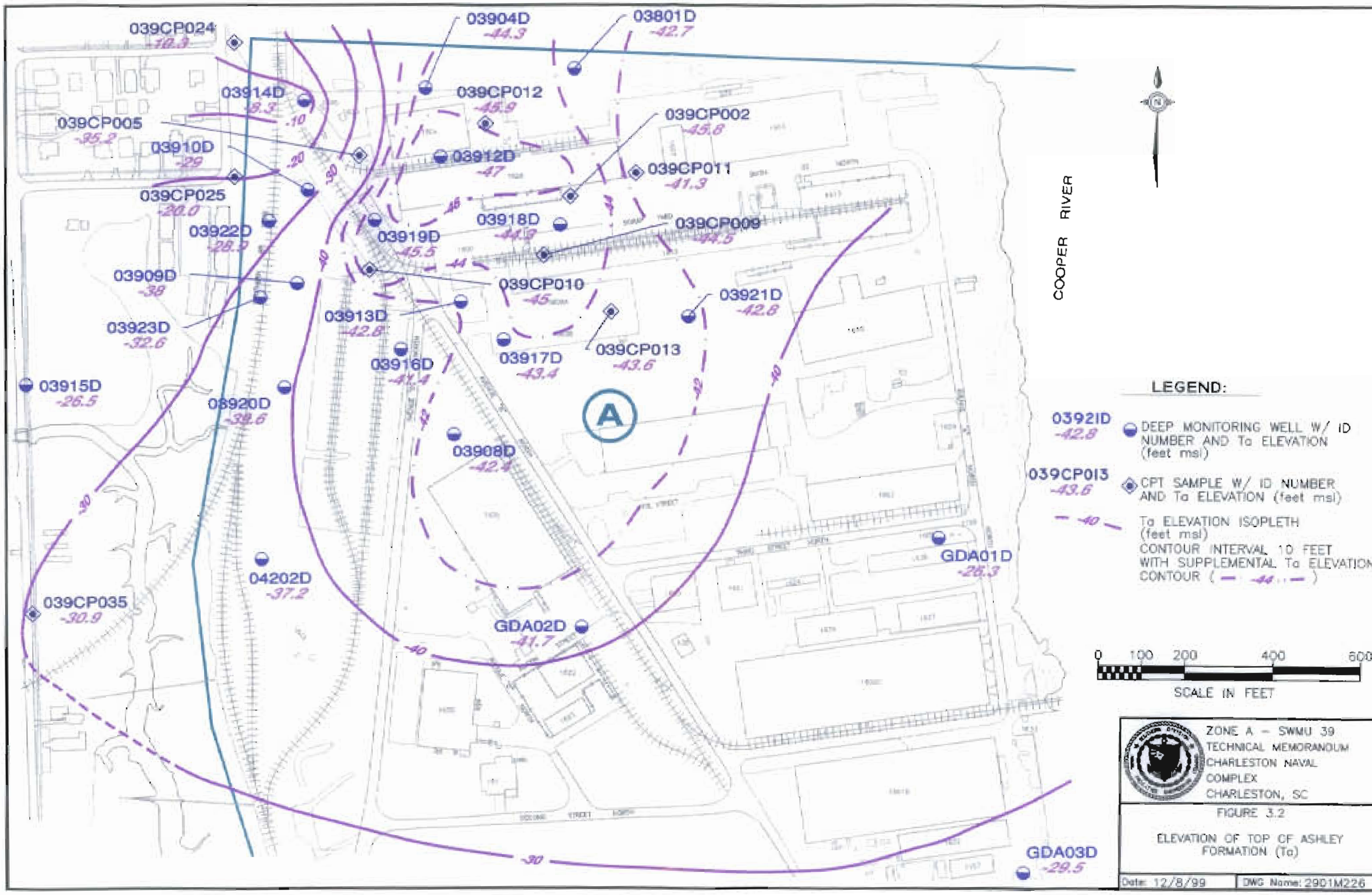
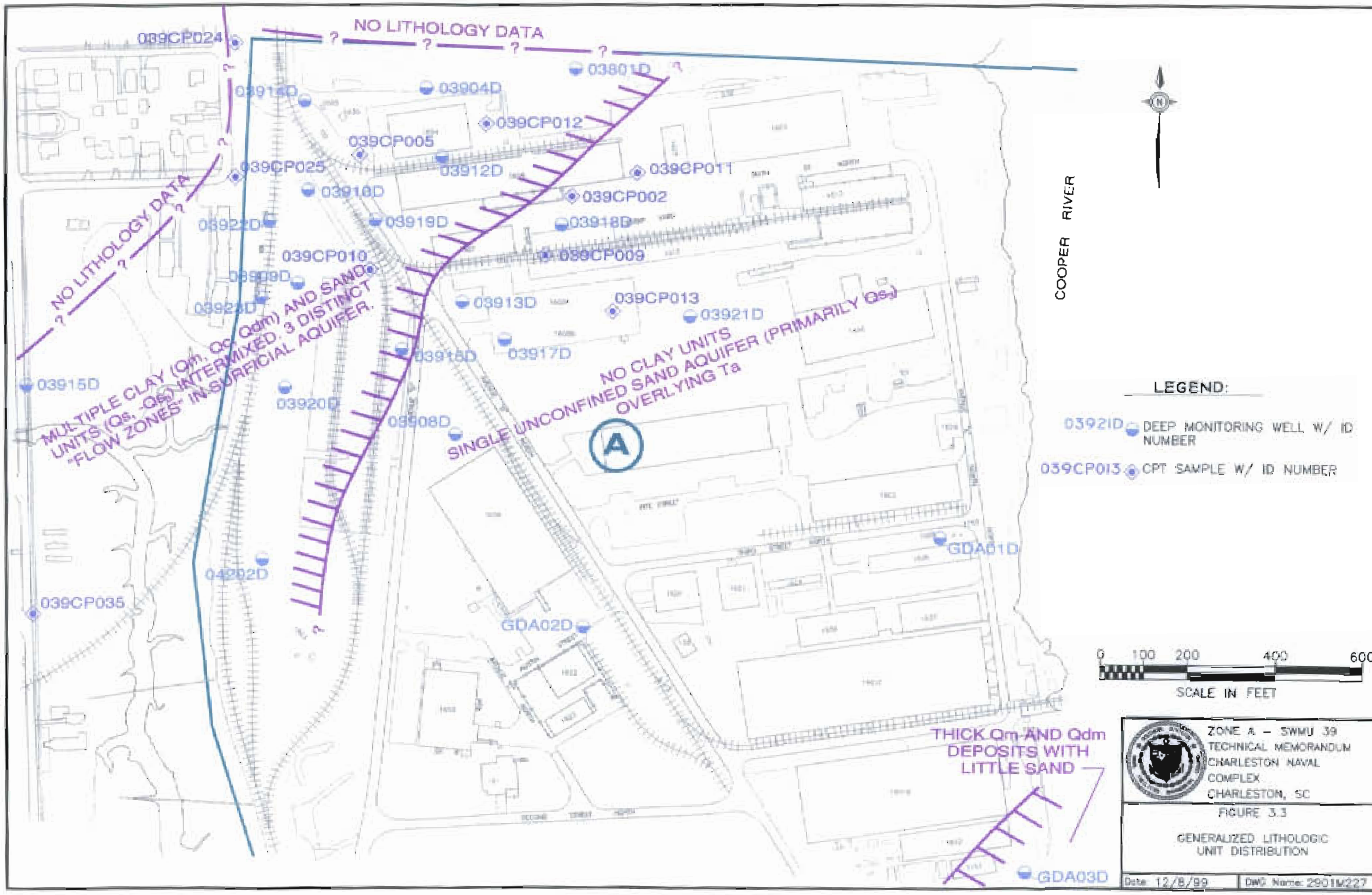



FIGURE 3.2

ELEVATION OF TOP OF ASHLEY FORMATION (Ta)



NO LITHOLOGY DATA
039CP024
03914D
03904D
03801D
039CP012
039CP005
039CP025
03912D
039CP011
03916D
039CP002
03922D
03919D
03918D
039CP010
039CP009
03909D
03923D
03913D
039CP013
03921D
03915D
03917D
03920D
03908D
04202D
039CP035
GDA02D
GDA01D
GDA03D
NO LITHOLOGY DATA
MULTIPLE CLAY (Qm, Qc, Qdm) AND SAND UNITS (Qs, Qs) INTERMIXED. 3 DISTINCT "FLOW ZONES" IN SURFICIAL AQUIFER.
NO CLAY UNITS
SINGLE UNCONFINED SAND AQUIFER (PRIMARILY Qs)
OVERLYING Ta
A
THICK Qm AND Qdm DEPOSITS WITH LITTLE SAND
COOPER RIVER
N
LEGEND:
03921D DEEP MONITORING WELL W/ ID NUMBER
039CP013 CPT SAMPLE W/ ID NUMBER
0 100 200 400 600
SCALE IN FEET
ZONE A – SWMU 39
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC
FIGURE 3.3
GENERALIZED LITHOLOGIC UNIT DISTRIBUTION
Date: 12/8/99
DWG Name: 2901M227

The complex multi-layered nature of the surficial aquifer in the northwestern region of the site necessitated the installation of shallow, intermediate, and deep wells to investigate the potential chemical and hydraulic isolation of the various sand units.

A northeast to southwest trending line illustrated on Figure 3.3 approximates the transition area between complex and simple geologic regions. This line (herein referred to as the Zone A clay/sand boundary) demarcates the disappearance of the clay (Qm and Qdm) units that behave as aquitards northwest of the "clay/sand boundary" and the predominance of extensive $Qs_3$ deposits that extend from ground surface to the Ta in the southeast. Clearly, an erosive event scoured much of the central and southeastern region of Zone A, leaving behind the thick $Qs_3$ deposits.

West to east cross sections D-D', E-E', and F-F' illustrate how $Q_1$ and $Q_2$ series sediments, which are prevalent in the northwestern portion of SWMU 39, have been reduced to a roughly northeast to southwest trending ridge of modest relief, present as an erosional remnant bounded by $Q_3$ sand. $Qs_1$ thickens to the east and north and is better developed than $Qs_2$, which is of very limited areal extent. The best development of $Qs_2$ is in the northwest portion of Zone A as illustrated on cross section F-F' where it is also shown to pinch out to the east. Cross sections A-A' through F-F' illustrate how the thin development of $Q_3$ sand thickens and becomes the predominant unit in the surficial aquifer beneath SWMU 39 southeast of the Zone A clay/sand boundary line.

## 3.2 SWMU 39 Groundwater Flow

The complex geology at the site results in complicated groundwater flowpaths. A generalization of the site hydrogeology requires the assumption that groundwater flow in the northwestern region of the site flows predominantly lateral due to the presence of clay units like Qm and Qdm, which act to vertically confine groundwater flow. However, discontinuities in clay deposition would allow vertical groundwater migration to occur as would interconnections between sand lenses encountered in the Qm and Qdm deposits. Such sand lenses would also behave as preferential contaminant flowpaths as well. Furthermore, despite the localized separation of some sand bodies, it can be reasonably assumed that all the sand bodies are hydraulically connected at some locations, such that they collectively behave as an unconfined aquifer which may have semi-confined zones locally within it. Hydraulic head data collected from shallow, intermediate, and deep wells in this region suggest that each interval may be considered a separate aquifer or flow zone in the surficial aquifer, which is reasonable considering the overall lateral preference for groundwater flow in this region.

Southeast of the Zone A clay/sand boundary, vertical groundwater flow potential becomes much greater due to the absence of clay. The extensive sand deposits southeast of this boundary behave as an unconfined aquifer. In this region, preferential flow would likely be controlled by such micro-scale differences as grain size or macropores. The increased preference in vertical migration is best seen in contaminant data since concentrations generally increase with depth.

Prior to this technical memorandum, the most comprehensive groundwater piezometric maps were constructed from January 1997 data and were presented in Section 10.4 of the Zone A RFI Report. Synoptic groundwater levels were measured zone-wide on September 24, 1998 (concurrent with the 2nd round of MNA sampling), January 29, 1999, and August 11, 1999 (concurrent with the 3rd round of MNA sampling). Figure 3.4 presents groundwater elevation contour maps for the shallow wells, intermediate wells, and deep wells for these three events. These events were not timed respective of any tidal events since it had been previously documented from tidally-timed water level measurements from February 13 and August 7, 1996 events that no major differences in groundwater flow direction result from tidal influence (Zone A RFI Report, EnSafe, 1998). While many small-scale variations exist between these three events, only the major changes and observations in groundwater elevation will be discussed.

### 3.2.1 Upper Aquifer– Shallow Groundwater

The most notable refinement since January 1997 has been the northeast trending "trough" in shallow groundwater that lies north and west of the recharge zone in Zone A. This "trough" coincides closely with the Zone A clay/sand boundary and further emphasizes the predominance of the thick sand deposits pervasive in the southeastern portion of the site. Shallow temporary piezometers (039PZ1 through PZ5) added definition to the size and shape of the shallow groundwater recharge zone in September 1998, indicating that shallow groundwater over the entire zone may consist of two groundwater highs separated by a narrow saddle.

### 3.2.2 Intermediate Aquifer – Intermediate Groundwater

The southeastern flow direction for intermediate groundwater has remained consistent during all water level events. Groundwater elevations decrease rapidly to the southeast. Those wells located southeast of the Zone A clay/sand boundary (i.e., 16I, 13I, and 17I) reveal very subtle differences in hydraulic head, reflecting a lessened horizontal hydraulic gradient in this locale due to the role of the massive $Qs_3$ sand body as a large, homogenous, unconfined aquifer. As a result, wells in clusters 16, 17, and to a lesser extent 13 monitor vertical gradient differences in the aquifer as opposed to horizontal gradient differences as had been the rationale behind clustered wells upgradient in the multi-layered portion of the aquifer.

### 3.2.3 Lower Aquifer – Deep Groundwater

The common theme of all three deep groundwater elevation contour maps is that piezometric heads decrease rapidly from a high in the extreme northwest of the site (due to the shallow depth to the Ta at this location) and create a very flat and unremarkable piezometric surface downgradient to the southeast. Small but measurable differences in deep hydraulic heads in September 1998 were contoured to detail subtleties in deep groundwater flow, particularly in the central portion of Zone A. This data indicated that flow direction could be southwest to northeast at certain locations. However, these small-scale subtleties were not evident in either January or

August 1999, such that supplemental contouring would not accentuate groundwater flow directions in this portion of the site. This makes it difficult to determine the exact groundwater flow direction from many well locations without a more rigorous investigation, such as numerical modeling.

The other most notable feature in the September 1998 and January 1999 events was the appearance of an anomalous but localized depression at 04D. The depression was not evident in August 1999 due to the lack of data collected in surrounding wells.

## 3.3 Aquifer Characterization Testing

During the weeks of May 3, August 23 and 31, and September 6, 1999, numerous specific capacity (specap), step drawdown, and constant rate tests were conducted on selected shallow, intermediate, and deep wells at SWMU 39 to enhance estimates of several aquifer characteristics including hydraulic conductivity, vertical connectivity between aquifers, radius of influence, and well yield. A total of 39 specap, four step drawdown, and two constant rate tests were conducted on wells at 11 well clusters across SWMU 39. General procedures for all aquifer testing techniques as well as equipment decontamination protocol is presented in Attachment G-1.

### 3.3.1 Specific Capacity Testing

Specific capacity tests involve pumping a well at a constant rate and measuring the drawdown in the well when the water level stabilized. The goal of these tests were to estimate aquifer hydraulic conductivity, as well as, determine the potential vertical interconnectivity between intervals at a well cluster or well pair. During the tests, water level measurements were collected by hand using an electronic water level indicator. Depending on well yield, either a peristaltic sampling pump, an Enviro-Tech ES-40 disposable development pump, or Grundfos Redi-Flo II electric submersible pump and dedicated tubing were used to pump the wells.

A computer spreadsheet program was used to develop time-verses-drawdown graphs for extrapolation at wells that did not reach a stabilized drawdown level by the end of the test. The graphs were used to estimate the point that drawdown would begin to stabilize in the well.

**Specap Test Results**

Aquifer parameters were calculated from the specific capacity test data using a computer program developed by Bradbury and Rothschild (1985) which is based on equations presented in Lohman (1972). Drawdown in the well being purged and the duration of pumping were entered into the computer program with other variables characterizing the aquifer and the pumping system. The program estimated specific capacity, transmissivity, and hydraulic conductivity. The computer printouts and stabilization estimation graphs are presented in Attachment G-2.

The two assumed variables entered into the specific capacity program were the aquifer storage coefficient and the well-loss coefficient of the well. Wells exhibiting unconfined aquifer conditions were assigned a storage coefficient based on lithology (Heath, 1989). Wells screened primarily in sand were assigned a storage coefficient of 0.22. Silty or clayey sands were assigned a coefficient of 0.1 and clays were assigned a coefficient of 0.02. Confined aquifer wells were given a storage coefficient of 0.0001 (Heath, 1989). A well-loss coefficient of 1 was used in the program for little or no well loss as recommended by Bradbury and Rothschild (1985) when the value is unknown. The specap results are presented in Table 3-1.

**Table 3-1**
**SWMU 39 Specific Capacity Test Results**

| Well | Hydraulic Conductivity cm/sec | Specific Capacity gpm/ft | Discharge gpm | Drawdown feet |
|---|---|---|---|---|
| 004 | 5.0E-04 | 0.21 | 0.31 | 1.44 |
| 04I | 8.5E-03 | 0.77 | 2.5 | 3.23 |
| 04D | 1.2E-02 | 1.10 | 2.3 | 2.10 |
| 009 | 2.2E-03 | 0.15 | 0.55 | 3.79 |
| 09I | 7.9E-05 | 0.01 | 0.058 | 5.40 |
| 09D | 2.6E-04 | 0.04 | 0.055 | 1.56 |
| 010 | 2.0E-04 | 0.05 | 0.24 | 4.75 |

**Table 3-1**
**SWMU 39 Specific Capacity Test Results**

| Well | Hydraulic Conductivity cm/sec | Specific Capacity gpm/ft | Discharge gpm | Drawdown feet |
|---|---|---|---|---|
| 10I | 1.1E-02 | 0.27 | 0.28 | 1.03 |
| 10D | 1.4E-03 | 0.06 | 0.087 | 1.43 |
| 012 | 3.5E-03 | 0.93 | 1.25 | 1.34 |
| 12I | 3.8E-04 | 0.03 | 0.052 | 1.60 |
| 12D | 5.8E-03 | 0.81 | 0.79 | 0.97 |
| 013 | 3.8E-04 | 0.07 | 0.14 | 2.00 |
| 13I | 2.4E-02 | 0.83 | 0.9 | 1.08 |
| 13D | 2.2E-02 | 2.90 | 2.4 | 0.83 |
| [illegible] | 2.8E-02 | 3.45 | 5.66 | 1.64 |
| 016 | 7.3E-05 | 0.02 | 0.15 | 6.60 |
| 16I | 9.0E-03 | 0.79 | 0.88 | 1.12 |
| 16D | 2.1E-02 | 2.94 | 1.88 | 0.64 |
| 017 | 5.8E-04 | 0.10 | 0.067 | 0.70 |
| 17I | 2.1E-02 | 3.60 | 2.00 | 0.56 |
| 17D | 1.1E-02 | 1.80 | 2.00 | 1.09 |
| | 1.1E-02 | 1.76 | 3.5 | 1.99 |
| | 9.5E-03 | 1.57 | 4.75 | 3.02 |
| | 9.7E-03 | 1.60 | 6.66 | 4.15 |
| 018 | NS | NS | NS | NS |
| 18I | 1.6E-02 | 2.50 | 2.6 | 1.02 |
| 18D | 2.2E-02 | 3.50 | 2.7 | 0.77 |
| | 2.4E-02 | 3.73 | 4.48 | 1.20 |
| 019 | 3.0E-04 | 0.04 | 0.25 | 6.15 |
| 19I | 2.6E-03 | 0.32 | 1.3 | 4.04 |
| 19D | 1.1E-03 | 0.14 | 0.73 | 5.24 |
| 020 | 4.5E-03 | 1.00 | 0.87 | 0.85 |
| | 5.5E-03 | 1.20 | 5.36 | 4.29 |
| 20I | 3.2E-03 | 0.73 | 0.53 | 0.73 |
| 20D | 1.8E-04 | 0.03 | 0.048 | 1.89 |
| 021 | NS | NS | 0.053 | NS |
| 21I | 1.1E-02 | 1.90 | 2.8 | 1.49 |
| 21D | 9.2E-03 | 1.50 | 2.6 | 1.71 |

*Notes:*
NS Never stabilized.

Based on water level responses in wells clustered with a tested well, it was possible to determine whether the tested interval was interconnected with those not being tested. For example, at well cluster 18 during the specap test on intermediate well 18I, water levels were measured in the shallow well 018 and deep well 18D to observe whether or not those intervals responded to the pumping stress on the tested interval. In fact, water level declines were measured in 18D, suggesting interconnection. Based on the cross sections shown previously, this is not surprising given the absence of clay between these three intervals.

The following intervals were determined to be interconnected to some extent during the specap tests: shallow (019) and intermediate (19I) at cluster 19; shallow (020) and intermediate (20I) at cluster 20; intermediate (17I) and deep (17D) at cluster 17; intermediate (13I) and deep (13D) at cluster 13; intermediate (21I) and deep (21D) at cluster 21; and intermediate (18I) and deep (18D) at cluster 18.

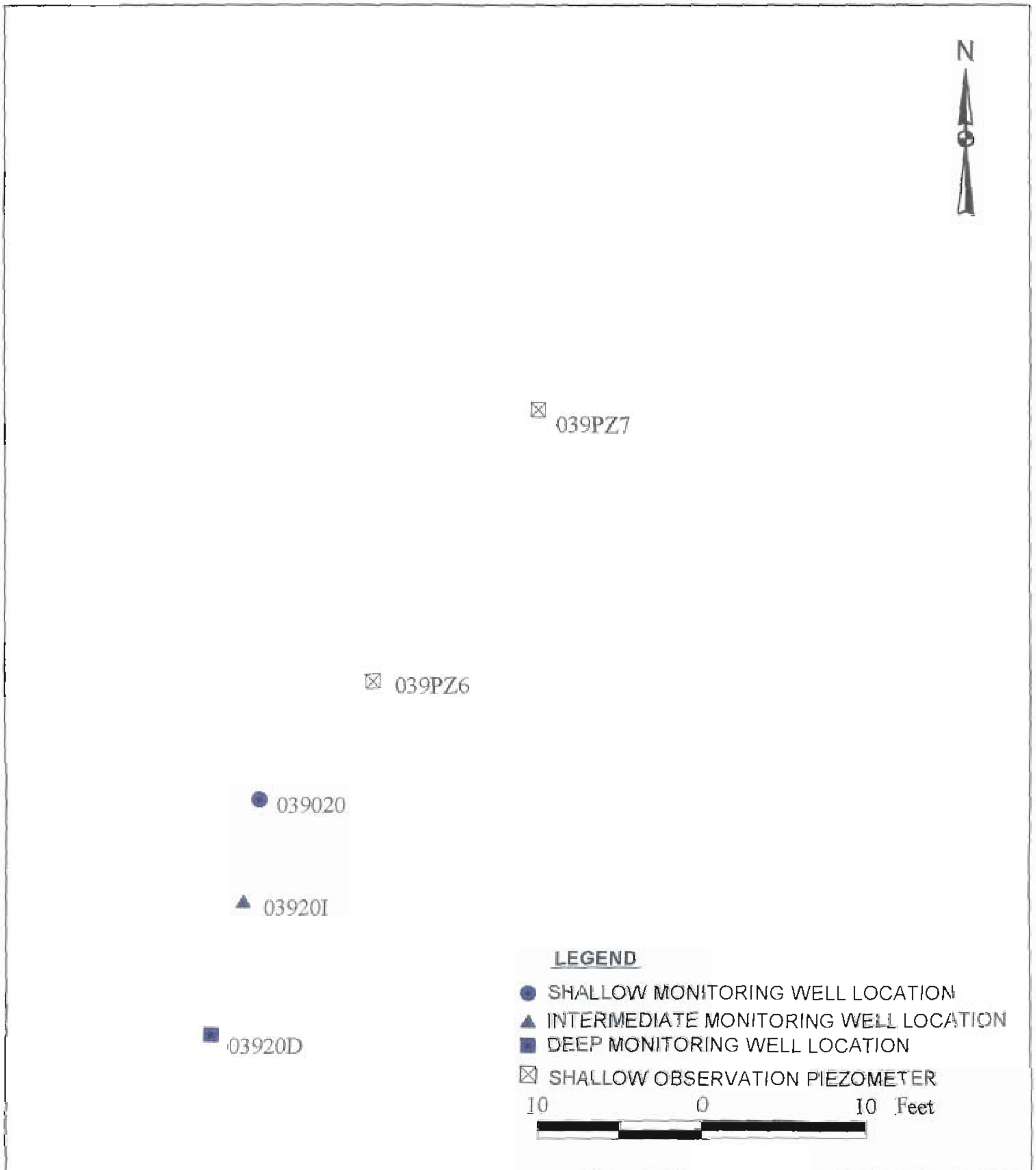
### 3.3.2 Multi-Well Aquifer Tests

Based on the specap data results, it was decided that a larger, scaled-up multi-well aquifer test would be necessary to enhance estimates of aquifer characteristics, determine the optimal pumping rate for potential extraction wells, measure the radius of influence for potential groundwater extraction remedial alternatives, and provide additional insight to interconnectivity at two primary areas of interest. One was shallow groundwater along the western property boundary at well cluster 20. This area was targeted due to the potential for offsite contaminant migration and the need for site-specific aquifer parameters should any Fate and Transport modeling be necessary in this locale. The second test area was intermediate to deep groundwater near the center of the site south of the Zone A clay/sand boundary. This area was targeted due to the prevalence of chlorinated solvent compounds in intermediate and deep groundwater and the limited understanding of the groundwater flow hydraulics within the massive $Qs_3$ sand body.

Groundwater was pumped at a constant rate during these tests using a Grundfos Redi-Flo II electric submersible pump and dedicated tubing. Two shallow piezometers, 039PZ6 and PZ7, were installed upgradient from pumping well 020 for the test in the western portion of the site. The piezometer layout is shown in Figure 3.5. No additional observation points were installed for the test conducted at 17D due to the availability of nearby wells at cluster 13 and the shallow and intermediate wells in cluster 17. Data loggers were used to monitor water level responses in all observation points.

During the multi-well aquifer tests, groundwater from the pumping well was routed to the sanitary sewer. To comply with the North Charleston Sewer District discharge permit, effluent samples were collected and analyzed for VOC concentrations approximately halfway through each test. Throughout the tests, VOC concentrations never exceeded the 1 ppm total VOC limit imposed by the permit (Attachment G-3).

SWMU 39 multi-well aquifer tests were composed of four separate phases that will be discussed separately: 1) ambient condition monitoring; 2) step drawdown testing; 3) constant-rate pumping test; and 4) recovery monitoring.




ZONE A - SWMU 39
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE 3- 5
039020 PUMPING TEST CONFIGURATION

#### 3.3.2.1 Phase 1, Ambient Condition Monitoring

Ambient monitoring includes the collection of barometric pressure and static water level data. This data is useful in identifying rising or falling water level trends in an aquifer that may be a consequence of atmospheric pressure changes or other cyclical events such as ocean tides.

Before and after each multi-well aquifer test, water levels in the wells to be tested were monitored with data loggers and transducers to determine ambient trends that must be accounted for before determining pumping influences on the aquifer. Manual water levels were collected during the tests at surrounding wells to provide additional ambient data outside the anticipated radius of influence. A data logger and two transducers were installed at wells 21I and 21D and recorded water level data from 1800 hrs on August 26, 1999, to 1200 hrs September 10, 1999, as a record of ambient aquifer conditions.

Attachment G-4 includes all ambient data plots from background locations and hand-monitored wells during the multi-well aquifer tests. The ambient data recorded at 21I and 21D throughout the testing period indicate significant tidal influence as evidenced by the sinusoidal water level pattern. This pattern was seen in greater detail at several other well locations. A more detailed discussion of tidal influence is included in Attachment G-4.

#### 3.3.2.2 Phase 2, Step Drawdown Testing

Step drawdown testing involves a series of increases in discharge (steps) after water level in the pumping well has stabilized. By comparing each discharge rate with the corresponding drawdown, the well loss may be calculated and a suitable optimum pumping rate for the tested well can be estimated. Step drawdown tests were conducted on the wells at which pumping tests would be conducted (17D and 020) and two separate wells, 13D and 18D, that were considered for future pumping tests. Drawdown curves of each step test are presented in Attachment G-5.

### 3.3.2.3 Phase 3, Multi-Well Aquifer Test

A multi-well aquifer test involves pumping a well at a constant discharge rate while simultaneously recording water levels in pumping and observation wells and the time elapsed from the start of pumping. The water level/elapsed-time measurements are used to estimate aquifer characteristics (hydraulic conductivity, storativity, etc.).

The multi-well aquifer test on 17D began at 1800 hours on August 28, 1999, and lasted for 9.67 hours (580 minutes). The pumping rate was maintained at 6.67 gallons per minute (gpm) throughout the test. Water levels were monitored at the shallow well (017) and intermediate well (17I) and at the cluster as well as those at 039013/13I/13D, the nearest well cluster.

The multi-well aquifer test on 020 began at 1750 hours on September 9, 1999, and lasted 5.67 hours (340 minutes). The pumping rate for this test was 3.7 gpm. During this test, water levels in the intermediate (20I) and deep well (20D) at the cluster were monitored as were those in nearby shallow observation piezometers, 039PZ6 and PZ7.

### 3.3.2.4 Phase 4, Recovery Monitoring

Recovery tests involve monitoring the rise of water levels back to static conditions after pumping has stopped. Recovering water levels are recorded with the time elapsed after pump shutoff and the relationships between pumping rate, pumping duration, and recovery time are used to estimate aquifer characteristics. Generally, recovery data provides a means to double-check the results obtained during the pumping test.

#### 3.3.2.5 Drawdown Corrections

Drawdown data were evaluated for correlation with barometric pressure and ambient water level trends. Figure 3.6 reveals water level responses due to pumping at 17D. Superimposed on these water level responses are tidally-influenced, sinusoidal wave patterns. Also evident is the response to pump shut-off at approximately 600 minutes. The sinusoidal wave pattern indicates that each well has an approximate 0.5 foot response to tidal forces. The initial decline in water levels marks the influence of pumping, but also appears to coincide closely with a decreasing tidally-influenced water level trend. The effects of pumping are seen clearly by the separation of water levels in each well during pumping; after pump shut-off, this separation is not evident as each well responds to tidal influences solely. Thus, it is apparent that pumping influenced each observation well, but at a magnitude less than that of the tidal influence. It is not practical to subtract out the tidal influence on the observation well data without imparting substantial error to the corrected drawdown curves. Thus, no aquifer parameters were estimated from the test other than specific capacity and vertical connectivity.

For the test on 020, both tidal influence and barometric pressure were determined to have a negligible effect on water levels. Therefore, drawdown corrections were not required or conducted on the drawdown curves of this test.

### 3.3.3 Multi-Well Aquifer Test Results

The multi-well aquifer test results and step test results provided information on aquifer characterization parameters, radius of influence, and well yield.

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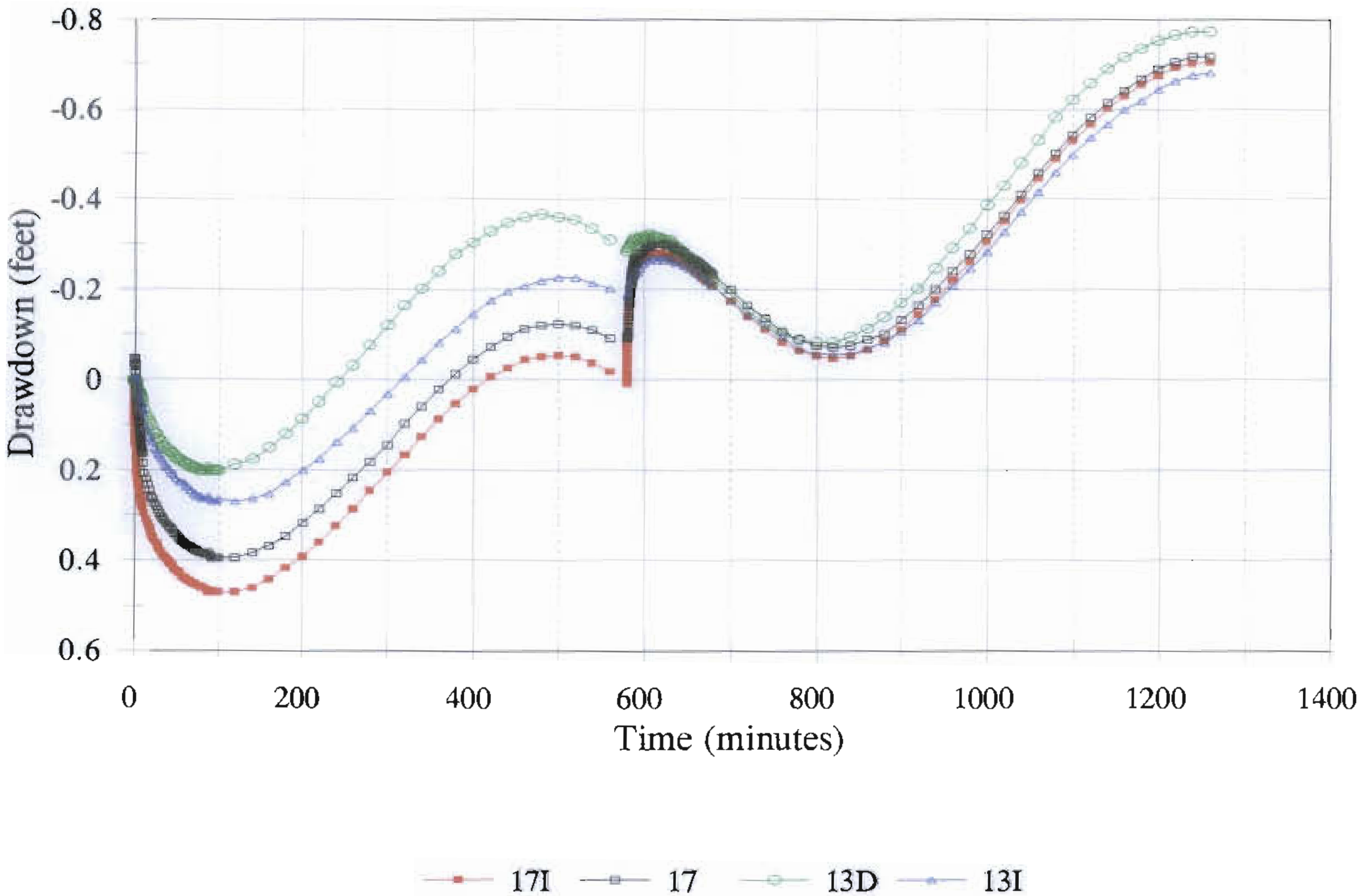
**Figure 3-6**
Tidal Influence on 17D Obs. Wells



#### 3.3.3.1 Step Tests

The step tests on deep wells 13D, 17D, and 18D indicate that the intermediate/deep aquifer zones at these locations are capable of yielding much more than the 3 to 10 gpm pumping rate used during testing. Specific capacities at these locations ranged from 1.57 to 3.73 gpm per foot of drawdown. Therefore, assuming 20 feet of available drawdown, these aquifer zones should sustain pumping rates of 30 to 70 gpm.

#### 3.3.3.2 17D Multi-well Aquifer Test

Although detailed transmissivity, hydraulic conductivity, and storativity results could not be estimated from the 17D test, valuable information on tidal influence, vertical interconnection, and radius of influence was generated. Because measurable drawdown occurred at 13I and 13D during the test, the radius of influence is greater than the 140-foot distance to that cluster. Moreover, with only 3.75 feet of drawdown measured at 17D, a much higher pumping rate than the 6.66 gpm rate used during the test could be sustained, which would result in a much greater radius of influence. The nearly symmetrical responses at 13I, 13D, 17I, and 017 indicate a vertical connection between these intervals.

A higher yielding pumping well in this locale would provide the necessary stress to fully evaluate aquifer parameters. It was realized that the test conducted on 17D was not ideal given the lack of closer observation wells than had been available at the site. However, due to time constraints, it had been determined that installing a pumping well in this vicinity was not feasible. Installing a pumping well between well clusters 13 and 17 would enable proper evaluation of aquifer hydraulic parameters in this locale.

### 3.3.3.3 020 Multi-Well Aquifer Test

Data from the 020 pumping test were compiled using the computer program Aquifer Test Solver (AQTESOLV) for Windows by HydroSOLVE, Inc. (1998). AQTESOLV has several widely published and accepted analytical solutions for many different kinds of aquifer tests. Specifically, drawdown models associated with unconfined [Cooper and Jacob (1946) and Theis (1935)] and leaky confined aquifers [Hantush and Jacob (1955) ] were used to estimate aquifer characteristics. These methods use time (elapsed) plotted against displacement (drawdown) on logarithmic or semi-logarithmic graph paper to calculate aquifer transmissivity (T) and storativity (S). The AQTESOLV graphs are presented Attachment G-6.

Table 3-2 presents the transmissivity (T), hydraulic conductivity (K), and storativity (S) results of the 020 multi-well aquifer test.

**Table 3-2**
**020 Multi-Well Aquifer Test Results**

| Observation Well | Transmissivity ($ft^2$/min) | | | Storativity (unitless) | | |
|---|---|---|---|---|---|---|
| | Hantush-Jacob | Cooper-Jacob | Theis | Hantush-Jacob | Cooper-Jacob | Theis |
| 201 | 0.26 | 0.29 | 0.28 | 0.0014 | 0.0048 | 0.0056 |
| PZ-6 | 0.25 | 0.28 | 0.28 | 0.0034 | 0.0012 | 0.0013 |
| PZ-7 | 0.24 | 0.28 | 0.28 | 0.0006 | 0.00045 | 0.0005 |
| Geometric Mean | All methods and wells combined: | | T = 0.27 $ft^2$/min<br>S = 0.0014 | | K = 15 ft/day or 5.3E-3 cm/sec | |

*Notes: T = K*b; where b = 26 feet at this site.*

Because these aquifer parameters are lognormally distributed, the geometric mean is the best measure of central tendency. Therefore, the average for the test is presented as the geometric mean of the three solutions and all three wells combined.

During the 020 test, water levels in PZ-7 approached static conditions after approximately 1 foot of drawdown. The radius of influence during the test was at least 28 feet, the linear distance between 020 and PZ-7. Because areas of less drawdown would have extended beyond PZ-7 and the aquifer could probably sustain much higher pumping rates, the radius of influence is expected to be much greater than 28 feet.

To estimate the potential radius of influence, a distance/drawdown plot was created from the 020 test data (Figure 3-7). This figure shows the raw data from the test and a linear regression line of that data. When the regression line is extended to the zero drawdown point, the estimated maximum radius of influence can be calculated. The graph indicates that the maximum radius of influence at 020 is approximately 100 feet using a pumping rate of 3.7 gpm. The pumping test data also revealed a connection between shallow and intermediate groundwater at this location.

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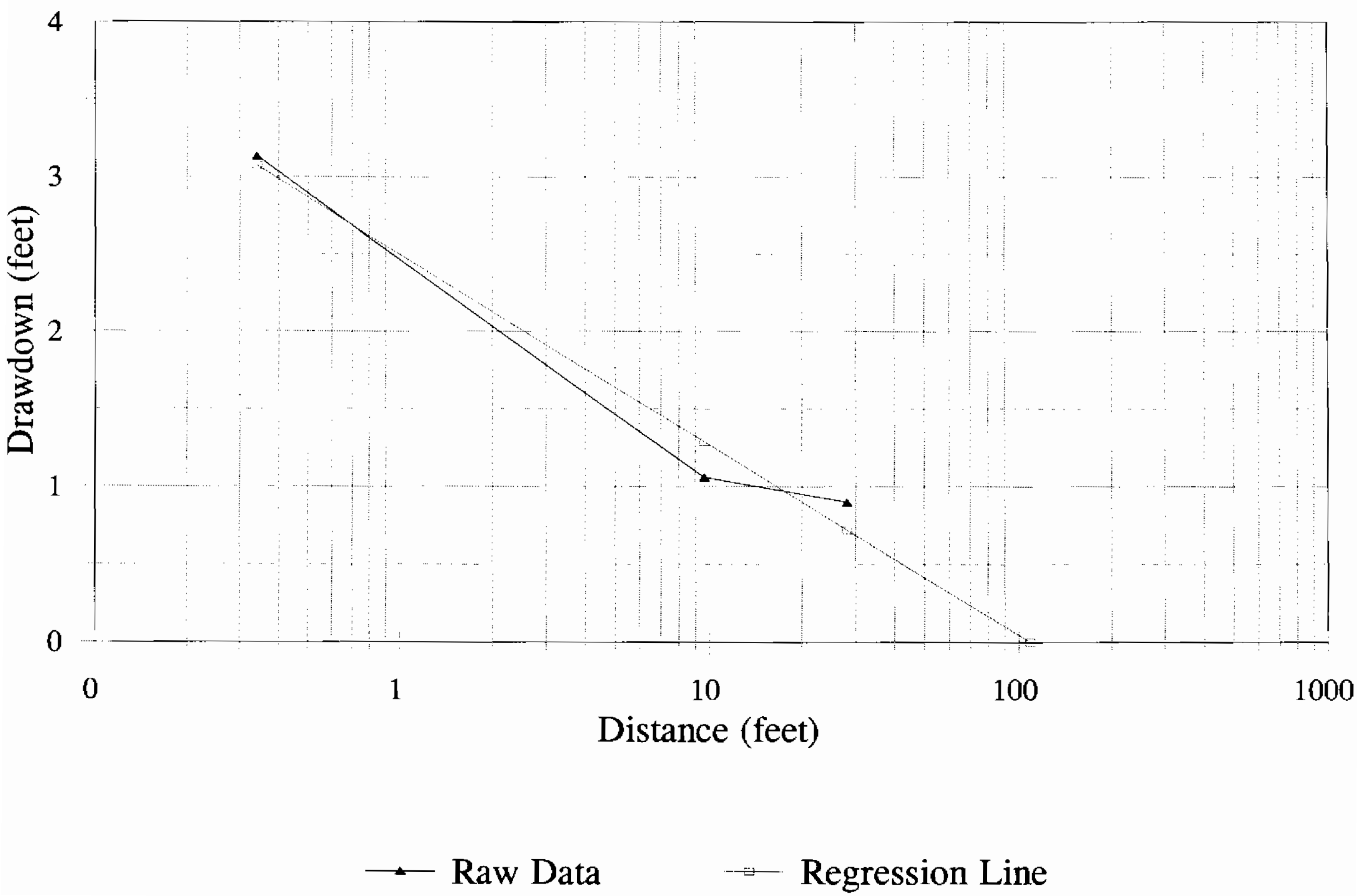
**Figure 3-7**

Distance vs. Drawdown at 020



# 4.0 MNA EVALUATION

## 4.1 Parameters and Locations

As part of CMS activities at SWMU 39, baseline natural attenuation data were gathered from shallow, intermediate, and deep wells based upon a selection criteria discussed in greater detail in Section 1.5 of the *Monitored Natural Attenuation Interim Report* (EnSafe, 1999). One benefit of continued groundwater data collection at the site allowed for continued evaluation of the solvent plume morphology, leading to additional well installations and source area investigations already discussed in Section 2.0 of this document. This section serves only as a summary of the MNA sampling events conducted at the site. All data evaluation and interpretation is conducted in Attachment H.

Three rounds of MNA data were collected at SWMU 39. A combination of off-site fixed laboratory analyses and on-site mobile laboratory analyses were utilized during the first two rounds. All Round 3 data was generated by two off-site fixed laboratories. The analyses and methods are presented in greater detail in Attachment H.

Table 4-1 summarizes the three MNA sampling rounds and indicates the differences in analyses and well locations sampled in each.

**Table 4-1**
**MNA Sampling Round Summary**

| Round | Date | # Shallow Wells | # Intermediate Wells | # Deep Wells | Parameter/Well Changes | Attachment B VOC figures |
|---|---|---|---|---|---|---|
| 1 | 12-20 FEB 98 | 15 | 5 | 8 | only SWMU 39 locations | B-13 to B-15 |

**Table 4-1**
**MNA Sampling Round Summary**

| Round | Date | # Shallow Wells | # Intermediate Wells | # Deep Wells | Parameter/Well Changes | Attachment B VOC figures |
|---|---|---|---|---|---|---|
| 2 | 6-9 OCT 98 | 24 | 9 | 11 | 1. Added well locs. in SWMUs 2, 38, and AOCs 42 and 505;<br>2. Added newly-installed SWMU 39 wells<br>3. Added MTBE to VOC list for Rds. 2 & 3;<br>4. Added TKN, P, Fe (III), Mn (II), $S^-$, $N_2$ gas, HPC, and BTEX degraders analyses;<br>5. Omitted $Cl^-$ analysis;<br>6. Collected synoptic water levels. | B-16 to B-18 |
| 3 | 4-10 AUG 99 | 26 | 11 | 17 | 1. Added new SWMU 39 well pairs;<br>2. Omitted AOC 505 and one AOC 42 well;<br>3. Omitted Fe (III), Mn (II), TKN, P, $Cl^-$, $N_2$ (gas), HPC, and BTEX degrader analyses.<br>4. Sampled other dissolved gases at selected locations only;<br>5. Omitted mobile lab;<br>6. Collected synoptic water levels. | B-22 to B-24 |

## 4.1 MNA Process at CNC

SWMU 39 is one of ten CNC sites where two rounds of baseline MNA data were collected in 1998. SWMUs 39, 9, 17, 166 and AOC 607 were the only five sites that had progressed to the CMS. The other five sites were located in Zone E. During the August 1998 CNC Project Team Meeting, it was agreed upon by SCDHEC, the Navy, and EnSafe that no MNA data evaluation would be conducted on the Zone E sites until the RFI had been reviewed by SCDHEC. SCDHEC's comments were presented to the Navy in the fall of 1999, but presently, no evaluation of Zone E MNA data has yet been conducted.

MNA activities have been conducted in parallel with other CMS tasks at these five sites since the beginning of the CMS process. As a result, the focus of MNA at these sites has changed several times based on continued delineation during the CMS and planned treatability studies to address sites deemed more critical by SCDHEC. An April 14, 1999 memorandum to the Project Team concerning the status and proposed documentation of MNA at these five CMS sites serves as the best summary of these issues (end of Attachment H). No additional sampling or data evaluation has occurred at any of these sites except SWMU 39 since that time.

## 4.2 Results and Preliminary Ranking

For each MNA study at CNC, the USEPA guidance document entitled *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (referred to herein as Technical Protocol, 1998) was consulted for proper evaluation and documentation of the data. The document presents a protocol for data collection and analysis to improve characterization of sites at which a remedy involving MNA is being considered. The data collected using this protocol can be used to compare the effectiveness of MNA as well as other remedial options.

The Technical Protocol devises a preliminary ranking system to determine the potential effectiveness of chlorinated solvent biodegradation at specific well locations. The ranking system is summarized in Tables 4-2 and 4-3. Table 4-4 serves two purposes: it summarizes only the primary VOC results of importance for the MNA evaluation, as well as, all the supporting geochemical data required by the Technical Protocol while including the preliminary screening rankings. Although the ranking for BTEX-contaminated wells are not relevant, those wells are included in this table for data presentation since the ranking may be considered a potential screening value should chlorinated solvents migrate toward these wells. Furthermore, points were not awarded for chloride or methane concentrations as suggested by the Technical Protocol since both are naturally occurring and would mask any production due to biodegradation of chlorinated solvent compounds. Background determinations are provided for those parameters and analytes requiring comparison to background locations for awarding points in the system. More detailed data evaluation and interpretation, as well as, the full data packages are presented in Attachment H.

**Table 4-2**
**Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes**

| Analysis | Concentration in Most Contaminated Zone | Value |
|---|---|---|
| Oxygen | <0.5 mg/L | 3 |
| | >5.0 mg/L | -3 |
| Nitrate | <1.0 mg/L | 2 |
| Iron(II) | >1.0 mg/L | 3 |
| Sulfate | <20 mg/L | 2 |
| Sulfide | > 1.0 mg/L | 3 |
| Methane | < 0.5 mg/L | 0 |
| | > 0.5 mg/L | 3 |
| Oxidation Reduction Potential | < 50 millivolts (mv) | 1 |
| | < -100 mv | 2 |
| pH | 5.0 < pH < 9.0 | 0 |
| | 5.0 > pH > 9.0 | -2 |
| Total Organic Carbon | > 20.0 mg/L | 2 |
| Temperature | > 20°C | 1 |
| Carbon Dioxide | > 2x background | 1 |
| Alkalinity | > 2x background | 1 |
| Chloride | > 2x background | 2 |
| Hydrogen | > 1.0 nanomole (nM) | 3 |
| | < 1.0 nM | 0 |
| BTEX | > 0.1 mg/L | 2 |
| PCE | Released material | 0 |
| TCE | Released material | 0 |
| | Daughter product | 2 |
| DCE | Released material | 0 |
| | Daughter product | 2 |

**Table 4-2**
**Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes**

| Analysis | Concentration in Most Contaminated Zone | Value |
|---|---|---|
| VC | Released material | 0 |
| | Daughter product | 2 |
| 1,1,1-Trichloroethane (TCA) | Released material | 0 |
| Dichloroethane (DCA) | Daughter product of 1,1,1-TCA under reducing conditions. | 2 |
| Carbon Tetrachloride | Released material | 0 |
| Chloroethane | Daughter product of DCA under reducing conditions. | 2 |
| Ethane/Ethene | >0.01 mg/L | 2 |
| | >0.1 mg/L | 3 |
| Chloroform | Released material | 0 |
| | Daughter product of carbon tetrachloride | 2 |
| Dichloromethane | Released material | 0 |
| | Daughter product of chloroform | 2 |

**Table 4-3**
**Interpretation of Total Points from Site Ranking**

| Score | Interpretation |
|---|---|
| 0 | No evidence for biodegradation of chlorinated organics. |
| 1 to 5 | Inadequate evidence for biodegradation of chlorinated organics. |
| 6 to 14 | Limited evidence for biodegradation of chlorinated organics. |
| 15 to 20 | Adequate evidence for biodegradation of chlorinated organics. |
| >20 | Strong evidence for biodegradation of chlorinated organics. |

Table 4.4
SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING

| | Analyte | units | 039001 Rd 1 | 039001 Rd 2 | 039001 Rd 3 | 039002 Rd 1 | 039002 Rd 2 | 039002 Rd 3 | 039003 Rd 1 | 039003 Rd 2 | 039003 Rd 3 | 039004 Rd 1 | 039004 Rd 2 | 039004 Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOCs | Benzene | µg/L | 60 | 40 | | | | | | | | | | |
| | Toluene | µg/L | 6 | 7 | | | | | | | | | | |
| | Ethylbenzene | µg/L | 63 | 53 | | | | | | | | | | |
| | Xylene | µg/L | 78 | 260 | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | |
| | MTBE | µg/L | 21 | 7 | [illegible] | 66 | 49 | | | 8 | 15 | 26 | 33 | 52 |
| | PCE | µg/L | | | | | | | 30 | 23 | 3 | | 3 | |
| | TCE | µg/L | | | | | | | 35 | 28 | 16 | | 3 | 2 |
| | cis-1,2-DCE | µg/L | | | | | | | | 13 | 1 | | 5 | 5 |
| | trans-1,2-DCE | µg/L | | | | | | | | | | | | |
| | 1,2-DCE total | µg/L | | | | | | | 24 | 13 | 1 | | 5 | 5 |
| | VC | µg/L | | | | | | | | | | | | |
| | 1,1-DCA | µg/L | | | | | | | | | | | | |
| | 1,1-DCE | µg/L | | | | | | | | | | | | |
| Dissolved Gases | Carbon Dioxide | mg/L | NA | 97.2 | NA | NA | 143 | NA | NA | 51.8 | NA | NA | 39.3 | 38.8 |
| | log Carbon Dioxide | | | 1.99 | | | 2.16 | | | 1.71 | | | 1.59 | 1.59 |
| | Dissolved Oxygen | mg/L | NA | 0.75 | 0.73 | 0.15 | 2.9 | 3.1 | 0.15 U | 0.60 | 0.19 | 1.1 | 0.65 | 0.49 |
| | Hydrogen | nmol/L | 0.44 | 0.45 | NA | 0.26 | 1.3 | NA | 0.39 | 0.33 | NA | 0.51 | 0.33 | 2.2 |
| | Nitrogen | mg/L | NA | 2.80 | NA | NA | 5.35 | NA | NA | 15.2 | NA | NA | 16.0 | NA |
| | $N_2/O_2$ ratio | | | 3.73 | | | 1.84 | | | 25.3 | | | 24.6 | |
| | Methane | µg/L | NA | 2925 | NA | 32 | 2065 | NA | NA | 202 | NA | NA | 348 | 471 |
| | log Methane | | | 3.47 | | 1.50 | 3.31 | | | 2.30 | | | 2.54 | 2.67 |
| | Ethane | ng/L | 2516 | 3225 | NA | 3.00 U | 215 | NA | 174 | 524 | NA | 115 | 1315 | 2172 |
| | Ethene | ng/L | 3.00 U | 5.00 U | NA | 3.00 U | 5.00 U | NA | 13 | 14 | NA | 3.00 U | 5.00 U | 22 |
| Geochemical Parameters | pH | std units | 6.66 | 6.48 | 6.83 | 6.43 | 6.53 | 6.91 | 6.40 | 6.33 | 6.71 | 6.97 | 6.63 | 6.83 |
| | Redox Potential | mV | -150 | -139 | -151 | -57 | -87 | -133 | 70 | 60 | 106 | -104 | -97 | -128 |
| | Alkalinity | mg/L | 64 | 100 | 312 | 42 | 69 | 158 | 52 | 75 | 145 | 82 | 60 | 166 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | 0.795 | NA | NA | .500 U | NA | NA | .500 U | NA | NA | 2.37 | NA |
| | Iron (II) | mg/L | 33.2 | 21.3 | 0.005 U | 13.5 | 26.6 | 31.5 | .500 U | .500 U | 0.005 U | 2.10 | 14.6 | 0.005 U |
| | Iron (III) | mg/L | NA | 0.668 | NA | NA | .500 U | NA | NA | .500 U | NA | NA | 0.712 | N |
| | Sulfate | mg/L | 5520 | 49 | 2.4 | 35 | 2600 | 19 | 5710 | 16 | 17 | 13 | 66 | 3 |
| | log Sulfate | | 3.74 | 1.69 | 0.38 | 1.54 | 3.41 | 1.28 | 3.76 | 1.20 | 1.24 | 1.10 | 1.82 | 1.54 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 9.7 | 8.1 | 5.6 | 4.3 | 4.5 | 5.7 | 2.0 U | 1.7 | 2.5 | 4.1 | 4.0 | 3.2 |
| | Nitrogen (TKN) | mg/L | NA | 1.4 | NA | NA | 1.7 | NA | NA | 1.0 U | NA | NA | 1.1 | NA |
| | Total Phosphorus | mg/L | NA | 0.58 | NA | NA | 0.42 | NA | NA | 0.19 | NA | NA | 0.49 | NA |
| | Chloride | mg/L | 7.5 | NA | NA | 8.1 | NA | NA | 12.6 | NA | NA | 12.1 | NA | NA |
| | Specific Conductivity | mmho/cm | 0.19 | 0.32 | 0.38 | 0.20 | 0.34 | 0.38 | 0.23 | 0.31 | 0.38 | 0.23 | 0.41 | 0.46 |
| | Temperature | °C | 15.8 | [illegible] | 25.7 | 16.6 | 23.4 | 22.4 | 18.2 | 27.8 | [illegible] | 15.6 | 26.8 | 24.3 |
| Preliminary Screening Ranking | *Dissolved Oxygen* | POINTS | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | [illegible] | 0 | 0 | 3 |
| | *Nitrate as N* | | 2 | [illegible] | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | [illegible] | [illegible] | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 3 | 3 | 0 |
| | *Sulfate* | | 0 | [illegible] | 2 | 0 | 0 | 2 | 0 | 2 | [illegible] | 2 | 0 | 0 |
| | *Redox Potential* | | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 1 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | [illegible] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Temperature* | | 0 | [illegible] | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| | *Carbon Dioxide* * | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Alkalinity** | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | *BTEX* | | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 2 | 2 |
| | *DCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 2 | 2 |
| | *VC* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 9 | 10 | 8 | 9 | 9 | 11 | 9 | 9 | 12 | 9 | 11 | 14 |
| | ***NA evidence*** | | L | L | L | L | L | L | L | L | L | L | L | I |

## Table 4.4
## SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING

| | Analyte | units | 039005 Rd 1 | 039005 Rd 2 | 039005 Rd 3 | 039006 Rd 1 | 039006 Rd 2 | 039006 Rd 3 | 039007 Rd 1 | 039007 Rd 2 | 039007 Rd 3 | 039008 Rd 1 | 039008 Rd 2 | 039008 Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOCs | Benzene | µg/L | 10 | 91 | | | | | | | | | | |
| | Toluene | µg/L | [illegible] | | | | | | | | | | | |
| | Ethylbenzene | µg/L | 60 | | | | | | | | | | | |
| | Xylene | µg/L | 33 | | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | 5 | | | | |
| | MTBE | µg/L | 52 | 90 | | | | | | | | | | |
| | PCE | µg/L | 9 | | | | | | | | | | | |
| | TCE | µg/L | 130 | | | | | | | | | | | |
| | cis-1,2-DCE | µg/L | | | | | | | | | | | | |
| | trans-1,2-DCE | µg/L | | | | | | | | | | | | |
| | 1,2-DCE total | µg/L | 220 | | | | | | | | | | | |
| | VC | µg/L | 46 | | | | | | | | | | | |
| | 1,1-DCA | µg/L | 58 | 10 | | | | | | | | | | |
| | 1,1-DCE | µg/L | 5 | | | | | | | | | | | |
| Dissolved Gases | Carbon Dioxide | mg/L | NA | 56.0 | NA | 82.4 | 162 | NA | 138 | 461 | NA | 237 | 418 | NA |
| | log Carbon Dioxide | | | 1.75 | | 1.92 | 2.21 | | 2.14 | 2.66 | | 2.38 | 2.62 | |
| | Dissolved Oxygen | mg/L | 0.32 | 0.80 | 0.50 | 1.4 | 1.1 | 0.51 | 0.49 | 0.80 | 0.94 | 0.30 | 0.50 | 0.31 |
| | Hydrogen | nmol/L | 0.46 | 0.82 | NA | 0.35 | 0.69 | NA | 1.0 | 0.55 | NA | 0.27 | 1.0 | NA |
| | Nitrogen | mg/L | NA | 11.4 | NA | 0.234 | 1.70 | NA | 0.642 | 2.20 | NA | 0.657 | 1.10 | NA |
| | $N_2/O_2$ ratio | | | 14.2 | | 0.17 | 1.6 | | 1.3 | 2.8 | | 2.2 | 2.2 | |
| | Methane | µg/L | NA | 765 | NA | 669 | 2100 | NA | 822 | 4810 | [illegible] | 1137 | 1265 | NA |
| | log Methane | | | 3.68 | | 2.83 | 3.32 | | 2.91 | 3.68 | [illegible] | 3.06 | 3.10 | |
| | Ethane | ng/L | 1071 | 618 | NA | 126 | 325 | NA | 3.00 U | 5.00 U | NA | 3.00 U | 5.00 U | NA |
| | Ethene | ng/L | 10901 | 5455 | NA | 3.00 U | 5.00 U | NA | 3.00 U | 5.00 U | NA | 3.00 U | 5.00 U | NA |
| Geochemical Parameters | pH | std units | 6.74 | 6.53 | 6.88 | 6.51 | 6.33 | 6.60 | 6.39 | 5.95 | 6.30 | 6.31 | 6.16 | 6.26 |
| | Redox Potential | mV | -136 | -101 | -193 | -118 | -56 | -159 | -138 | -52 | -83 | -55 | -60 | -153 |
| | Alkalinity | mg/L | 53 | 75 | 179 | 75 | 90 | 371 | 68 | 210 | 608 | 86 | 380 | 790 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | 1.22 | 0.10 U | NA | .500 U | NA | NA | .500 U | NA | NA | 1.06 | NA |
| | Iron (II) | mg/L | 36.3 | 43.1 | 8.70 | 9.75 | 14.6 | 5.30 | 16.0 | 9.89 | 8.70 | 14.3 | 16.4 | 0.005 U |
| | Iron (III) | mg/L | NA | 1.52 | NA | NA | .500 U | NA | NA | 0.575 | NA | NA | 1.33 | NA |
| | Sulfate | mg/L | 0.62 | 100 | 6.0 | 5620 | 8.7 | 4.5 | 5340 | 14 | 4.7 | 997 | 360 | 77 |
| | log Sulfate | | -0.21 | 2.00 | 0.78 | 3.75 | 0.94 | 0.65 | 3.73 | 1.15 | 0.23 | 3.00 | 2.56 | 1.88 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 5.1 | [illegible] | 5.0 | 9.8 | 8.2 | 20 | 9.8 | 13 | 53 | 12 | 15 | 128 |
| | Nitrogen (TKN) | mg/L | NA | [illegible] | NA | NA | 4.2 | NA | NA | 7.8 | NA | NA | 7.6 | NA |
| | Total Phosphorus | mg/L | NA | 0.36 | NA | NA | 0.100 U | NA | NA | 0.27 | NA | NA | 0.35 | NA |
| | Chloride | mg/L | 9.8 | NA | NA | 387 | NA | NA | 265 | NA | NA | 68.8 | NA | NA |
| | Specific Conductivity | mmho/cm | 0.46 | 0.38 | 0.53 | 0.24 | 0.24 | 2.04 | 0.67 | 0.24 | 2.03 | 0.42 | 0.38 | 2.29 |
| | Temperature | °C | 17.2 | 25.9 | 22.6 | 20.5 | 28.5 | 26.3 | 18.5 | 29.3 | 26.7 | 18.2 | 23.4 | 22.1 |
| Preliminary Screening Ranking | *Dissolved Oxygen* | POINTS | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | [illegible] | 3 | 0 | 3 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | [illegible] | [illegible] | 2 | 2 | 2 |
| | *Iron (II)* | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | [illegible] | [illegible] | 3 | 3 | 0 |
| | *Sulfate* | | 2 | 0 | 2 | 0 | 2 | 2 | 0 | [illegible] | [illegible] | 0 | 0 | 0 |
| | *Redox Potential* | | 2 | 2 | 2 | 2 | 1 | 2 | 2 | [illegible] | [illegible] | 1 | 1 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | [illegible] | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | [illegible] | [illegible] | 0 | 0 | 2 |
| | *Temperature* | | 0 | 1 | 1 | 1 | 1 | 1 | 0 | [illegible] | [illegible] | 0 | 1 | 1 |
| | *Carbon Dioxide ** | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | [illegible] | 0 | 1 | 1 | 0 |
| | *Alkalinity** | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | [illegible] | [illegible] | 0 | 1 | 1 |
| | *Hydrogen* | | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| | *BTEX* | | 2 | [illegible] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCE* | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *VC* | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 21 | 10 | 11 | 8 | 10 | 13 | 11 | 11 | 12 | 10 | 10 | 11 |
| | ***NA evidence*** | | S | L | L | L | L | L | L | L | L | L | L | L |

VOCs were left blank in table if non-detect at 5.0 mg/L; values less than that were estimated by lab.

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 039009 Rd 1 | 039009 Rd 2 | 039009 Rd 3 | 039010 Rd 1 | 039010 Rd 2 | 039010 Rd 3 | 039011 Rd 1 | 039011 Rd 2 | 039011 Rd 3 | 039012 Rd 1 | 039012 Rd 2 | 039012 Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOCs | Benzene | µg/L | | [illegible] | | | | | 180 | 160 | 96 | 2 | 18 | |
| | Toluene | µg/L | | | | | | | 170 | 12 | 2 | | | |
| | Ethylbenzene | µg/L | | | | | | | 20 | 160 | 44 | | 3 | |
| | Xylene | µg/L | | | | | | | 440 | 370 | 120 | | 3 | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | | | | 48 | 54 | 50 |
| | PCE | µg/L | | 50 | | | | | | | | | | |
| | TCE | µg/L | 1 | 47 | | | | | | | | 78 | 110 | 87 |
| | cis-1,2-DCE | µg/L | | 530 | 20 | | | | | | | | 340 | 170 |
| | trans-1,2-DCE | µg/L | | 22 | | | | | | | | | 10 | 5 |
| | 1,2-DCE total | µg/L | 37 | 552 | 20 | | | | | | | 110 | 350 | 175 |
| | VC | µg/L | 6 | 90 | 4 | | | | | | | 3 | 65 | 7 |
| | 1,1-DCA | µg/L | | 16 | | | | | | | | 1 | 20 | 4 |
| | 1,1-DCE | µg/L | | 10 | | | | | | | | 2 | 6 | 3 |
| Dissolved Gases | Carbon Dioxide | mg/L | 73.6 | 84.0 | NA | 12.6 | 65.4 | NA | 141 | 37.5 | NA | NA | 60.9 | 60.8 |
| | log Carbon Dioxide | | 1.87 | 1.92 | | 1.10 | 1.82 | | 2.15 | 1.57 | | | 1.78 | 1.78 |
| | Dissolved Oxygen | mg/L | 0.15 | 1.2 | 0.31 | 1.1 | 1.1 | 1.7 | 0.25 | 0.85 | 0.93 | NA | 0.85 | 0.26 |
| | Hydrogen | nmol/L | 0.42 | 0.29 | NA | 0.61 | 0.46 | NA | 3.6 | 0.30 | NA | 0.25 | 0.43 | 1.5 |
| | Nitrogen | mg/L | 0.726 | 13.3 | NA | 1.25 | 8.00 | NA | 3.36 | 4.10 | NA | NA | 10.2 | NA |
| | $N_2/O_2$ ratio | | 4.8 | 11.5 | | 1.1 | 7.3 | | 13.3 | 4.8 | | | 12.0 | |
| | Methane | µg/L | 80 | 1295 | NA | 1.0 U | 385 | NA | 13003 | 76 | NA | NA | 2735 | 848 |
| | log Methane | | 1.90 | 3.11 | | | 2.58 | | 4.11 | 1.88 | | | 3.44 | 2.93 |
| | Ethane | ng/L | 36 | 434 | NA | 3 | 43 | NA | 405 | 18 | NA | 606 | 839 | 655 |
| | Ethene | ng/L | 538 | 2545 | NA | 10 | 5 | NA | 3.00 U | 5.00 U | NA | 244 | 4705 | 917 |
| Geochemical Parameters | pH | std units | 6.26 | 5.95 | 6.28 | 6.80 | 5.89 | 6.25 | 6.21 | 5.92 | 4.24 | 6.73 | 6.74 | 6.84 |
| | Redox Potential | mV | -73 | -53 | -44 | 134 | -21 | -119 | -154 | -26 | -67 | -128 | -130 | -178 |
| | Alkalinity | mg/L | 44 | 65 | 129 | 25 | 35 | 123 | 34 | 64 | 329 | 63 | 70 | 203 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | 0.986 | NA | NA | .500 U | NA | NA | 0.900 | NA | NA | 2.34 | NA |
| | Iron (II) | mg/L | .500 U | 13.0 | 0.005 U | .500 U | 8.34 | 92.5 | 48.4 | 8.42 | 0.005 U | 36.8 | 20.1 | 0.005 U |
| | Iron (III) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA | NA | 0.526 | NA |
| | Sulfate | mg/L | 11 | 9.0 | 6.4 | 4490 | 7.9 | 2.4 | 0.2 U | 28 | 0.20 U | 5090 | 22 | 4.5 |
| | log Sulfate | | 1.03 | 0.95 | 0.81 | 3.65 | 0.90 | 0.38 | | 1.45 | | 3.71 | 1.34 | 0.65 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 6.8 | 3.1 | 17 | 2.0 U | 1.6 | 9.1 | 29 | 36 | 16 | 3.4 | 3.5 | 2.7 |
| | Nitrogen (TKN) | mg/L | NA | 1.0 U | NA | NA | 2.2 | NA | NA | 4.8 | NA | NA | 2.2 | NA |
| | Total Phosphorus | mg/L | NA | 0.15 | NA | NA | 0.100 U | NA | NA | 0.19 | NA | NA | 0.22 | NA |
| | Chloride | mg/L | 4.9 | NA | NA | 0.02 U | NA | NA | 5.7 | NA | NA | 0.02 U | NA | NA |
| | Specific Conductivity | mmho/cm | 0.08 | 0.26 | 0.31 | 0.01 | 0.18 | 0.29 | 0.24 | 0.12 | 0.24 | 0.30 | 0.31 | 0.44 |
| | Temperature | °C | [illegible] | 22.8 | 22.6 | 16.8 | 25.6 | 23.6 | 17.6 | 24.4 | 24.0 | 16.7 | 27.6 | 24.9 |
| Preliminary Screening Ranking | *Dissolved Oxygen* | POINTS | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | 0 | [illegible] | 0 | 0 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 0 |
| | *Sulfate* | | 2 | 2 | 2 | 0 | 2 | 2 | 2 | 0 | 2 | 0 | 0 | 2 |
| | *Redox Potential* | | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| | *pH* | | 0 | [illegible] | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| | *Temperature* | | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| | *Carbon Dioxide ** | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Alkalinity** | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 |
| | *TCE* | | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| | *DCE* | | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| | *VC* | | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 15 | 17 | 13 | 2 | 9 | 10 | 17 | 11 | 7 | 15 | 16 | 20 |
| | ***NA evidence*** | | A | A | L | I | L | L | A | L | L | A | A | A |

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 039013 | | | 039014 | | | 039015 | 039016 | | 039017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 2 | Rd 3 |
| *VOCs* | Benzene | µg/L | | | | 14 | 10 | | | 2 | 1 | | |
| | Toluene | µg/L | | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | |
| | MTBE | µg/L | | | | 26 | 12 | 14 | | | | | |
| | PCE | µg/L | 6 | 1 | 1 | | | | | 40 | 9 | | |
| | TCE | µg/L | 2 | | | | | | | 23 | 13 | | |
| | cis-1,2-DCE | µg/L | | 12 | 15 | | | | | 380 | 350 | | |
| | trans-1,2-DCE | µg/L | | | | | | | | 13 | 9 | | |
| | 1,2-DCE total | µg/L | 13 | 12 | 15 | | | | | 393 | 359 | | |
| | VC | µg/L | | | | | | | | 69 | 40 | | |
| | 1,1-DCA | µg/L | | | | | | | | 15 | 7 | | |
| | 1,1-DCE | µg/L | | | | | | | | 8 | 4 | | |
| *Dissolved Gases* | Carbon Dioxide | mg/L | 59.9 | 104 | NA | 35.3 | 57.7 | NA | 19.7 | 108 | 136 | 167 | 178 |
| | log Carbon Dioxide | | 1.78 | 2.01 | | 1.55 | 1.76 | | 1.29 | 2.03 | 2.13 | 2.22 | 2.25 |
| | Dissolved Oxygen | mg/L | 0.75 | 6.1 | 1.0 | 0.90 | 0.80 | 0 | 0.30 | 1.5 | 0.25 | 0.75 | 0.45 |
| | Hydrogen | nmol/L | 0.36 | 0.46 | NA | 0.50 | 5.6 | NA | 0.52 | NA | 3.4 | NA | 1.6 |
| | Nitrogen | mg/L | 1.51 | 10.8 | NA | 1.83 | 5.15 | NA | 3.13 | 10.1 | NA | 4.30 | NA |
| | $N_2/O_2$ ratio | | 2.0 | 1.8 | | 2.0 | 6.4 | | 10.4 | 6.9 | | 5.7 | |
| | Methane | µg/L | 1.0 U | 2 | NA | 275 | 4575 | NA | 6700 | 782 | 686 | [illegible] | 8310 |
| | log Methane | | | 0.27 | | 2.44 | 3.66 | | 3.83 | 2.89 | 2.84 | 3.82 | 3.92 |
| | Ethane | ng/L | 2 | 5.00 U | NA | 82 | 1460 | NA | 1628 | 655 | 651 | 5.00 U | 5.00 U |
| | Ethene | ng/L | 11 | 5.00 U | NA | 3.00 U | 5.00 U | NA | 3.00 U | 2875 | 2377 | 5.00 U | 5.00 U |
| *Geochemical Parameters* | pH | std units | 5.47 | 5.27 | 5.57 | 6.76 | 6.38 | 7.40 | 7.62 | 5.86 | 4.98 | 6.63 | 6.65 |
| | Redox Potential | mV | 63 | 84 | 245 | -131 | -120 | -145 | -21 | 8 | 162 | -189 | 136 |
| | Alkalinity | mg/L | 10 | 10 U | 100 | 52 | 75 | 179 | 82 | 43 | 166 | [illegible] | 52 |
| | Nitrate as N | mg/L | 0.34 | 0.61 | 0.29 | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | 1.17 | NA | .500 U | NA |
| | Iron (II) | mg/L | .500 U | .500 U | 20.5 | 28.0 | 26.1 | 40.1 | .500 U | 1.78 | 0.005 U | 16.8 | 0.005 U |
| | Iron (III) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA | 0.663 | NA |
| | Sulfate | mg/L | 34 | 30 | 30 | 7.3 | 54 | 2.2 | 79 | 15 | 23 | 62 | 15 |
| | log Sulfate | | 1.53 | 1.48 | 1.48 | 0.86 | 1.73 | 0.34 | 1.90 | 1.18 | 1.36 | [illegible] | [illegible] |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | 1.00 U | 4.6 |
| | Total Organic Carbon | mg/L | 2.0 U | 1.0 U | 18 | 6.2 | 5.3 | 6.2 | 17 | 3.1 | 9.6 | [illegible] | [illegible] |
| | Nitrogen (TKN) | mg/L | NA | 1.0 U | NA | NA | 2.8 | NA | NA | 1.0 U | NA | [illegible] | NA |
| | Total Phosphorus | mg/L | NA | 0.12 | NA | NA | 0.40 | NA | NA | 0.19 | NA | [illegible] | NA |
| | Chloride | mg/L | 4.0 | NA | NA | 16.5 | NA | NA | 1800 | NA | NA | NA | NA |
| | Specific Conductivity | mmho/cm | 88 | 0.26 | 0.14 | 0.13 | 0.28 | 0.42 | 3.7 | 0.29 | 0.13 | [illegible] | 0.96 |
| | Temperature | °C | 16.7 | 26.5 | 26.8 | 17.9 | 26.9 | 25.2 | 18.8 | 28.6 | 28.7 | [illegible] | [illegible] |
| *Preliminary Screening Ranking* | *Dissolved Oxygen* | *POINTS* | 0 | 3 | 0 | 0 | 0 | 3 | 3 | 0 | 3 | [illegible] | [illegible] |
| | *Nitrate as N* | | [illegible] | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | [illegible] | [illegible] |
| | *Iron (II)* | | 0 | 0 | 3 | 3 | 3 | 3 | 0 | 3 | 0 | [illegible] | 0 |
| | *Sulfate* | | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | [illegible] |
| | *Redox Potential* | | 0 | 0 | 0 | 2 | 2 | 2 | 1 | 1 | 0 | 2 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -2 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | *Temperature* | | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| | *Carbon Dioxide* * | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 1 |
| | *Alkalinity** | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | [illegible] | 0 |
| | *Hydrogen* | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| | *DCE* | | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| | *VC* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 6 | 2 | 8 | 9 | 9 | 14 | 6 | 17 | 14 | 10 | 14 |
| | ***NA evidence*** | | L | I | L | L | L | L | L | A | L | L | L |

[illegible] VOCs were left blank in table if non detect at 5.0 mg/L ; values less than that were estimated by lab.

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 039018 Rd 2 | 039018 Rd 3 | 039019 Rd 2 | 039019 Rd 3 | 039020 Rd 3 | 039021 Rd 3 | 039022 Rd 3 | 039023 Rd 3 | 042001 Rd 2 | 042002 Rd 2 | 042002 Rd 3 | 505001 Rd 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | Benzene | µg/L | | | | | | | | | | | | |
| | Toluene | µg/L | | | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | | | | | | |
| | PCE | µg/L | | | | | | | | | | | | |
| | TCE | µg/L | 2 | 3 | | | | | | | | | | |
| | cis-1,2-DCE | µg/L | 9 | 10 | | | 2 | | | | | | 4 | |
| | trans-1,2-DCE | µg/L | | | | | | | | | | | | |
| | 1,2-DCE total | µg/L | 9 | 10 | | | 2 | | | | | | 4 | |
| | VC | µg/L | | | | | | | | | | | | |
| | 1,1-DCA | µg/L | | | | | | | | | | | | |
| | 1,1-DCE | µg/L | | | | | | | | | | | | |
| *Dissolved Gases* | Carbon Dioxide | mg/L | 95.6 | 90.4 | 231 | NA | 104 | NA | NA | NA | 136 | 254 | NA | 121 |
| | log Carbon Dioxide | | 1.98 | 1.96 | 2.36 | | 2.02 | | | | 2.13 | 2.40 | | 2.08 |
| | Dissolved Oxygen | mg/L | 1.9 | 1.2 | 0.75 | 4.8 | 0.24 | 0.08 | 0.73 | 0.16 | 0.60 | 0.70 | 1.70 | 0.70 |
| | Hydrogen | nmol/L | NA | 1.5 | NA | NA | 2.9 | NA | NA | NA | 0.38 | 0.20 | NA | 0.32 |
| | Nitrogen | mg/L | 14.1 | NA | 3.25 | NA | NA | NA | NA | NA | 8.85 | 11.3 | NA | 14.1 |
| | $N_2/O_2$ ratio | | 7.6 | | 4.3 | | | | | | 14.8 | 16.1 | | 20.1 |
| | Methane | µg/L | 132 | 63 | 7210 | NA | 15 | NA | NA | NA | 18 | 150 | NA | 842 |
| | log Methane | | 2.12 | 1.80 | 3.86 | | 1.16 | | | | 1.26 | 2.18 | | 2.93 |
| | Ethane | ng/L | 14 | 12 | 5.00 U | NA | 23 | NA | NA | NA | 39 | 19 | NA | 5.00 U |
| | Ethene | ng/L | 112 | 109 | 5.00 U | NA | 66 | NA | NA | NA | 19 | 5.00 U | NA | 5.00 U |
| *Geochemical Parameters* | pH | std units | 6.00 | 5.86 | 6.03 | 6.05 | 5.15 | 6.65 | 6.03 | 7.20 | 5.85 | 4.91 | 5.55 | 5.46 |
| | Redox Potential | mV | -70 | -53 | -137 | -13 | 60 | -70 | 17 | -77 | 50 | 51 | 91 | -122 |
| | Alkalinity | mg/L | 58 | 128 | 85 | 229 | 25 | 254 | 156 | 212 | 55 | 10 U | 50 | 70 |
| | Nitrate as N | mg/L | 0.62 | 0.27 | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | .500 U | NA | .500 U | NA | NA | NA | NA | NA | .500 U | .500 U | NA | .500 U |
| | Iron (II) | mg/L | 1.99 | 15.6 | 41.8 | 0.005 U | 0.005 U | 14.3 | 0.005 U | 27.7 | .500 U | 7.80 | 11.2 | 25.7 |
| | Iron (III) | mg/L | .500 U | NA | 0.821 | NA | NA | NA | NA | NA | .500 U | .500 U | NA | 0.641 |
| | Sulfate | mg/L | 44 | 30 | 12 | 0.34 | 97 | 5.0 | 16 | 30 | 60 | 100 | 92 | 52 |
| | log Sulfate | | 1.64 | 1.47 | 1.08 | -0.47 | 1.98 | 0.70 | 1.19 | 1.48 | 1.78 | 2.00 | 1.96 | 1.72 |
| | Sulfide | mg/L | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.2 | 1.00 U | 1.2 | 1.00 U | 1.00 U | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 10 | 8.7 | 10 | 71 | 12 | 59 | 9.1 | 7.4 | 2.3 | 1.0 U | 15 | 1.0 U |
| | Nitrogen (TKN) | mg/L | 2.0 | NA | 41 | NA | NA | NA | NA | NA | 1.0 U | [illegible] | NA | 1.7 |
| | Total Phosphorus | mg/L | 0.40 | NA | 0.51 | NA | NA | NA | NA | NA | 0.14 | 0.14 | NA | 0.78 |
| | Chloride | mg/L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | Specific Conductivity | mmho/cm | 0.07 | 0.20 | 0.09 | 0.48 | 0.28 | 11.98 | 0.16 | [illegible] | 0.34 | 0.17 | 0.11 | 0.29 |
| | Temperature | °C | 28.2 | 27.2 | 25.4 | 24.0 | 21.9 | 21.7 | 22.9 | 25.6 | 25.5 | 25.6 | 26.9 | 25.9 |
| *Preliminary Screening Ranking* (*POINTS*) | *Dissolved Oxygen* | | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | [illegible] | 2 | 2 |
| | *Iron (II)* | | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 3 | 0 | [illegible] | 3 | 3 |
| | *Sulfate* | | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| | *Redox Potential* | | 1 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | *Carbon Dioxide* * | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | *Alkalinity** | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| | *Hydrogen* | | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCE* | | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| | *VC* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | **11** | **12** | **11** | **9** | **9** | **15** | **7** | **11** | **3** | **5** | **8** | **8** |
| | ***NA evidence*** | | **L** | **L** | **L** | **L** | **L** | **A** | **L** | **L** | **I** | **I** | **L** | **L** |

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 002004 Rd 2 | 002004 Rd 3 | 002006 Rd 2 | 002006 Rd 3 | 038002 Rd 2 | 038002 Rd 3 | 03904I Rd 1 | 03904I Rd 2 | 03904I Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | Benzene | μg/L | | | | | | | | | |
| | Toluene | μg/L | | | | | | | | | |
| | Ethylbenzene | μg/L | | | | | | | | | |
| | Xylene | μg/L | | | | | | | | | |
| | Chlorobenzene | μg/L | | | 2 | | | | | | |
| | MTBE | μg/L | | | | | 6 | | | | 10 |
| | PCE | μg/L | | | | | | | | | |
| | TCE | μg/L | | | | | | | | | |
| | cis-1,2-DCE | μg/L | | | | | | | | | |
| | trans-1,2-DCE | μg/L | | | | | | | | | |
| | 1,2-DCE total | μg/L | | | | | | | | | |
| | VC | μg/L | | | | | | | | | |
| | 1,1-DCA | μg/L | | | | | | | | | |
| | 1,1-DCE | μg/L | | | | | | | | | |
| *Dissolved Gases* | Carbon Dioxide | mg/L | 141 | NA | 54.3 | NA | 52.0 | NA | NA | 7.10 | 12.1 |
| | log Carbon Dioxide | | 2.15 | | 1.73 | | 1.72 | | | 0.85 | 1.08 |
| | Dissolved Oxygen | mg/L | 1.4 | 0.38 | 1.3 | 2.0 | 1.1 | 1.5 | 0.14 | 0.70 | 0.19 |
| | Hydrogen | nmol/L | 0.54 | NA | 0.23 | NA | 0.42 | NA | 1.1 | 0.72 | 3.2 |
| | Nitrogen | mg/L | 3.20 | NA | 4.60 | NA | 5.10 | NA | NA | 16.4 | NA |
| | $N_2/O_2$ ratio | | 2.4 | | 3.7 | | 4.6 | | | 23.4 | |
| | Methane | μg/L | 326 | NA | 0.9 | NA | 110 | NA | 1.0 U | 29 | 22 |
| | log Methane | | 2.51 | | -0.04 | | 2.04 | | | 1.46 | 1.34 |
| | Ethane | ng/L | 5.00 U | NA | 5.00 U | NA | 40 | NA | 9 | 19 | 20 |
| | Ethene | ng/L | 5.00 U | NA | 6 | NA | 9 | NA | 41 | 46 | 30 |
| *Geochemical Parameters* | pH | std units | 6.55 | 6.56 | 4.21 | 4.95 | 6.67 | 6.66 | 7.25 | 7.13 | 7.32 |
| | Redox Potential | mV | -94 | -145 | 300 | 234 | 2 | -59 | 0.37 | -92 | -143 |
| | Alkalinity | mg/L | 210 | 525 | 10 U | 0.1 U | 65 | 162 | 48 | 55 | 146 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 1.2 | 1.0 U | 0.10 U | 0.10 U | 0.13 | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | .500 U | NA | .500 U | NA | .500 U | NA | NA | .500 U | NA |
| | Iron (II) | mg/L | 9.95 | 0.005 U | .500 U | 0.005 U | .500 U | 0.005 U | .500 U | .500 U | 0.005 U |
| | Iron (III) | mg/L | .500 U | NA | .500 U | NA | .500 U | NA | NA | .500 U | NA |
| | Sulfate | mg/L | 31 | 4.9 | 36 | 32 | 12 | 13 | 35 | 30 | 26 |
| | log Sulfate | | 1.49 | 0.69 | 1.56 | 1.50 | 1.08 | 1.10 | 1.54 | 1.48 | 1.41 |
| | Sulfide | mg/L | 1.00 U | 1.4 | 1.00 U | 1.00 U | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 9.4 | 18 | 1.0 U | 3.3 | 6.1 | 5.6 | 3.2 | 2.3 | 2.1 |
| | Nitrogen (TKN) | mg/L | 6.2 | NA | 2.8 | NA | 2.0 | NA | NA | 1.4 | NA |
| | Total Phosphorus | mg/L | 0.100 U | NA | 0.15 | NA | 0.21 | NA | NA | 0.19 | NA |
| | Chloride | mg/L | NA | NA | NA | NA | NA | NA | 6.4 | NA | NA |
| | Specific Conductivity | mmho/cm | 1.2 | 1.17 | NA | 0.13 | 0.40 | 0.45 | -147 | 0.33 | 0.40 |
| | Temperature | °C | 26.6 | 24.5 | 26.2 | 26.6 | 24.8 | 22.2 | 20.0 | 23.4 | 20.5 |
| *Preliminary Screening Ranking* | *Dissolved Oxygen* | *POINTS* | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| | *Nitrate as N* | | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Sulfate* | | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| | *Redox Potential* | | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 2 |
| | *pH* | | 0 | 0 | -2 | -2 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| | *Carbon Dioxide ** | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Alkalinity** | | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *VC* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 8 | 11 | -1 | 1 | 6 | 7 | 7 | 4 | 10 |
| | ***NA evidence*** | | L | L | N | I | L | L | L | I | L |

F... VOC ... left blank in table if non detect at 5.0 mg/L; values less than that were estimated by lab.

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 03909I | | | 03910I | | | 03912I | | | 03913I | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 |
| *VOCs* | Benzene | μg/L | | | | | | 2 J | 1 | 2 | | | | |
| | Toluene | μg/L | | | | | | | | | | | | |
| | Ethylbenzene | μg/L | | | | | | | | | | | | |
| | Xylene | μg/L | | | | | | | | | | | | |
| | Chlorobenzene | μg/L | | | | | | | | | | | | |
| | MTBE | μg/L | | | | 9 | 4 | | 9 | 9 | 13 | | | |
| | PCE | μg/L | | | | | | | | | | 140 | 100 | 29 |
| | TCE | μg/L | | | | | | | 130 | 120 | 73 | 30 | 24 | 18 |
| | cis-1,2-DCE | μg/L | | | 4 | | 20 | 10 | | 340 | 300 | | 130 | 100 |
| | trans-1,2-DCE | μg/L | | | | | | | | 4 | 5 | | 2 | 2 |
| | 1,2-DCE total | μg/L | 7 | | 4 | 22 | 20 | 10 | 420 | 344 | 305 | 88 | 132 | 102 |
| | VC | μg/L | 2 | | | 4 | 3 | 1 | 3 | 5 | | 9 | 13 | 10 |
| | 1,1-DCA | μg/L | | | | | | | | 2 | | 2 | 4 | 3 |
| | 1,1-DCE | μg/L | | | | | | | 5 | 6 | 4 | 2 | 1 | 2 |
| *Dissolved Gases* | Carbon Dioxide | mg/L | 25.5 | 23.4 | NA | 55.5 | 86.4 | NA | NA | 17.4 | 18.3 | 108 | 120 | NA |
| | log Carbon Dioxide | | 1.41 | 1.37 | | 1.74 | 1.94 | | | 1.24 | 1.26 | 2.03 | 2.08 | |
| | Dissolved Oxygen | mg/L | 0.60 | 0.80 | 0 | 1.4 | 0.85 | 0.44 | 0.06 | 0.75 | 0.29 | 0.40 | 1.1 | 0.41 |
| | Hydrogen | nmol/L | 0.27 | 0.60 | NA | 1.1 | 0.23 | NA | 0.11 | 0.29 | 2.2 | 0.63 | 0.44 | NA |
| | Nitrogen | mg/L | 1.37 | 14.4 | NA | 2.46 | 15.0 | NA | NA | 12.3 | NA | 5.71 | 4.95 | NA |
| | $N_2/O_2$ ratio | | 2.3 | 17.9 | [illegible] | 1.8 | 17.6 | | [illegible] | 16.3 | | 14.3 | 4.5 | |
| | Methane | μg/L | 110 | 1400 | NA | 35 | 360 | NA | NA | 700 | 377 | 144 | 147 | NA |
| | log Methane | | 2.04 | 3.15 | | 1.54 | 2.56 | | | 2.85 | 2.58 | 2.16 | 2.17 | |
| | Ethane | ng/L | 9 | 117 | NA | 25 | 208 | NA | 112 | 468 | 388 | 106 | 97 | NA |
| | Ethene | ng/L | 120 | 884 | NA | 60 | 418 | NA | 344 | 830 | 549 | 193 | 486 | NA |
| *Geochemical Parameters* | pH | std units | 6.87 | 6.84 | 7.05 | 6.26 | 6.15 | 6.57 | 6.94 | 7.24 | 7.37 | 5.93 | 5.82 | 6.05 |
| | Redox Potential | mV | -110 | -104 | -140 | -58 | -61 | -105 | -112 | -163 | -133 | 113 | 70 | 61 |
| | Alkalinity | mg/L | 54 | 50 | 628 | 68 | 55 | 138 | 511 | 60 | 241 | 52 | 40 | 108 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | .500 U | NA | NA | 3.24 | NA | NA | 0.691 | NA | NA | .500 U | NA |
| | Iron (II) | mg/L | 1.43 | 1.35 | 0.005 U | 9.61 | 10.2 | 0.005 U | 0.600 | .500 U | 0.005 U | .500 U | .500 U | 0.005 U |
| | Iron (III) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA |
| | Sulfate | mg/L | 4.9 | 10 | 6.4 | 5510 | 17 | 0.71 | 5210 | 11 | 10 | 20 | 17 | 22 |
| | log Sulfate | | 0.69 | 1.00 | 0.81 | 3.74 | 1.23 | -0.15 | 3.72 | 1.04 | 1.02 | 1.30 | 1.23 | 1.34 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.8 |
| | Total Organic Carbon | mg/L | 2.0 U | 2.0 | 17 | 3.1 | 5.4 | 33 | 2.0 U | 2.0 | 17 | 2.0 U | 1.6 | 27 |
| | Nitrogen (TKN) | mg/L | NA | 1.0 U | NA | NA | 3.9 | NA | NA | 1.1 | NA | NA | 1.0 U | NA |
| | Total Phosphorus | mg/L | NA | 0.29 | NA | NA | 0.100 U | NA | NA | 0.23 | NA | NA | 0.23 | NA |
| | Chloride | mg/L | 9.3 | NA | NA | 5.0 | NA | NA | 11.8 | NA | NA | 7.4 | NA | NA |
| | Specific Conductivity | mmho/cm | 0.12 | 0.09 | 0.51 | 0.11 | 0.09 | 0.37 | 0.17 | 0.30 | 0.47 | 0.24 | 0.63 | 0.27 |
| | Temperature | °C | 20.2 | 21.6 | 20.3 | 21.6 | 23.9 | 21.5 | 20.0 | 24.1 | 21.0 | 21.4 | 24.1 | 21.9 |
| *Preliminary Screening Ranking* | *Dissolved Oxygen* | *POINTS* | 0 | 0 | 3 | 0 | 0 | 3 | 3 | 0 | 3 | 3 | 0 | 3 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | [illegible] | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Sulfate* | | 2 | 2 | 2 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 0 |
| | *Redox Potential* | | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 0 | 0 | 0 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| | *Carbon Dioxide ** | | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| | *Alkalinity** | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *DCE* | | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *VC* | | 2 | 0 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 2 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | **15** | **11** | **13** | **13** | **14** | **17** | **13** | **16** | **17** | **17** | **14** | **17** |
| | ***NA evidence*** | | **A** | **L** | **L** | **L** | **L** | **A** | **L** | **A** | **A** | **A** | **L** | **A** |

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 039161 Rd 2 | 039161 Rd 3 | 039171 Rd 2 | 039171 Rd 3 | 039181 Rd 2 | 039181 Rd 3 | 039191 Rd 2 | 039191 Rd 3 | 039201 Rd 3 | 039211 Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | Benzene | µg/L | | | | | | | 1 | | | |
| | Toluene | µg/L | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | 3 | | |
| | Chlorobenzene | µg/L | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | | | | |
| | PCE | µg/L | | 13 | 5 | 2 | | | | 1 | 7 | |
| | TCE | µg/L | 7 | 13 | 1 | | 24 | 8 | 78 | | 7 | |
| | cis-1,2-DCE | µg/L | 18 | 160 | 4 | 2 | 26 | 10 | 450 | | 41 | |
| | trans-1,2-DCE | µg/L | | 10 | | | 7 | 3 | 12 | | | |
| | 1,2-DCE total | µg/L | 18 | 170 | 4 | 2 | 33 | 13 | 462 | | 41 | |
| | VC | µg/L | | 51 | | | 8 | | 83 | | 8 | |
| | 1,1-DCA | µg/L | | 10 | | | | | 26 | | 2 | |
| | 1,1-DCE | µg/L | | 4 | | | | | 13 | | | |
| *Dissolved Gases* | Carbon Dioxide | mg/L | 127 | 140 | 49.8 | 84.6 | 75.6 | 90.0 | 55.3 | NA | 131 | NA |
| | log Carbon Dioxide | | 2.10 | 2.15 | 1.70 | 1.93 | 1.88 | 1.95 | 1.74 | | 2.12 | |
| | Dissolved Oxygen | mg/L | 0.95 | 0 | 1.2 | 0.33 | 0.90 | 2.6 | 0.65 | 0 | 0.25 | 0.50 |
| | Hydrogen | nmol/L | NA | 5.0 | NA | 2.3 | NA | 27 | NA | NA | 7.3 | NA |
| | Nitrogen | mg/L | 9.70 | NA | 11.6 | NA | 10.5 | NA | 14.2 | NA | NA | NA |
| | $N_2/O_2$ ratio | | 10.2 | | 9.6 | | 11.7 | | 21.8 | | | |
| | Methane | µg/L | 867 | 786 | 10 | 8 | 196 | 110 | 1170 | NA | 220 | NA |
| | log Methane | | 2.94 | 2.90 | 1.01 | 0.90 | 2.29 | 2.04 | 3.07 | | 2.34 | |
| | Ethane | ng/L | 6545 | 11385 | 1375 | 8 | 699 | 169 | 1280 | NA | 1156 | NA |
| | Ethene | ng/L | 2430 | 2561 | 1026 | 82 | 622 | 293 | 6250 | NA | 316 | NA |
| *Geochemical Parameters* | pH | std units | 5.99 | 6.56 | 6.21 | 5.83 | 6.67 | 7.10 | 6.58 | 6.64 | 5.93 | 6.51 |
| | Redox Potential | mV | -11 | 22 | -208 | -34 | -200 | -84 | -193 | -7 | 20 | -122 |
| | Alkalinity | mg/L | 70 | 149 | 35 | 48 | 80 | 270 | 67 | 171 | 112 | 786 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.28 | 0.8 | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | 2.23 | NA | .500 U | NA | 0.944 | NA | 0.657 | NA | NA | NA |
| | Iron (II) | mg/L | 1.88 | 0.005 U | 16.8 | 0.005 U | 2.41 | 0.005 U | 2.20 | 0.005 U | 0.005 U | 0.005 U |
| | Iron (III) | mg/L | .500 U | NA | .500 U | NA | .500 U | NA | .500 U | NA | NA | NA |
| | Sulfate | mg/L | 11 | 8.2 | 65 | 74 | 24 | 15 | 18 | 1.5 | 32 | 56 |
| | log Sulfate | | 1.04 | 0.91 | 1.81 | 1.87 | 1.38 | 1.19 | 1.26 | 0.18 | 1.50 | 1.75 |
| | Sulfide | mg/L | 1.00 U | 1.00 U | 1.00 U | 2 | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 4.4 |
| | Total Organic Carbon | mg/L | 2.1 | 10 | 1.8 | 4.9 | 4.7 | 4.1 | 4.2 | 38 | 25 | 33 |
| | Nitrogen (TKN) | mg/L | 1.0 U | NA | 1.0 U | NA | 1.0 U | NA | 1.0 U | NA | NA | NA |
| | Total Phosphorus | mg/L | 0.32 | NA | 0.29 | NA | 2.0 | NA | 0.25 | NA | NA | NA |
| | Chloride | mg/L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | Specific Conductivity | mmho/cm | 0.32 | 0.38 | 0.03 | 0.32 | 0.75 | 0.81 | 0.45 | 0.43 | 0.25 | 4.40 |
| | Temperature | °C | 24.9 | 22.8 | 24.9 | 22.9 | 25.5 | 23.2 | 22.8 | 21.9 | 20.0 | 20.6 |
| *Preliminary Screening Ranking* | *Dissolved Oxygen* | *POINTS* | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 3 | [illegible] | 0 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | [illegible] | 2 | 2 | 2 | [illegible] | 2 |
| | *Iron (II)* | | 3 | 0 | 3 | 0 | [illegible] | 0 | 3 | 0 | 0 | 0 |
| | *Sulfate* | | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 |
| | *Redox Potential* | | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | *Carbon Dioxide* * | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| | *Alkalinity** | | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| | *Hydrogen* | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 1 | 2 | 0 | 2 | 2 | 2 | 0 | 2 | 0 |
| | *DCE* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 0 |
| | *VC* | | 0 | 2 | 0 | 0 | [illegible] | 0 | 2 | 0 | 2 | 0 |
| | *Ethane* | | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 12 | 21 | 13 | 11 | 15 | 13 | 19 | 12 | 19 | 8 |
| | ***NA evidence*** | | L | S | L | L | A | L | A | L | A | L |

[illegible] left blank in table if non detect at 5.0 mg/L; values less than that were estimated by lab.

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 03904D Rd 1 | 03904D Rd 2 | 03904D Rd 3 | 03908D Rd 1 | 03908D Rd 2 | 03908D Rd 3 | 03909D Rd 1 | 03909D Rd 2 | 03909D Rd 3 | 03910D Rd 1 | 03910D Rd 2 | 03910D Rd 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOCs | Benzene | µg/L | | | | | | | | | | | | |
| | Toluene | µg/L | | | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | | 2 | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | | | | 13 | 12 | 24 |
| | PCE | µg/L | | | | | | | | | | | | |
| | TCE | µg/L | | | | | | | | | | | | |
| | cis-1,2-DCE | µg/L | | | | | | | | 47 | | | | |
| | trans-1,2-DCE | µg/L | | | | | | | | 1 | | | | |
| | 1,2-DCE total | µg/L | | | | | | | | 48 | | 2 | | |
| | VC | µg/L | | | | | | | | 11 | | | | |
| | 1,1-DCA | µg/L | | | | | | | | | | | | |
| | 1,1-DCE | µg/L | | | | | | | | | | | | |
| Dissolved Gases | Carbon Dioxide | mg/L | 0.3 U | 3.40 | 5.86 | 124 | 148 | 145 | 5.83 | 24.1 | NA | 6.49 | 6.70 | NA |
| | log Carbon Dioxide | | | 0.53 | 0.77 | 2.09 | 2.17 | 2.16 | 0.77 | 1.38 | | 0.81 | 0.83 | |
| | Dissolved Oxygen | mg/L | 0.15 U | 1.0 | 0.21 | 0.20 | 0.50 | 0.89 | 0.35 | 1.2 | 0 | 0.32 | 1.0 | 0 |
| | Hydrogen | nmol/L | 0.57 | 0.67 | 2.3 | 0.40 | 0.47 | 1.5 | 0.34 | 0.60 | NA | 0.83 | 0.34 | NA |
| | Nitrogen | mg/L | NA | 11.4 | NA | 1.52 | 3.55 | NA | 1.42 | 10.6 | NA | 1.11 | 15.7 | NA |
| | $N_2/O_2$ ratio | | | 11.4 | | 7.6 | 7.1 | | 4.1 | 9.2 | | 3.5 | 15.7 | |
| | Methane | µg/L | NA | 1420 | 1136 | 1.0 U | 9 | 5 | 97 | 2480 | NA | 42 | 505 | NA |
| | log Methane | | | 3.15 | 3.06 | | 0.96 | 0.66 | 1.99 | 3.39 | | 1.62 | 2.70 | |
| | Ethane | ng/L | 3.00 U | 5.00 U | 59 | 6 | 15 | 27 | 8 | 5.00 U | NA | 59 | 545 | NA |
| | Ethene | ng/L | 3.00 U | 5.00 U | 26 | 6 | 22 | 28 | 17 | 57 | NA | 11 | 45 | NA |
| Geochemical Parameters | pH | std units | 7.59 | 7.42 | 7.73 | 5.49 | 5.47 | 5.57 | 7.45 | 6.86 | 7.69 | 7.06 | 7.12 | 8.23 |
| | Redox Potential | mV | -215 | -68 | -152 | 40 | 66 | 10 | -83 | -125 | -175 | -136 | -147 | -74 |
| | Alkalinity | mg/L | 39 | 70 | 171 | 12 | 10 U | 67 | 38 | 70 | 208 | 72 | 73 | 216 |
| | Nitrate as N | mg/L | 0.34 | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | .500 U | NA | NA | 2.28 | NA | NA | .500 U | NA | NA | .500 U | NA |
| | Iron (II) | mg/L | .500 U | .500 U | 0.005 U | 16.9 | 9.02 | 11.8 | .500 U | 2.77 | 0.500 U | .500 U | .500 U | 0.005 U |
| | Iron (III) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | 0.005 U | NA | .500 U | NA |
| | Sulfate | mg/L | 6.4 | 1.4 | 9.2 | 123 | 140 | 138 | 3.2 | 9.0 | 2.9 | 5700 | 19 | 23 |
| | log Sulfate | | 0.81 | 0.15 | 0.96 | 2.09 | 2.15 | 2.14 | 0.51 | 0.95 | 0.46 | 3.76 | 1.28 | 1.35 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 2.0 U | [illegible] | 1.1 | 2.0 U | 1.0 U | 37 | 2.0 U | 7.3 | 24 | 2.0 U | 3.6 | 1.6 |
| | Nitrogen (TKN) | mg/L | NA | 1.0 U | NA | NA | 1.0 U | NA | NA | 1.7 | NA | NA | 1.4 | NA |
| | Total Phosphorus | mg/L | NA | 0.12 | NA | NA | 1.3 | NA | NA | 0.26 | NA | NA | 0.26 | NA |
| | Chloride | mg/L | 16.4 | NA | NA | 14.0 | NA | NA | 14.9 | NA | NA | 7.0 | NA | NA |
| | Specific Conductivity | mmho/cm | 0.30 | 0.28 | 0.33 | 0.23 | 0.60 | 0.63 | 0.69 | 0.24 | 0.46 | 0.10 | 0.28 | 0.35 |
| | Temperature | °C | 20.2 | 21.3 | 20.5 | 20.7 | 21.8 | 20.6 | 18.7 | 22.8 | 20.2 | 22.5 | 22.3 | 21.2 |
| Preliminary Screening Ranking | *Dissolved Oxygen* | POINTS | 3 | 0 | 3 | 3 | 0 | 0 | 3 | 0 | 3 | 3 | 0 | 3 |
| | *Nitrate as N* | | 2 | [illegible] | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| | *Sulfate* | | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 2 | 0 |
| | *Redox Potential* | | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 2 | 2 | 1 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| | *Carbon Dioxide ** | | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Alkalinity** | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCE* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 |
| | *VC* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 10 | 6 | 12 | 11 | 7 | 11 | 8 | 14 | 13 | 10 | 7 | 8 |
| | ***NA evidence*** | | L | L | L | L | L | L | L | L | L | L | L | L |

Table 4.4
SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING

| | | | 03912D | | | 03913D | | | 03914D | | | 03915D | 03916D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analyte | units | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 | Rd 1 | Rd 2 | Rd 3 |
| *VOCs* | Benzene | µg/L | | | | | | | | | | | | |
| | Toluene | µg/L | | | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | 19 | 16 | 13 | | | |
| | PCE | µg/L | | | | 50 | 53 | 17 | | | | | | 5 |
| | TCE | µg/L | | | 3 | 72 | 87 | 38 | | | | | | 4 |
| | cis-1,2-DCE | µg/L | | 1 | 10 | | 190 | 90 | | | | | | 2 |
| | trans-1,2-DCE | µg/L | | | | | | 1 | | | | | | |
| | 1,2-DCE total | µg/L | | 1 | 10 | 130 | 190 | 91 | | | | | | 2 |
| | VC | µg/L | | | | 6 | 8 | 4 | | | | | | |
| | 1,1-DCA | µg/L | | | | 2 | 3 | 2 | | | | | | |
| | 1,1-DCE | µg/L | | | | 3 | 5 | 2 | | | | | | |
| *Dissolved Gases* | Carbon Dioxide | mg/L | NA | 2.35 | 3.66 | 75.7 | 81.7 | NA | 4.39 | 5.00 | NA | 7.10 | 31.6 | 42.1 |
| | log Carbon Dioxide | | | 0.37 | 0.56 | 1.88 | 1.91 | | 0.64 | 0.70 | | 0.85 | 1.50 | 1.62 |
| | Dissolved Oxygen | mg/L | NA | 0.95 | 0.28 | 0.30 | 0.85 | 0.27 | 0.30 | 0.90 | 0 | 0.30 | 2.1 | 0 |
| | Hydrogen | nmol/L | 0.17 | 0.31 | 2.9 | 0.29 | 0.42 | NA | 0.50 | 0.29 | NA | 0.80 | NA | 5.4 |
| | Nitrogen | mg/L | NA | 17.4 | NA | 4.94 | 4.25 | NA | 1.43 | 15.2 | NA | 4.17 | 11.5 | NA |
| | $N_2/O_2$ ratio | | | 18.3 | | 16.5 | 5.0 | | 4.8 | 16.9 | | 13.9 | 5.5 | |
| | Methane | µg/L | NA | 81 | 63 | 44 | 32 | NA | 40 | 366 | NA | 43 | 13 | 36 |
| | log Methane | | | 1.91 | 1.80 | 1.64 | 1.50 | | 1.60 | 2.56 | | 1.63 | 1.13 | 1.56 |
| | Ethane | ng/L | 58 | 114 | 170 | 67 | 67 | NA | 42 | 309 | NA | 10 | 62 | 779 |
| | Ethene | ng/L | 53 | 28 | 56 | 99 | 185 | NA | 13 | 10 | NA | 12 | 33 | 43 |
| *Geochemical Parameters* | pH | std units | 7.80 | 8.12 | 8.49 | 5.99 | 5.91 | 6.79 | 7.47 | 7.26 | 8.48 | 7.41 | 6.82 | 7.01 |
| | Redox Potential | mV | -162 | -219 | -147 | 75 | 65 | -12 | -138 | -141 | -101 | -201 | -98 | -66 |
| | Alkalinity | mg/L | 68 | 40 | 120 | 40 | 35 | 214 | 40 | 45 | [illegible] | 76 | 75 | 177 |
| | Nitrate as N | mg/L | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA |
| | Iron (II) | mg/L | 9.61 | .500 U | 0.005 U | .500 U | .500 U | 0.005 U | .500 U | .500 U | 0.005 U | .500 U | 0.809 | 0.005 U |
| | Iron (III) | mg/L | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA | NA | .500 U | NA |
| | Sulfate | mg/L | 4930 | 10 | 14 | 27 | 26 | 30 | 28 | 32 | 31 | 50 | 37 | 35 |
| | log Sulfate | | 3.69 | 0.99 | 1.14 | 1.43 | 1.41 | 1.48 | 1.45 | 1.51 | 1.49 | 1.70 | 1.57 | 1.55 |
| | Sulfide | mg/L | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.2 | NA | 1.00 U | 1.00 U | NA | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 2.0 U | 1.1 | 1.0 U | 2.0 U | 1.1 | 12 | 2.0 U | 1.8 | [illegible] | 2.0 U | 1.0 U | 3.0 |
| | Nitrogen (TKN) | mg/L | NA | 1.4 | NA | NA | 1.0 U | NA | NA | 2.5 | NA | NA | 1.0 U | NA |
| | Total Phosphorus | mg/L | NA | 0.19 | NA | NA | 1.2 | NA | NA | 0.31 | NA | NA | 0.25 | NA |
| | Chloride | mg/L | 0.02 U | NA | NA | 13.9 | NA | NA | 6.0 | NA | NA | 153 | NA | NA |
| | Specific Conductivity | mmho/cm | [illegible] | [illegible] | 0.34 | 0.14 | 0.06 | 0.58 | 0.09 | 0.23 | [illegible] | 0.57 | [illegible] | 0.48 |
| | Temperature | °C | [illegible] | 22.3 | 20.6 | 20.7 | 23.7 | 22.0 | [illegible] | 23.8 | [illegible] | 21.2 | [illegible] | [illegible] |
| *Preliminary Screening Ranking* | *Dissolved Oxygen* | *POINTS* | 0 | 0 | 3 | 3 | 0 | 3 | 3 | 0 | [illegible] | 3 | [illegible] | [illegible] |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | [illegible] | 2 | [illegible] | [illegible] |
| | *Iron (II)* | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Sulfate* | | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | [illegible] | 0 | [illegible] | 0 |
| | *Redox Potential* | | 2 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | [illegible] | 2 | [illegible] | 1 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Temperature* | | 0 | [illegible] | 1 | 1 | 1 | 1 | [illegible] | 1 | [illegible] | 1 | [illegible] | [illegible] |
| | *Carbon Dioxide* * | | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | [illegible] | 0 | [illegible] | 1 |
| | *Alkalinity** | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | [illegible] | 0 | 0 | 1 |
| | *Hydrogen* | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | [illegible] | 0 | 0 | 1 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 0 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| | *DCE* | | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| | *VC* | | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | 7 | 9 | 15 | 15 | 12 | 16 | 8 | 5 | 8 | 8 | 5 | 14 |
| | ***NA evidence*** | | L | L | A | A | L | A | L | L | L | L | L | L |

For clarity, VOCs were left blank in table if non-detect at 5.0 mg/L; values less than that were estimated by lab.

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | Analyte | units | 03917D | | 03918D | | 03919D | | 03920D | 03921D | 03922D | 03923D | 03801D | | 04202D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rd 2 | Rd 3 | Rd 2 | Rd 3 | Rd 2 | Rd 3 | Rd 3 | Rd 3 | Rd 3 | Rd 3 | Rd 2 | Rd 3 | Rd 3 |
| ***VOCs*** | Benzene | µg/L | | | 2 | | | | | | 1 | | | | |
| | Toluene | µg/L | | | | | | | | | | | | | |
| | Ethylbenzene | µg/L | | | | | | | | | | | | | |
| | Xylene | µg/L | | | | | | | | | | | | | |
| | Chlorobenzene | µg/L | | | | | | | | | | | | | |
| | MTBE | µg/L | | | | | | | | | | | 6 | 8 | |
| | PCE | µg/L | 25 | 10 | | | | | | | | | | | |
| | TCE | µg/L | 100 | 51 | 360 | 2 | | | | | | | | | 3 |
| | cis-1,2-DCE | µg/L | 250 | 140 | 480 | 5 | | | 2 | | 6 | | | | 88 |
| | trans-1,2-DCE | µg/L | 3 | | 6 | | | | | | | | | | 2 |
| | 1,2-DCE total | µg/L | 253 | 140 | 486 | 5 | | | 2 | | 6 | | | | 90 |
| | VC | µg/L | 9 | 4 | 7 | | | | | | | | | | |
| | 1,1-DCA | µg/L | 5 | | 5 | | | | | | | | | | |
| | 1,1-DCE | µg/L | 6 | | 11 | | | | | | | | | | |
| ***Dissolved Gases*** | Carbon Dioxide | mg/L | 52.7 | 100 | 67.0 | 98.8 | 2.20 | NA | 8.42 | 117 | NA | NA | 32.15 | NA | NA |
| | log Carbon Dioxide | | 1.72 | 2.00 | 1.83 | 1.99 | 0.34 | | 0.93 | 2.07 | | | 1.51 | | |
| | Dissolved Oxygen | mg/L | 0.80 | 0.44 | 0.70 | 1.1 | 0.90 | 0 | 0.21 | 6.7 | 0.53 | 0 | 0.70 | 0.21 | 0 |
| | Hydrogen | nmol/L | NA | 2.1 | NA | 2.5 | NA | NA | 2.2 | 2.0 | NA | NA | 0.42 | NA | NA |
| | Nitrogen | mg/L | 14.6 | NA | 15.1 | NA | 11.0 | NA | NA | NA | NA | NA | 3.50 | NA | NA |
| | $N_2/O_2$ ratio | | 18.2 | | 21.5 | | 12.2 | | | | | | 5.0 | | |
| | Methane | µg/L | 148 | 126 | 567 | 503 | 87 | NA | 822 | 50 | NA | NA | 25 | NA | NA |
| | log Methane | | 2.17 | 2.10 | 2.75 | 2.70 | 1.94 | | 2.91 | 1.70 | | | 1.40 | | |
| | Ethane | ng/L | 1435 | 150 | 354 | 355 | 415 | NA | 26 | 30 | NA | NA | 73 | NA | NA |
| | Ethene | ng/L | 937 | 210 | 742 | 635 | 285 | NA | 164 | 194 | NA | NA | 21 | NA | NA |
| ***Geochemical Parameters*** | pH | std units | 6.33 | 6.42 | 6.50 | 6.78 | 8.05 | 7.61 | 7.63 | 6.81 | 7.68 | 6.65 | 6.96 | 7.24 | 7.91 |
| | Redox Potential | mV | -174 | 202 | -226 | 50 | -272 | -123 | -200 | -137 | -180 | -139 | -138 | -132 | -204 |
| | Alkalinity | mg/L | 35 | 99 | 58 | 129 | 55 | 179 | 191 | 815 | 56.2 | 266 | 70 | 320 | 316 |
| | Nitrate as N | mg/L | 0.53 | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 6.1 | 0.13 | 0.10 U | 0.54 | 0.10 U | 0.10 U |
| | Manganese (II) | mg/L | 2.81 | NA | .500 U | NA | .500 U | NA | NA | NA | NA | NA | 0.97 | NA | NA |
| | Iron (II) | mg/L | 5.29 | 0.005 U | 1.49 | 15.3 | .500 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 1.88 | 0.005 U | 0.005 U |
| | Iron (III) | mg/L | .500 U | NA | .500 U | NA | .500 U | NA | NA | NA | NA | NA | 0.880 | NA | N[illegible] |
| | Sulfate | mg/L | 58 | 66 | 35 | 22 | 5.9 | 11 | 4.4 | 44 | 12 | 97 | 17 | 9.6 | |
| | log Sulfate | | 1.76 | 1.82 | 1.54 | 1.35 | 0.77 | 1.06 | 0.64 | 1.65 | 1.08 | 1.98 | 1.23 | 0.98 | 1.9[illegible] |
| | Sulfide | mg/L | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.8 | 1.00 U | 1.00 U | 1.00 U | 1.00 U | 1.00 U |
| | Total Organic Carbon | mg/L | 1.0 U | 6.5 | 3.4 | 2.0 | 4.1 | 23 | 20 | 46 | 6.9 | 9.6 | 4.5 | 5.4 | 21 |
| | Nitrogen (TKN) | mg/L | 1.0 U | NA | 3.6 | NA | 1.0 U | NA | NA | NA | NA | NA | 2.2 | NA | NA |
| | Total Phosphorus | mg/L | 0.12 | NA | 0.37 | NA | 0.34 | NA | NA | NA | NA | NA | 0.52 | NA | NA |
| | Chloride | mg/L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | Specific Conductivity | mmho/cm | 0.08 | 0.56 | 0.37 | 0.37 | 0.23 | 0.35 | 0.60 | 26.10 | 0.36 | 0.74 | [illegible] | 0.96 | 2.36 |
| | Temperature | °C | 24.1 | 22.6 | 24.5 | 23.0 | 23.0 | 21.5 | 20.3 | 20.5 | 20.3 | 19.9 | 21.9 | 20.1 | 20.98 |
| ***Preliminary Screening Ranking*** | *Dissolved Oxygen* | ***POINTS*** | 0 | 3 | 0 | 0 | 0 | 3 | [illegible] | -3 | 0 | 3 | 0 | 3 | 3 |
| | *Nitrate as N* | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 |
| | *Iron (II)* | | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| | *Sulfate* | | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 2 | 0 | 2 | 2 | 0 |
| | *Redox Potential* | | 2 | 0 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | *pH* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total Organic Carbon* | | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 |
| | *Temperature* | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| | *Carbon Dioxide ** | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| | *Alkalinity** | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| | *Hydrogen* | | 0 | 1 | 0 | 1 | 0 | 0 | [illegible] | 1 | 0 | 0 | 0 | 0 | 0 |
| | *BTEX* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TCE* | | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | *DCE* | | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 2 |
| | *VC* | | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethane* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Ethene* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCA* | | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *CA* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ***Total Points*** | | **17** | **14** | **17** | **13** | **7** | **13** | **16** | **5** | **9** | **8** | **11** | **11** | **15** |
| | ***NA evidence*** | | **A** | **L** | **A** | **L** | **L** | **L** | **A** | **I** | **L** | **L** | **L** | **L** | |

**Table 4.4**
**SWMU 39 MNA DATA RESULTS AND PRELIMINARY RANKING**

| | | | |
|---|---|---|---|
| **SWMU 39 BACKGROUND DETERMINATIONS** | | | |
| ***Notes:*** | *= parameters must exceed 2X background | | |
| | | **Shallow** | |
| offsite bkgd--> | | 039015 | (Rd1 only) |
| non-039 bkgd--> | | 505001 | (Rd2 only) |
| Average Alk= | | 76 | mg/L |
| | 2X = | 152 | mg/L |
| Average CO2 = | | 70.5 | mg/L |
| | 2X = | 141 | mg/L |
| | | | |
| | | **Intermediate** | |
| upgradient bkgd --> | | 03904I | (Rd1+Rd2) |
| Average Alk= | | 51.5 | mg/L |
| | 2X= | 103 | mg/L |
| Average CO2= | | 7.1 | mg/L |
| | 2X= | 14.2 | mg/L |
| | | | |
| | | **Deep** | |
| offsite bkgd--> | | 03915D | (Rd 1 only) |
| upgradient bkgd--> | | 03801D | (Rd 2 only) |
| upgradient bkgd--> | | 03904D | (Rd1+Rd2) |
| Average Alk = | | 63.8 | mg/L |
| | 2X= | 127.5 | mg/L |
| Average CO2= | | 14.1 | mg/L |
| | 2X= | 28.3 | mg/L |
| | | | |
| | | | |
| **RANKING RESULTS:** | | | |
| N= | No evidence (0) | | |
| I= | Inadequate evidence (1-5) | | |
| L= | Limited evidence(6-14) | | |
| A= | Adequate evidence(15-20) | | |
| S= | Strong evidence(>20) | | |

[illegible] VOC [illegible] left blank in table if non-detect at 5.0 mg/L; values less than that were estimated by lab

### 4.3 Summary of Major MNA Findings at SWMU 39

The following findings were taken from the more comprehensive data evaluation and interpretation included in Attachment H. In general, biodegradation is occurring at selected locales at SWMU 39 but due to the complicated geology and hydrogeology, certain areas are prone to accumulate father and daughter products.

- The Zone A clay/sand boundary is evident geochemically as an aerobic zone in shallow, intermediate, and deep groundwater. PCE through VC were detected in wells located downgradient from this boundary (in the massive $Qs_3$ sand body).

- The presence of daughter products cis-1,2-DCE and VC above and below the clay/sand boundary indicates that PCE and TCE breakdown is occurring. However, it is unclear if their presence below the boundary is due to mobilization from more anaerobic upgradient zones or if they degraded within the $Qs_3$ sand body, which tends to be less reducing.

- Geochemical conditions in shallow, intermediate, and deep groundwater upgradient of the clay/sand boundary are generally anaerobic and more reducing than they are below the boundary in the massive $Qs_3$ sand body.

- Denitrification is limited at the site and confined to a small area upgradient of the clay/sand boundary coinciding with an isolated aerobic zone and within the larger aerobic zone across the center of the site that coincides with the transition to a predominant sand lithology. Nitrates were higher in shallow and intermediate groundwater than deep in these locales.

- Iron (III) reduction appears to be the primary redox mechanism operating sitewide with significant iron (II) production above the clay/sand boundary in shallow and intermediate groundwater, but not in deep groundwater. Very little to no iron (II) was detected in the aerobic zone across the center of the site in shallow, intermediate, or deep groundwater where nitrate was encountered. However, iron (II) production increases further downgradient in the $Qs_3$ sand body in all three intervals.

- Certain locations appear to be progressing to sulfate reduction based on third round sulfide detections and higher hydrogen concentrations.

- Significant production of ethene and ethane end products were encountered in shallow and intermediate groundwater at isolated locations suggesting complete breakdown may be achieved at these locations.

- Redox zonation was contradictory based on three identification methods (ORP-DO, hydrogen, and redox couples). Dissolved gas samples, including hydrogen, were found to be susceptible to dilutional errors and precipitation/aquifer recharge influences. Redox couple data appears more consistent throughout the three rounds of data and the most definitive means to identify Redox zones within the aquifer.

- Temporal VOC results are several wells reveal pulses of contamination, suggesting that the plume in some locales cannot be considered stable. Attempts to determine whether these pulses were merely anomalies, lab errors, or field errors could not be adequately confirmed, and as such, the data are treated as real.

- As seen in Section 3.0, groundwater flowpaths are complicated due to the presence of multiple "flow zones" in the surficial aquifer at upgradient locations closest to the primary source area (north of Buildings 1604 and 1605). Once contaminants migrate beyond the clay/sand boundary, they enter the massive $Qs_3$ sand body where they generally disperse and migrate vertically. Thus, demonstrating biodegradation along a flow path is difficult since the flowpaths have lateral and vertical components that encompass a variety of geochemical zones.

- Attempts at quantifying biodegradation rates have been limited to analytical models in an attempt to simplify the complex hydrogeology at the site. The model is discussed in detail in Section 5.0.

## 5.0 FATE AND TRANSPORT MODELING

The analytical fate and transport model, Biochlor (beta version 1.0, Groundwater Services, Inc., 1998) was used to provide a means of quantifying biodegradation rates of chlorinated VOCs at SWMU 39. Biochlor can be used to simulate 1-dimensional advection, 3-dimensional dispersion, linear adsorption, and biodegradation by reductive dechlorination. The model is based upon the semi-analytical solution developed by Domenico (1987) and operates in Microsoft Excel spreadsheets.

A detailed discussion of the modeling procedure is included in Attachment I. The assumptions and limitations of the model, its input parameters, its output and results, and an evaluation of its results are also presented in the attachment. This section will briefly summarize the methodology followed for the modeling and the modeling results.

### 5.1 Modeling Approach

Since Biochlor only evaluates 1-dimensional advection, reductive dechlorination can only be evaluated along a single groundwater flowpath. Thus, the vertical migration between the shallow, intermediate, and deep aquifers cannot be represented in Biochlor and each aquifer must be modeled separately. After careful consideration of VOC data, the piezometric surfaces for each aquifer, and the availability of decreasing VOC concentrations along a groundwater flowpath, it was decided that the shallow aquifer was most suitable for modeling. Additionally, shallow groundwater flowpaths are more consistently reproduced over time than are those in intermediate and deep groundwater, which tend to have less piezometric surfaces of less relief.

The general premise followed during the fate and transport modeling was the coupling of inverse modeling with predictive forward modeling. The inverse modeling process selectively solves for each unknown variable in the governing equation by matching the observed field data, in this case the VOC data, from the second and third rounds of sampling (October 1998 and August 1999).

The three critical input variables that are unknown at the site are dispersion, retardation factor, and the biodegradation rates for any of the VOCs. Using a combination of literature data and site-specific data, two of these variables may be held constant while manipulating the third until the VOC data is matched as closely as possible. For example, to solve for dispersion, a best-guess for retardation factor and biodegradation rate must be made. Fortunately, the retardation factor may be computed directly from site-specific data (such as bulk density and porosity) and literature values for VOC partitioning coefficients. Biodegradation rates are provided in Biochlor User Manual and other widely published sources. Dispersion constants are successively altered until the observed field data is most closely matched by the model. This iterative process was repeated for each variable for each sampling round. The model results were judged against literature values or the site-specific calculations and determined whether or not the model produced reasonable values.

Once values for biodegradation rates, retardation factor, and dispersion were determined, forward model simulations were run to allow the model to predict contaminant distribution in the future. The area of interest for this procedure was along the western property boundary where anomalously high VOC concentrations had been detected in the second round sample from shallow well 039009. Just beyond the western property boundary is a marsh, the point of compliance. The appearance of solvents at 039009, which is the nearest well to the receptor at the time of the October 1998 sampling round, raised the concern that contaminants may be migrating off-site and might potentially impact the ecological receptor. Forward modeling at this location would assist in determining the plausibility of this scenario.

## 5.2 Results

Matching observed VOC data in October 1998 and August 1999 could not be accomplished without producing erroneous values for dispersion and retardation based on their respective inverse models. Calibrated biodegradation rates for each sampling round were more reasonable and fell within accepted literature ranges. For the forward modeling, a combination of literature values for dispersion, calculated retardation factors, and model-calibrated biodegradation rates were used.

The predictive model, using 039009 as a source, indicated that PCE, TCE, and DCE would attenuate to below maximum concentration levels (MCLs) prior to reaching the off-site point of compliance. The lack of compliance of VC can be largely attributed to the fact that no site-specific decay constant could be applied since no VC was evident in the downgradient well during the calibration of the inverse model. It is also recognized that while reductive dechlorination of VC may not be adequately accomplished, it may be readily oxidized at the site under more aerobic conditions. The August 1999 data represent the first and only groundwater data from the downgradient well 039020 and indicates less reducing conditions prevail at that locale.

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# 6.0 CONCLUSION AND RECOMMENDATIONS

Based on the results of the data collection and site evaluation activities presented, MNA is recommended for continuation. The MNA results reflect degradation of the chlorinated solvents in groundwater throughout most areas of the site. Since the DET's diffusion samples did not indicate the solvent plume has migrated into the marsh area west of the site and groundwater flow directions do not appear to be toward the marsh area, this alternative is acceptable for preventing exposure to offsite receptors. However, continued sampling in the marsh area is recommended to monitor VOC transport during MNA.

In addition to the naturally occurring degradation, MNA results show that some areas of the site are conducive to attenuation enhancement through the use of biological stimulation. Therefore, it is recommended that these areas be further treated using bioenhancement additives. While the solvent plume is attenuating naturally, to enhance biological degradation would serve to reduce the attenuation time and consequently, the remediation cost.

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## 7.0 REFERENCES

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ATTACHMENT A

SOIL ANALYTICAL DATA

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846 VOA | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **SAMPLE ID ------->** | 039-S-B047-01 | 039-S-B048-01 | 039-S-B049-01 | 039-S-B050-01 | 039-S-B051-01 | 039-S-B052-01 |
| | **ORIGINAL ID ----->** | 039SB04701 | 039SB04801 | 039SB04901 | 039SB05001 | 039SB05101 | 039SB05201 |
| | **LAB SAMPLE ID --->** | S886228*1 | S886228*2 | S886228*3 | S886228*4 | S886228*5 | S886267*8 |
| | **ID FROM REPORT -->** | 039SB04701 | 039SB04801 | 039SB04901 | 039SB05001 | 039SB05101 | 039SB05201 |
| | **SAMPLE DATE ----->** | 10/12/98 | 10/12/98 | 10/12/98 | 10/12/98 | 10/12/98 | 10/13/98 |
| | **DATE ANALYZED --->** | 10/16/98 | 10/16/98 | 10/16/98 | 10/16/98 | 10/16/98 | 10/16/98 |
| | **MATRIX ---------->** | Soil | Soil | Soil | Soil | Soil | Soil |
| | **UNITS ----------->** | UG/KG A | UG/KG A | UG/KG A | UG/KG A | UG/KG A | UG/KG A |

| CAS # | Parameter | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74-87-3 | Chloromethane | 12. | U | 11. | U | 10. | U | 9.8 | U | 11. | U | 8.8 | U |
| 75-01-4 | Vinyl chloride | 12. | U | 11. | U | 10. | U | 9.8 | U | 130. | J | 8.8 | U |
| 74-83-9 | Bromomethane | 12. | U | 11. | U | 10. | U | 9.8 | U | 11. | U | 8.8 | U |
| 75-00-3 | Chloroethane | 12. | U | 11. | U | 110. | | 9.8 | U | 11. | U | 8.8 | U |
| 67-64-1 | Acetone | 93. | U | 36. | U | 300. | | 150. | J | 130. | J | 150. | |
| 75-35-4 | 1,1-Dichloroethene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 7.3 | J | 4.4 | U |
| 75-15-0 | Carbon disulfide | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 75-09-2 | Methylene chloride | 6.2 | U | 39. | | 25. | | 46. | J | 5.7 | U | 4.4 | U |
| 108-05-4 | Vinyl acetate | 12. | U | 11. | U | 10. | U | 9.8 | U | 11. | U | 8.8 | U |
| 75-34-3 | 1,1-Dichloroethane | 6.2 | U | 5.3 | U | 25. | | 4.9 | U | 5.7 | U | 4.4 | U |
| 78-93-3 | 2-Butanone (MEK) | 18. | J | 26. | U | 81. | | 24. | J | 28. | U | 14. | J |
| 67-66-3 | Chloroform | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 71-55-6 | 1,1,1-Trichloroethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 56-23-5 | Carbon tetrachloride | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 107-06-2 | 1,2-Dichloroethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 71-43-2 | Benzene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 79-01-6 | Trichloroethene | 6.2 | U | 5.3 | U | 0.94 | J | 4.9 | U | 460. | J | 4.4 | U |
| 78-87-5 | 1,2-Dichloropropane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 75-27-4 | Bromodichloromethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 62. | UR | 53. | UR | 50. | UR | 49. | UR | 57. | UR | 44. | UR |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 31. | U | 26. | U | 25. | U | 24. | U | 28. | U | 22. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 108-88-3 | Toluene | 6.2 | U | 3. | J | 3.8 | J | 3.1 | J | 5.7 | U | 4.4 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 591-78-6 | 2-Hexanone | 31. | U | 26. | U | 25. | U | 24. | UJ | 28. | UJ | 22. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 127-18-4 | Tetrachloroethene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | UJ | 5.7 | U | 4.4 | U |
| 124-48-1 | Dibromochloromethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 108-90-7 | Chlorobenzene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | U | 5.7 | U | 4.4 | U |
| 100-41-4 | Ethylbenzene | 6.2 | U | 1.3 | J | 2. | J | 4.9 | UJ | 5.7 | UJ | 4.4 | U |
| 1330-20-7 | Xylene (Total) | 1.3 | J | 4.8 | J | 5.4 | | 2.5 | J | 5.5 | J | 4.4 | U |
| 100-42-5 | Styrene | 6.2 | U | 5.3 | U | 5. | U | 4.9 | UJ | 5.7 | UJ | 4.4 | U |
| 75-25-2 | Bromoform | 6.2 | U | 5.3 | U | 5. | U | 4.9 | UJ | 5.7 | UJ | 4.4 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 6.2 | U | 5.3 | U | 5. | U | 4.9 | UJ | 5.7 | UJ | 4.4 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 6.2 | U | 5.3 | U | 0.96 | J | 4.9 | U | 3800. | J | 0.74 | J |
| 156-60-5 | trans-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 156-59-2 | cis-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |

*** Validation Complete ***

| SW846 VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B053-01 | | 039-S-B054-01 | | 039-S-B055-01 | | 039-S-B056-01 | | 039-S-B057-01 | | 039-S-B060-01 | |
| | ORIGINAL ID -----> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB06001 | |
| | LAB SAMPLE ID ---> | S886267*9 | | S886267*7 | | S886267*6 | | S886267*5 | | S886267*4 | | S886267*1 | |
| | ID FROM REPORT --> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB06001 | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | |
| | DATE ANALYZED ---> | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL | ECZA01 | VAL |
| 74-87-3 | Chloromethane | 8.9 | U | 11. | U | 9.6 | U | 9.8 | U | 12. | U | 9.2 | U |
| 75-01-4 | Vinyl chloride | 8.9 | U | 11. | U | 9.6 | U | 9.8 | U | 12. | U | 9.2 | U |
| 74-83-9 | Bromomethane | 8.9 | U | 11. | U | 9.6 | U | 9.8 | U | 12. | U | 9.2 | U |
| 75-00-3 | Chloroethane | 8.9 | U | 11. | U | 9.6 | U | 9.8 | U | 12. | U | 9.2 | U |
| 67-64-1 | Acetone | 59. | U | 11. | U | 14. | U | 9.8 | U | 12. | U | 9.2 | U |
| 75-35-4 | 1,1-Dichloroethene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 75-15-0 | Carbon disulfide | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 75-09-2 | Methylene chloride | 4.5 | U | 1.4 | J | 36. | | 4.9 | U | 5.8 | U | 4.6 | U |
| 108-05-4 | Vinyl acetate | 8.9 | U | 11. | U | 9.6 | U | 9.8 | U | 12. | U | 9.2 | U |
| 75-34-3 | 1,1-Dichloroethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 78-93-3 | 2-Butanone (MEK) | 22. | U | 26. | U | 24. | U | 24. | U | 29. | U | 23. | U |
| 67-66-3 | Chloroform | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 71-55-6 | 1,1,1-Trichloroethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 56-23-5 | Carbon tetrachloride | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 107-06-2 | 1,2-Dichloroethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 71-43-2 | Benzene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 79-01-6 | Trichloroethene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 1.1 | J | 4.6 | U |
| 78-87-5 | 1,2-Dichloropropane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 75-27-4 | Bromodichloromethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 45. | UR | 53. | UR | 48. | UR | 49. | UR | 58. | UR | 46. | UR |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 22. | U | 26. | U | 24. | U | 24. | U | 29. | U | 23. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 108-88-3 | Toluene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 591-78-6 | 2-Hexanone | 22. | U | 26. | U | 24. | U | 24. | U | 29. | U | 23. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 127-18-4 | Tetrachloroethene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 124-48-1 | Dibromochloromethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 108-90-7 | Chlorobenzene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 100-41-4 | Ethylbenzene | 4.5 | U | 2.1 | J | 0.91 | J | 4.9 | U | 5.8 | U | 4.6 | U |
| 1330-20-7 | Xylene (Total) | 4.5 | U | 3.2 | J | 3.4 | J | 4.9 | U | 5.8 | U | 4.6 | U |
| 100-42-5 | Styrene | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 75-25-2 | Bromoform | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 4.5 | U | 5.3 | U | 4.8 | U | 4.9 | U | 5.8 | U | 4.6 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 4.5 | U | 5.3 | U | 4.3 | J | 4.9 | U | 35. | | 2.4 | J |
| 156-60-5 | trans-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 156-59-2 | cis-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |

*** Validation Complete ***

| SW846 VOA | | | |
|---|---|---|---|
| | SAMPLE ID -------> | 039-C-B060-01 | 039-S-B061-01 |
| | ORIGINAL ID -----> | 039CB06001 | 039SB06101 |
| | LAB SAMPLE ID ---> | S886267*2 | S886267*3 |
| | ID FROM REPORT --> | 039CB06001 | 039SB06101 |
| | SAMPLE DATE -----> | 10/13/98 | 10/13/98 |
| | DATE ANALYZED ---> | 10/16/98 | 10/16/98 |
| | MATRIX ----------> | Soil | Soil |
| | UNITS -----------> | UG/KG A | UG/KG A |

| CAS # | Parameter | ECZA01 | VAL | ECZA01 | VAL |
|---|---|---|---|---|---|
| 74-87-3 | Chloromethane | 9.2 | U | 8.9 | U |
| 75-01-4 | Vinyl chloride | 9.2 | U | 8.9 | U |
| 74-83-9 | Bromomethane | 9.2 | U | 8.9 | U |
| 75-00-3 | Chloroethane | 9.2 | U | 8.9 | U |
| 67-64-1 | Acetone | 9.2 | U | 8.9 | U |
| 75-35-4 | 1,1-Dichloroethene | 4.6 | U | 4.5 | U |
| 75-15-0 | Carbon disulfide | 4.6 | U | 4.5 | U |
| 75-09-2 | Methylene chloride | 4.6 | U | 4.5 | U |
| 108-05-4 | Vinyl acetate | 9.2 | U | 8.9 | U |
| 75-34-3 | 1,1-Dichloroethane | 4.6 | U | 4.5 | U |
| 78-93-3 | 2-Butanone (MEK) | 23. | U | 22. | U |
| 67-66-3 | Chloroform | 4.6 | U | 4.5 | U |
| 71-55-6 | 1,1,1-Trichloroethane | 4.6 | U | 4.5 | U |
| 56-23-5 | Carbon tetrachloride | 4.6 | U | 4.5 | U |
| 107-06-2 | 1,2-Dichloroethane | 4.6 | U | 4.5 | U |
| 71-43-2 | Benzene | 4.6 | U | 4.5 | U |
| 79-01-6 | Trichloroethene | 4.6 | U | 4.5 | U |
| 78-87-5 | 1,2-Dichloropropane | 4.6 | U | 4.5 | U |
| 75-27-4 | Bromodichloromethane | 4.6 | U | 4.5 | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 46. | UR | 45. | UR |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 23. | U | 22. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 4.6 | U | 4.5 | U |
| 108-88-3 | Toluene | 4.6 | U | 4.5 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 4.6 | U | 4.5 | U |
| 591-78-6 | 2-Hexanone | 23. | U | 22. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 4.6 | U | 4.5 | U |
| 127-18-4 | Tetrachloroethene | 4.6 | U | 4.5 | U |
| 124-48-1 | Dibromochloromethane | 4.6 | U | 4.5 | U |
| 108-90-7 | Chlorobenzene | 4.6 | U | 4.5 | U |
| 100-41-4 | Ethylbenzene | 4.6 | U | 4.5 | U |
| 1330-20-7 | Xylene (Total) | 4.6 | U | 4.5 | U |
| 100-42-5 | Styrene | 4.6 | U | 4.5 | U |
| 75-25-2 | Bromoform | 4.6 | U | 4.5 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 4.6 | U | 4.5 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 4.6 | U | 0.79 | J |
| 156-60-5 | trans-1,2-Dichloroethene | ?????????? | | ?????????? | |
| 156-59-2 | cis-1,2-Dichloroethene | ?????????? | | ?????????? | |

*** Validation Complete ***

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846-META | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B047-01 | | 039-S-B048-01 | | 039-S-B049-01 | | 039-S-B050-01 | | 039-S-B051-01 | | 039-S-B052-01 | |
| | ORIGINAL ID -----> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | LAB SAMPLE ID ---> | 9810291-01 | | 9810291-02 | | 9810291-03 | | 9810291-04 | | 9810291-05 | | 9810398-12 | |
| | ID FROM REPORT --> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | SAMPLE DATE -----> | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/22/98 | | 10/22/98 | | 10/22/98 | | 10/22/98 | | 10/22/98 | | 10/23/98 | |
| | DATE ANALYZED ---> | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # | Parameter | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN009 | VAL |
| 7429-90-5 | Aluminum (Al) | 3840. | J | 1090. | J | 1170. | J | 6830. | J | 4360. | J | 5090. | |
| 7440-36-0 | Antimony (Sb) | 1.9 | UJ | 1.8 | UJ | 1.8 | UJ | 1.7 | UJ | 1.9 | UJ | 1.7 | UJ |
| 7440-38-2 | Arsenic (As) | 1.1 | | 0.82 | J | 0.83 | J | 2.6 | | 8.1 | | 2.1 | |
| 7440-39-3 | Barium (Ba) | 15.1 | J | 7.5 | J | 8.3 | J | 20.3 | | 125. | | 21.4 | |
| 7440-41-7 | Beryllium (Be) | 0.17 | J | 0.05 | J | 0.04 | J | 0.13 | J | 0.37 | J | 0.16 | J |
| 7440-43-9 | Cadmium (Cd) | 0.17 | U | 0.28 | UJ | 0.23 | UJ | 0.15 | U | 0.77 | U | 0.28 | J |
| 7440-70-2 | Calcium (Ca) | 186. | J | 72.9 | J | 115. | J | 1900. | J | 7210. | J | 797. | U |
| 7440-47-3 | Chromium (Cr) | 3.7 | | 2.4 | | 2.7 | | 9.5 | | 18.9 | | 6. | |
| 7440-48-4 | Cobalt (Co) | 0.75 | J | 0.45 | U | 0.46 | U | 0.43 | U | 2.8 | J | 0.85 | J |
| 7440-50-8 | Copper (Cu) | 2. | J | 0.49 | J | 1.8 | J | 1.7 | J | 35. | | 2.5 | |
| 7439-89-6 | Iron (Fe) | 2270. | J | 1120. | J | 1500. | J | 6980. | J | 11300. | J | 4220. | |
| 7439-92-1 | Lead (Pb) | 9.4 | | 2.4 | | 12.2 | | 8.7 | | 92. | | 9.1 | |
| 7439-95-4 | Magnesium (Mg) | 155. | J | 63. | J | 68.8 | J | 364. | J | 349. | J | 193. | J |
| 7439-96-5 | Manganese (Mn) | 10.1 | J | 6. | J | 5. | J | 19. | J | 31.2 | J | 18.9 | |
| 7439-97-6 | Mercury (Hg) | 0.05 | | 0.03 | U | 0.05 | | 0.06 | | 0.09 | | 0.08 | |
| 7440-02-0 | Nickel (Ni) | 1.9 | J | 0.57 | U | 0.58 | U | 1.8 | J | 8.2 | | 1.9 | J |
| 7440-09-7 | Potassium (K) | 103. | J | 62.5 | J | 67.8 | J | 253. | J | 454. | J | 127. | U |
| 7782-49-2 | Selenium (Se) | 0.97 | UJ | 0.93 | UJ | 1.1 | UJ | 0.94 | UJ | 0.99 | UJ | 0.09 | UJ |
| 7440-22-4 | Silver (Ag) | 0.89 | UJ | 0.45 | U | 0.77 | UJ | 0.43 | U | 0.55 | U | 0.48 | J |
| 7440-23-5 | Sodium (Na) | 13.3 | J | 6.7 | J | 13.3 | J | 36.2 | J | 465. | J | 16.4 | U |
| 7440-28-0 | Thallium (Tl) | 0.18 | U | 0.17 | U | 0.24 | J | 0.17 | U | 0.2 | J | 0.15 | U |
| 7440-62-2 | Vanadium (V) | 5.1 | J | 2.8 | J | 3.1 | J | 14.6 | | 19.2 | | 7.3 | |
| 7440-66-6 | Zinc (Zn) | 37.5 | J | 1.3 | UJ | 6.9 | J | 8.8 | J | 102. | J | 7.4 | |
| 7440-31-5 | Tin (Sn) | 100. | U | 100. | U | 100. | U | 100. | U | 100. | U | 100. | U |

*** Validation Complete ***

| SW846-META | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B053-01 | | 039-S-B054-01 | | 039-S-B055-01 | | 039-S-B056-01 | | 039-S-B057-01 | | 039-S-B059-01 | |
| | ORIGINAL ID -----> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | LAB SAMPLE ID ---> | 9810398-13 | | 9810398-11 | | 9810398-10 | | 9810398-09 | | 9810398-08 | | 9810398-07 | |
| | ID FROM REPORT --> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/23/98 | | 10/23/98 | | 10/23/98 | | 10/23/98 | | 10/23/98 | | 10/23/98 | |
| | DATE ANALYZED ---> | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | | 10/27/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL |
| 7429-90-5 | Aluminum (Al) | 6100. | | 1940. | | 22200. | | 6100. | | 15100. | | 3160. | |
| 7440-36-0 | Antimony (Sb) | 1.9 | UJ | 1.9 | UJ | 3.4 | J | 1.8 | UJ | 2. | UJ | 1.6 | UJ |
| 7440-38-2 | Arsenic (As) | 2.2 | | 0.96 | J | 7.7 | | 2.2 | | 6.6 | | 5. | |
| 7440-39-3 | Barium (Ba) | 19.7 | J | 5.4 | J | 22.9 | | 12.6 | J | 17.4 | J | 23.7 | |
| 7440-41-7 | Beryllium (Be) | 0.12 | J | 0.06 | J | 0.43 | J | 0.14 | J | 0.31 | J | 0.14 | J |
| 7440-43-9 | Cadmium (Cd) | 0.17 | U | 0.17 | U | 0.18 | U | 0.16 | U | 0.18 | U | 0.15 | U |
| 7440-70-2 | Calcium (Ca) | 297. | U | 198. | U | 1100. | | 591. | U | 594. | U | 13900. | |
| 7440-47-3 | Chromium (Cr) | 5.8 | | 7.7 | | 44.8 | | 8.9 | | 27.3 | | 8.3 | |
| 7440-48-4 | Cobalt (Co) | 1.1 | J | 0.47 | U | 2.9 | J | 0.81 | J | 1.7 | J | 1.3 | J |
| 7440-50-8 | Copper (Cu) | 0.36 | U | 1.5 | J | 4.3 | | 1.3 | J | 2.5 | J | 37.7 | |
| 7439-89-6 | Iron (Fe) | 3360. | | 1970. | | 25300. | | 5890. | | 24300. | | 5050. | |
| 7439-92-1 | Lead (Pb) | 5.4 | | 17.3 | | 9.3 | | 4. | | 8.3 | | 26.4 | |
| 7439-95-4 | Magnesium (Mg) | 232. | J | 145. | J | 2070. | | 421. | J | 1010. | | 285. | J |
| 7439-96-5 | Manganese (Mn) | 7.1 | | 7. | | 32.8 | | 9.7 | | 16.5 | | 33.2 | |
| 7439-97-6 | Mercury (Hg) | 0.06 | | 0.04 | U | 0.09 | | 0.04 | U | 0.05 | | 0.31 | |
| 7440-02-0 | Nickel (Ni) | 2.8 | J | 0.85 | J | 4.2 | J | 1.7 | J | 3.2 | J | 4.6 | |
| 7440-09-7 | Potassium (K) | 158. | U | 105. | U | 1300. | | 281. | J | 637. | | 135. | U |
| 7782-49-2 | Selenium (Se) | 0.52 | UJ | 0.51 | UJ | 0.54 | UJ | 0.49 | UJ | 0.55 | UJ | 0.09 | UJ |
| 7440-22-4 | Silver (Ag) | 0.86 | J | 0.47 | U | 0.56 | J | 0.45 | U | 0.5 | U | 0.61 | J |
| 7440-23-5 | Sodium (Na) | 20.6 | U | 33.7 | U | 87. | J | 14.1 | U | 30.9 | U | 34.6 | U |
| 7440-28-0 | Thallium (Tl) | 0.17 | U | 0.16 | U | 0.26 | J | 0.19 | J | 0.34 | J | 0.15 | U |
| 7440-62-2 | Vanadium (V) | 5.8 | | 3.3 | J | 54.6 | | 12.1 | | 44.2 | | 7.2 | |
| 7440-66-6 | Zinc (Zn) | 5.8 | U | 20.5 | | 24.3 | | 6.6 | | 14.3 | | 40.9 | |
| 7440-31-5 | Tin (Sn) | 100. | U | 100. | U | 100. | U | 100. | U | 100. | U | 100. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846-META | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B060-01 | | 039-C-B060-01 | | 039-S-B061-01 | | | | |
| | ORIGINAL ID -----> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | |
| | LAB SAMPLE ID ---> | 9810398-04 | | 9810398-05 | | 9810398-06 | | | | |
| | ID FROM REPORT --> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | | | |
| | DATE EXTRACTED --> | 10/23/98 | | 10/23/98 | | 10/23/98 | | | | |
| | DATE ANALYZED ---> | 10/27/98 | | 10/27/98 | | 10/27/98 | | | | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | | | |
| | UNITS -----------> | MG/KG | A | MG/KG | A | MG/KG | A | | | |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | | | |
| 7429-90-5 | Aluminum (Al) | 3710. | | 3640. | | 7400. | | | | |
| 7440-36-0 | Antimony (Sb) | 1.8 | UJ | 1.9 | UJ | 1.9 | UJ | | | |
| 7440-38-2 | Arsenic (As) | 1.1 | | 1. | | 3.3 | | | | |
| 7440-39-3 | Barium (Ba) | 19. | J | 16.3 | J | 14.8 | J | | | |
| 7440-41-7 | Beryllium (Be) | 0.12 | J | 0.14 | J | 0.16 | J | | | |
| 7440-43-9 | Cadmium (Cd) | 0.2 | J | 0.17 | U | 0.17 | U | | | |
| 7440-70-2 | Calcium (Ca) | 375. | U | 755. | U | 1270. | | | | |
| 7440-47-3 | Chromium (Cr) | 2.8 | U | 3.2 | U | 11.6 | | | | |
| 7440-48-4 | Cobalt (Co) | 0.64 | J | 0.78 | J | 0.97 | J | | | |
| 7440-50-8 | Copper (Cu) | 1.1 | J | 0.75 | U | 2.7 | | | | |
| 7439-89-6 | Iron (Fe) | 2310. | | 2540. | | 11900. | | | | |
| 7439-92-1 | Lead (Pb) | 6.3 | | 6. | | 6.3 | | | | |
| 7439-95-4 | Magnesium (Mg) | 81.5 | J | 81. | J | 414. | J | | | |
| 7439-96-5 | Manganese (Mn) | 43.2 | | 42. | | 10.4 | | | | |
| 7439-97-6 | Mercury (Hg) | 0.05 | | 0.06 | | 0.06 | | | | |
| 7440-02-0 | Nickel (Ni) | 1.3 | J | 1.1 | J | 1.3 | J | | | |
| 7440-09-7 | Potassium (K) | 70.9 | U | 73.8 | U | 384. | J | | | |
| 7782-49-2 | Selenium (Se) | 0.11 | UJ | 0.11 | UJ | 0.5 | UJ | | | |
| 7440-22-4 | Silver (Ag) | 0.46 | U | 0.47 | U | 0.47 | U | | | |
| 7440-23-5 | Sodium (Na) | 11.2 | U | 11.3 | U | 23.6 | U | | | |
| 7440-28-0 | Thallium (Tl) | 0.17 | U | 0.18 | U | 0.16 | U | | | |
| 7440-62-2 | Vanadium (V) | 4.5 | J | 4.8 | J | 19.9 | | | | |
| 7440-66-6 | Zinc (Zn) | 3.9 | U | 3.4 | U | 7.4 | | | | |
| 7440-31-5 | Tin (Sn) | 100. | U | 100. | U | 100. | U | | | |

*** Validation Complete ***

| SW846_SVOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B047-01 | | 039-S-B048-01 | | 039-S-B049-01 | | 039-S-B050-01 | | 039-S-B051-01 | | 039-S-B052-01 | |
| | ORIGINAL ID -----> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | LAB SAMPLE ID ---> | 9810291-01 | | 9810291-02 | | 9810291-03 | | 9810291-04 | | 9810291-05 | | 9810398-12 | |
| | ID FROM REPORT --> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | SAMPLE DATE -----> | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/24/98 | |
| | DATE ANALYZED ---> | 10/30/98 | | 10/30/98 | | 10/30/98 | | 10/30/98 | | 10/30/98 | | 11/12/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN009 | VAL |
| 108-95-2 | Phenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 95-57-8 | 2-Chlorophenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 100-51-6 | Benzyl alcohol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | UJ |
| 67-72-1 | Hexachloroethane | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 98-95-3 | Nitrobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 78-59-1 | Isophorone | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 88-75-5 | 2-Nitrophenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 105-67-9 | 2,4-Dimethylphenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 65-85-0 | Benzoic acid | 1900. | U | 1800. | U | 1900. | U | 1800. | U | 1900. | U | 1900. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 120-83-2 | 2,4-Dichlorophenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 91-20-3 | Naphthalene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 106-47-8 | 4-Chloroaniline | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 87-68-3 | Hexachlorobutadiene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 91-57-6 | 2-Methylnaphthalene | 370. | U | 360. | U | 110. | J | 370. | U | 380. | U | 370. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 91-58-7 | 2-Chloronaphthalene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 88-74-4 | 2-Nitroaniline | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 131-11-3 | Dimethyl phthalate | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 208-96-8 | Acenaphthylene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 99-09-2 | 3-Nitroaniline | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 83-32-9 | Acenaphthene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 51-28-5 | 2,4-Dinitrophenol | 750. | U | 720. | U | 760. | U | 730. | U | 760. | U | 740. | U |
| 100-02-7 | 4-Nitrophenol | 750. | U | 720. | U | 760. | U | 730. | U | 760. | U | 740. | U |
| 132-64-9 | Dibenzofuran | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)

| SW846_SVOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B047-01 | | 039-S-B048-01 | | 039-S-B049-01 | | 039-S-B050-01 | | 039-S-B051-01 | | 039-S-B052-01 | |
| | ORIGINAL ID -----> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | LAB SAMPLE ID ---> | 9810291-01 | | 9810291-02 | | 9810291-03 | | 9810291-04 | | 9810291-05 | | 9810398-12 | |
| | ID FROM REPORT --> | 039SB04701 | | 039SB04801 | | 039SB04901 | | 039SB05001 | | 039SB05101 | | 039SB05201 | |
| | SAMPLE DATE -----> | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/12/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/16/98 | | 10/24/98 | |
| | DATE ANALYZED ---> | 10/30/98 | | 10/30/98 | | 10/30/98 | | 10/30/98 | | 10/30/98 | | 11/12/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN008 | VAL | EN009 | VAL |
| 121-14-2 | 2,4-Dinitrotoluene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 84-66-2 | Diethylphthalate | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 86-73-7 | Fluorene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 100-01-6 | 4-Nitroaniline | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 534-52-1 | 2-Methyl-4,6-Dinitrophenol | 750. | U | 720. | U | 760. | U | 730. | U | 760. | U | 740. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 101-55-3 | 4-Bromophenyl-phenylether | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 118-74-1 | Hexachlorobenzene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 87-86-5 | Pentachlorophenol | 750. | U | 720. | U | 760. | U | 730. | U | 760. | U | 740. | U |
| 85-01-8 | Phenanthrene | 370. | U | 360. | U | 80. | J | 370. | U | 380. | U | 370. | U |
| 120-12-7 | Anthracene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 84-74-2 | Di-n-butylphthalate | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 206-44-0 | Fluoranthene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 129-00-0 | Pyrene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 85-68-7 | Butylbenzylphthalate | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 56-55-3 | Benzo(a)anthracene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 218-01-9 | Chrysene | 370. | U | 360. | U | 73. | J | 370. | U | 380. | U | 370. | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 370. | U | 360. | U | 460. | | 370. | U | 380. | U | 69. | J |
| 117-84-0 | Di-n-octyl phthalate | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 205-99-2 | Benzo(b)fluoranthene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 207-08-9 | Benzo(k)fluoranthene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 50-32-8 | Benzo(a)pyrene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 53-70-3 | Dibenz(a,h)anthracene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 370. | U | 360. | U | 380. | U | 370. | U | 380. | U | 370. | U |

*** Validation Complete ***

| SW846_SVOA | SAMPLE ID -------> | 039-S-B053-01 | | 039-S-B054-01 | | 039-S-B055-01 | | 039-S-B056-01 | | 039-S-B057-01 | | 039-S-B059-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | LAB SAMPLE ID ---> | 9810398-13 | | 9810398-11 | | 9810398-10 | | 9810398-09 | | 9810398-08 | | 9810398-07 | |
| | ID FROM REPORT --> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | |
| | DATE ANALYZED ---> | 11/12/98 | | 11/12/98 | | 11/09/98 | | 11/09/98 | | 11/09/98 | | 11/09/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL |
| 108-95-2 | Phenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 95-57-8 | 2-Chlorophenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 100-51-6 | Benzyl alcohol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 380. | UJ | 370. | UJ | 410. | U | 390. | U | 420. | U | 360. | U |
| 67-72-1 | Hexachloroethane | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 98-95-3 | Nitrobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 78-59-1 | Isophorone | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 88-75-5 | 2-Nitrophenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 105-67-9 | 2,4-Dimethylphenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 65-85-0 | Benzoic acid | 1900. | U | 1900. | U | 2100. | U | 2000. | U | 2100. | U | 1800. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 120-83-2 | 2,4-Dichlorophenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 91-20-3 | Naphthalene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 106-47-8 | 4-Chloroaniline | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 87-68-3 | Hexachlorobutadiene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 91-57-6 | 2-Methylnaphthalene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 91-58-7 | 2-Chloronaphthalene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 88-74-4 | 2-Nitroaniline | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 131-11-3 | Dimethyl phthalate | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 208-96-8 | Acenaphthylene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 99-09-2 | 3-Nitroaniline | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 83-32-9 | Acenaphthene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 51-28-5 | 2,4-Dinitrophenol | 760. | U | 750. | U | 820. | U | 780. | U | 840. | U | 720. | U |
| 100-02-7 | 4-Nitrophenol | 760. | U | 750. | U | 820. | U | 780. | U | 840. | U | 720. | U |
| 132-64-9 | Dibenzofuran | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |

*** Validation Complete ***

| SW846_SVOA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B053-01 | | 039-S-B054-01 | | 039-S-B055-01 | | 039-S-B056-01 | | 039-S-B057-01 | | 039-S-B059-01 | |
| | ORIGINAL ID -----> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | LAB SAMPLE ID ---> | 9810398-13 | | 9810398-11 | | 9810398-10 | | 9810398-09 | | 9810398-08 | | 9810398-07 | |
| | ID FROM REPORT --> | 039SB05301 | | 039SB05401 | | 039SB05501 | | 039SB05601 | | 039SB05701 | | 039SB05901 | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | | 10/13/98 | |
| | DATE EXTRACTED --> | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | | 10/24/98 | |
| | DATE ANALYZED ---> | 11/12/98 | | 11/12/98 | | 11/09/98 | | 11/09/98 | | 11/09/98 | | 11/09/98 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL | EN009 | VAL |
| 121-14-2 | 2,4-Dinitrotoluene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 84-66-2 | Diethylphthalate | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 86-73-7 | Fluorene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 100-01-6 | 4-Nitroaniline | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 534-52-1 | 2-Methyl-4,6-Dinitrophenol | 760. | U | 750. | U | 820. | U | 780. | U | 840. | U | 720. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 101-55-3 | 4-Bromophenyl-phenylether | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 118-74-1 | Hexachlorobenzene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 87-86-5 | Pentachlorophenol | 760. | U | 750. | U | 820. | U | 780. | U | 840. | U | 720. | U |
| 85-01-8 | Phenanthrene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 120-12-7 | Anthracene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 84-74-2 | Di-n-butylphthalate | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 206-44-0 | Fluoranthene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 45. | J |
| 129-00-0 | Pyrene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 47. | J |
| 85-68-7 | Butylbenzylphthalate | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 56-55-3 | Benzo(a)anthracene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 218-01-9 | Chrysene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 43. | J | 87. | J | 760. | J | 98. | J | 390. | J | 360. | U |
| 117-84-0 | Di-n-octyl phthalate | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 205-99-2 | Benzo(b)fluoranthene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 38. | J |
| 207-08-9 | Benzo(k)fluoranthene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 50-32-8 | Benzo(a)pyrene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 53-70-3 | Dibenz(a,h)anthracene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 380. | U | 370. | U | 410. | U | 390. | U | 420. | U | 360. | U |

| SW846_SVOA | SAMPLE ID -------> | 039-S-B060-01 | | 039-C-B060-01 | | 039-S-B061-01 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | |
| | LAB SAMPLE ID ---> | 9810398-04 | | 9810398-05 | | 9810398-06 | | | | |
| | ID FROM REPORT --> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | | | |
| | DATE EXTRACTED --> | 10/24/98 | | 10/24/98 | | 10/24/98 | | | | |
| | DATE ANALYZED ---> | 11/05/98 | | 11/06/98 | | 11/09/98 | | | | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | | | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | | | |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | | | |
| 108-95-2 | Phenol | 380. | U | 380. | U | 380. | U | | | |
| 111-44-4 | bis(2-Chloroethyl)ether | 380. | U | 380. | U | 380. | U | | | |
| 95-57-8 | 2-Chlorophenol | 380. | U | 380. | U | 380. | U | | | |
| 541-73-1 | 1,3-Dichlorobenzene | 380. | U | 380. | U | 380. | U | | | |
| 106-46-7 | 1,4-Dichlorobenzene | 380. | U | 380. | U | 380. | U | | | |
| 100-51-6 | Benzyl alcohol | 380. | U | 380. | U | 380. | U | | | |
| 95-50-1 | 1,2-Dichlorobenzene | 380. | U | 380. | U | 380. | U | | | |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 380. | U | 380. | U | 380. | U | | | |
| 621-64-7 | N-Nitroso-di-n-propylamine | 380. | U | 380. | U | 380. | U | | | |
| 67-72-1 | Hexachloroethane | 380. | U | 380. | U | 380. | U | | | |
| 98-95-3 | Nitrobenzene | 380. | U | 380. | U | 380. | U | | | |
| 78-59-1 | Isophorone | 380. | U | 380. | U | 380. | U | | | |
| 88-75-5 | 2-Nitrophenol | 380. | U | 380. | U | 380. | U | | | |
| 105-67-9 | 2,4-Dimethylphenol | 380. | U | 380. | U | 380. | U | | | |
| 65-85-0 | Benzoic acid | 1900. | U | 1900. | U | 1900. | U | | | |
| 111-91-1 | bis(2-Chloroethoxy)methane | 380. | U | 380. | U | 380. | U | | | |
| 120-83-2 | 2,4-Dichlorophenol | 380. | U | 380. | U | 380. | U | | | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 380. | U | 380. | U | 380. | U | | | |
| 91-20-3 | Naphthalene | 380. | U | 380. | U | 380. | U | | | |
| 106-47-8 | 4-Chloroaniline | 380. | U | 380. | U | 380. | U | | | |
| 87-68-3 | Hexachlorobutadiene | 380. | U | 380. | U | 380. | U | | | |
| 59-50-7 | 4-Chloro-3-methylphenol | 380. | U | 380. | U | 380. | U | | | |
| 91-57-6 | 2-Methylnaphthalene | 380. | U | 380. | U | 380. | U | | | |
| 77-47-4 | Hexachlorocyclopentadiene | 380. | U | 380. | U | 380. | U | | | |
| 88-06-2 | 2,4,6-Trichlorophenol | 380. | U | 380. | U | 380. | U | | | |
| 95-95-4 | 2,4,5-Trichlorophenol | 380. | U | 380. | U | 380. | U | | | |
| 91-58-7 | 2-Chloronaphthalene | 380. | U | 380. | U | 380. | U | | | |
| 88-74-4 | 2-Nitroaniline | 380. | U | 380. | U | 380. | U | | | |
| 131-11-3 | Dimethyl phthalate | 380. | U | 380. | U | 380. | U | | | |
| 208-96-8 | Acenaphthylene | 380. | U | 380. | U | 380. | U | | | |
| 606-20-2 | 2,6-Dinitrotoluene | 380. | U | 380. | U | 380. | U | | | |
| 99-09-2 | 3-Nitroaniline | 380. | U | 380. | U | 380. | U | | | |
| 83-32-9 | Acenaphthene | 380. | U | 380. | U | 380. | U | | | |
| 51-28-5 | 2,4-Dinitrophenol | 760. | U | 770. | U | 770. | U | | | |
| 100-02-7 | 4-Nitrophenol | 760. | U | 770. | U | 770. | U | | | |
| 132-64-9 | Dibenzofuran | 380. | U | 380. | U | 380. | U | | | |

*** Validation Complete ***

| SW846_SVOA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-B060-01 | | 039-C-B060-01 | | 039-S-B061-01 | | | | | |
| | ORIGINAL ID -----> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | | |
| | LAB SAMPLE ID ---> | 9810398-04 | | 9810398-05 | | 9810398-06 | | | | | |
| | ID FROM REPORT --> | 039SB06001 | | 039CB06001 | | 039SB06101 | | | | | |
| | SAMPLE DATE -----> | 10/13/98 | | 10/13/98 | | 10/13/98 | | | | | |
| | DATE EXTRACTED --> | 10/24/98 | | 10/24/98 | | 10/24/98 | | | | | |
| | DATE ANALYZED ---> | 11/05/98 | | 11/06/98 | | 11/09/98 | | | | | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | | | | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | | | | |
| CAS # | Parameter | EN009 | VAL | EN009 | VAL | EN009 | VAL | | | | |
| 121-14-2 | 2,4-Dinitrotoluene | 380. | U | 380. | U | 380. | U | | | | |
| 84-66-2 | Diethylphthalate | 380. | U | 380. | U | 380. | U | | | | |
| 7005-72-3 | 4-Chlorophenylphenylether | 380. | U | 380. | U | 380. | U | | | | |
| 86-73-7 | Fluorene | 380. | U | 380. | U | 380. | U | | | | |
| 100-01-6 | 4-Nitroaniline | 380. | U | 380. | U | 380. | U | | | | |
| 534-52-1 | 2-Methyl-4,6-Dinitrophenol | 760. | U | 770. | U | 770. | U | | | | |
| 86-30-6 | N-Nitrosodiphenylamine | 380. | U | 380. | U | 380. | U | | | | |
| 101-55-3 | 4-Bromophenyl-phenylether | 380. | U | 380. | U | 380. | U | | | | |
| 118-74-1 | Hexachlorobenzene | 380. | U | 380. | U | 380. | U | | | | |
| 87-86-5 | Pentachlorophenol | 760. | U | 770. | U | 770. | U | | | | |
| 85-01-8 | Phenanthrene | 380. | U | 380. | U | 380. | U | | | | |
| 120-12-7 | Anthracene | 380. | U | 380. | U | 380. | U | | | | |
| 84-74-2 | Di-n-butylphthalate | 380. | U | 380. | U | 380. | U | | | | |
| 206-44-0 | Fluoranthene | 380. | U | 380. | U | 380. | U | | | | |
| 129-00-0 | Pyrene | 380. | U | 380. | U | 380. | U | | | | |
| 85-68-7 | Butylbenzylphthalate | 380. | U | 380. | U | 380. | U | | | | |
| 91-94-1 | 3,3'-Dichlorobenzidine | 380. | U | 380. | U | 380. | U | | | | |
| 56-55-3 | Benzo(a)anthracene | 380. | U | 380. | U | 380. | U | | | | |
| 218-01-9 | Chrysene | 380. | U | 380. | U | 380. | U | | | | |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 100. | J | 380. | U | 380. | U | | | | |
| 117-84-0 | Di-n-octyl phthalate | 380. | U | 380. | U | 380. | U | | | | |
| 205-99-2 | Benzo(b)fluoranthene | 380. | U | 380. | U | 380. | U | | | | |
| 207-08-9 | Benzo(k)fluoranthene | 380. | U | 380. | U | 380. | U | | | | |
| 50-32-8 | Benzo(a)pyrene | 380. | U | 380. | U | 380. | U | | | | |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 380. | U | 380. | U | 380. | U | | | | |
| 53-70-3 | Dibenz(a,h)anthracene | 380. | U | 380. | U | 380. | U | | | | |
| 191-24-2 | Benzo(g,h,i)perylene | 380. | U | 380. | U | 380. | U | | | | |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 380. | U | 380. | U | 380. | U | | | | |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 380. | U | 380. | U | 380. | U | | | | |

*** Validation Complete ***

**HEARTLAND**
**ENVIRONMENTAL SERVICES, INC.**

## Data Validation Report

| | |
|---|---|
| SDG#: | EN008 |
| Date: | December 10, 1998 |
| Client Name: | EnSafe |
| Project/Site Name: | Charleston - Zone A |
| Date Sampled: | October 12-13, 1998 |
| Number of Samples: | 18 Non-aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Laucks Testing Laboratories, Inc. |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | EPA DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fractions: | Semivolatiles, Metals, TCLP Metals, SPLP Metals, Arsenic, and Beryllium |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Sexfass
for Paul B. Humburg, President

12-11-98.
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

SDG# EN008

## Samples and Fractions Reviewed

Sample Identifications — Analytical Fractions

| ENSAFE ID | MATRIX | SVOA | | MET | | T-MET | | S-MET | | AS | | BE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 039SB04701 | SOIL | | X | | X | | | | | | | | |
| 039SB04801 | SOIL | | X | | X | | | | | | | | |
| 039SB04901 | SOIL | | X | | X | | | | | | | | |
| 039SB05001 | SOIL | | X | | X | | | | | | | | |
| 039SB05101 | SOIL | | X | | X | | X | | X | | | | |
| 042SB02601 | SOIL | | X | | | | X | | X | | X | | X |
| 042SB02701 | SOIL | | X | | | | | | | | X | | X |
| 042SB02801 | SOIL | | X | | | | | | | | X | | X |
| 042SB02901 | SOIL | | X | | | | | | | | X | | X |
| 042SB03001 | SOIL | | X | | | | | | | | X | | X |
| 042SB03101 | SOIL | | X | | | | | | | | X | | X |
| 042SB03201 | SOIL | | X | | | | | | | | X | | X |
| 042CB03201 | SOIL | | X | | | | | | | | X | | X |
| 042SB03301 | SOIL | | X | | | | X | | X | | X | | X |
| 042SB03401 | SOIL | | X | | | | | | | | X | | X |
| 042SB03501 | SOIL | | X | | | | | | | | X | | X |
| 042SB03601 | SOIL | | X | | | | | | | | X | | X |
| 042SB03701 | SOIL | | X | | | | X | | X | | X | | X |
| Total Billable Samples (Water/Soil) | | 0 | 18 | 0 | 5 | 0 | 4 | 0 | 4 | 0 | 13 | 0 | 13 |

SVOA= SW846 Semivolatiles
MET= SW846 Metals
T-MET= SW846 TCLP Metals
S-MET= SW846 SPLP Metals
AS= SW846 Metals (Arsenic )
BE= SW846 Metals (Beryllium)

# DATA ASSESSMENT NARRATIVES

# DATA ASSESSMENT NARRATIVE
# METALS AND TCLP METALS

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDGs # EN008

A validation was performed on the Metals and TCLP Metals Data from SDG EN008. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Calibrations
- • Blanks
- * • Interferences
- • Matrix Spike Recovery
- * • Matrix Duplicates
- * • Field Duplicates
- * • Laboratory Control Samples
- • Serial Dilutions

* - All criteria were met for this parameter.

## Preparation and Field Blanks

The preparation blanks exhibited contamination for the following elements.

| Elements | Conc. | Samples affected |
|---|---|---|
| Barium | 0.1 mg/kg | no impact |
| Cadmium | 0.17 mg/kg | all soil samples below 0.85 mg/kg |
| Calcium | 3.28 mg/kg | no impact |
| Copper | 0.32 mg/kg | no impact |
| Iron | 1.62 mg/kg | no impact |
| Manganese | 0.27 mg/kg | no impact |
| Silver | 0.83 mg/kg | all soil samples below 4.15 mg/kg |
| Zinc | 0.46 mg/kg | all soil samples below 2.3 mg/kg |

The USEPA requires that all sample values below five times the preparation, field or calibration blank contamination be qualified as non-detect, "U".

The preparation blanks exhibited negative bias for the following elements.

| Elements | Conc. | Samples affected |
| --- | --- | --- |
| Arsenic | -24.0 ug/l | all TCLP samples below 240 ug/l |
| Lead | -24.0 ug/l | all TCLP samples below 240 ug/l |
| Selenium | -44.0 ug/l | all TCLP samples below 440 ug/l |

This reviewer qualifies all samples results below 10 times the absolute value of the negative blank value.

## Matrix Spike results

The Matrix Spike recoveries for soils for Antimony (46%), and Selenium (62%) and for TCLP samples for Cadmium (71%), Chromium (68%), Lead (74%) and Silver (65%) were below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

## Serial Dilution results

The Serial dilution results for soils for Aluminum, Calcium, Iron, Manganese and Zinc were greater than 10%. All positive results are qualified as estimated, "J".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

# SUMMARY OF DATA QUALIFICATIONS

| Sample ID | Analyte | DL | QL |
|---|---|---|---|
| all soil samples below 0.85 mg/kg | Cd. | + | U |
| all soil samples below 4.15 mg/kg | Ag. | | |
| all soil samples below 2.3 mg/kg | Zn. | | |
| all TCLP samples below 240 ug/l | As. | +/U | J/UJ |
| all TCLP samples below 240 ug/l | Pb. | | |
| all TCLP samples below 440 ug/l | Se. | | |
| all soil samples | Sb and Se. | +/U | J/UJ |
| all TCLP samples | Cd, Cr, Pb and Ag. | | |
| all soil samples | Al, Ca, Fe, Mn and Zn. | + | J |
| all "B" results | all analytes | B | J |

# DATA ASSESSMENT NARRATIVE

## SEMIVOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8270C; the National Functional Guidelines for Organic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

**SDG # EN008**

A validation was performed on the Semivolatile Data from SDG EN008. The data was evaluated based on the following parameters:

* • Data Completeness
• Holding Times
* • GC/MS Tuning
* • Calibration
• Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Internal Standard Performance
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

**Holding Times**

The following sample was re-extracted six (6) days outside the extraction holding time for soil samples because the original extract was lost. All reported positive and non-detect results in the sample are qualified as estimated, J/UJ.

042SB02601

## DATA ASSESSMENT NARRATIVE
## SEMIVOLATILE ANALYSIS



**Method Blanks**

One of the method blanks associated with samples in this SDG exhibited contamination. Several samples required qualification. The end-user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into consideration when applying the 5X or 10X criteria to field samples.

| Associated Blank | Compound | Conc. | Action Level |
|---|---|---|---|
| SBLK2 | bis(2-ethylhexyl)phthalate | 86J μg/Kg | 860 μg/Kg |

| Samples | Compound | Qualification |
|---|---|---|
| 042SB02601 | bis(2-ethylhexyl)phthalate | CRQL |

**System Performance and Overall Assessment**

The data required qualifications.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

**U** = Not detected

**J** = Estimated value

**UJ** = Reported Quantitation limit is qualified as estimated

**UR** = Result is rejected and unusable

**D** = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

**CRQL** = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

**U** = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

**No Action** = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| 042SB02601 | All compounds | +/- | J/UJ |
| 042SB02601 | bis(2-ethylhexyl)phthalate | +B | CRQL |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

**HEARTLAND**
ENVIRONMENTAL SERVICES, INC.

# Data Validation Report

| | |
|---|---|
| SDG#: | EN009 |
| Date: | December 16, 1998 |
| Client Name: | EnSafe |
| Project/Site Name: | Charleston - Zone A |
| Date Sampled: | October 13-14, 1998 |
| Number of Samples: | 3Aqueous Sample(s) with 0 MS/MSD(s)<br>16 Non-aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Laucks Testing Laboratories, Inc. |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | EPA DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fractions: | Semivolatiles, Metals, TCLP Metals, SPLP Metals, Arsenic, and Beryllium |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Sears for
Paul R. Humburg, President

12-17-98.
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

**SDG# EN009**

## Samples and Fractions Reviewed

Sample Identifications — Analytical Fractions

| ENSAFE ID | MATRIX | SVOA | | MET | | T-MET | | S-MET | | AS | | BE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 039SB05201 | SOIL | | X | | X | | | | | | | | |
| 039SB05301 | SOIL | | X | | X | | | | | | | | |
| 039EB05301 | WATER | X | | X | | | | | | | | | |
| 039SB05401 | SOIL | | X | | X | | | | | | | | |
| 039SB05501 | SOIL | | X | | X | | | | | | | | |
| 039SB05601 | SOIL | | X | | X | | | | | | | | |
| 039SB05701 | SOIL | | X | | X | | | | | | | | |
| 039SB05901 | SOIL | | X | | X | | | | | | | | |
| 039SB06001 | SOIL | | X | | X | | | | | | | | |
| 039CB06001 | SOIL | | X | | X | | | | | | | | |
| 039SB06101 | SOIL | | X | | X | | | | | | | | |
| 042SB03801 | SOIL | | X | | | | | | | | X | | X |
| 042SB03901 | SOIL | | X | | | | | | | | X | | X |
| 042SB04001 | SOIL | | X | | | | | | | | X | | X |
| 042SB04101 | SOIL | | X | | | | | | | | X | | X |
| 042SB04201 | SOIL | | X | | | | | | | | X | | X |
| 042SB04301 | SOIL | | X | | | | | | | | X | | X |
| 039SB05701 | WATER | | | | | X | | X | | | | | |
| 042SB04001 | WATER | | | | | X | | X | | | | | |
| Total Billable Samples (Water/Soil) | | 1 | 16 | 1 | 10 | 2 | 0 | 2 | 0 | 0 | 6 | 0 | 6 |

SVOA= SW846 Semivolatiles
MET= SW846 Metals
T-MET= SW846 TCLP Metals
S-MET= SW846 SPLP Metals
AS= SW846 Metals (Arsenic )
BE= SW846 Metals (Beryllium)

# DATA ASSESSMENT NARRATIVES

# DATA ASSESSMENT NARRATIVE

# SEMIVOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8270; the National Functional Guidelines for Organic Data Validation, 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

**SDG # EN009**

A validation was performed on the Semivolatile Data from SDG EN009. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- • Calibration
- • Blanks
- • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Internal Standard Performance
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

**Calibration**

The initial calibration exhibited compounds with RSDs greater than 15%, but less than 90%.

For the samples listed below, qualify the positive results for benzo(b)fluoranthene as estimated, J, because of a RSD response of 16.0% in the initial calibration.

039-S-B059-01
042-S-B040-01
042-S-B042-01

**Calibrations - continued**

The continuing calibrations exhibited compounds with %Ds greater than 20%. Qualifications are as follows.

The continuing calibration on 11/5/98 at 12:57 required qualification for the sample(s) and compound(s) listed below.

| | | |
|---|---|---|
| 042-S-B040-01 | benzo(b)fluoranthene (20.9%) | J |

The continuing calibration on 11/9/98 at 08:46 required qualification for the sample(s) and compound(s) listed below.

| | | |
|---|---|---|
| 039-S-B055-01 | bis(2-ethyhexyl)phthalate (-29.0%) | J |
| 039-S-B056-01 | | |

The continuing calibration on 11/12/98 at 10:22 required qualification for the sample(s) and compound(s) listed below.

| | | |
|---|---|---|
| 039-S-B054-01 | N-nitroso-di-n-propylamine (-62.2%) | UJ |

The continuing calibration on 11/12/98 at 18:10 required qualification for the sample(s) and compound(s) listed below.

| | | |
|---|---|---|
| 039-S-B052-01 | N-nitroso-di-n-propylamine (-54.5%) | UJ |
| 039-S-B053-01 | | |
| 042-S-B041-01 | | |
| 042-S-B042-01 | | |
| 042-S-B043-01 | | |

**Blanks**

All samples results in the electronic data were flagged incorrectly for bis(2-ethylhexyl)-phthalate contamination. A review of the raw data indicated that the laboratory blanks were free of target compound contamination.

**Surrogates**

Sample 042-S-B040-01 exhibited the acid surrogate tribromophenol-d5 with a 7% recovery. For the acid compounds only, reject (UR) all non detect results (no positive results for acid compounds).

**System Performance and Overall Assessment**

The data is reported as is with qualifications and rejections. Sample 042-S-B040-01 is reported in favor of the re-extraction due to holding time deficiencies, similar surrogate recoveries, and poor associated method blank surrogate recoveries.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

**U** = Not detected

**J** = Estimated value

**UJ** = Reported Quantitation limit is qualified as estimated

**UR** = Result is rejected and unusable

**D** = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

**CRQL** = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

**U** = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

**No Action** = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| 039-S-B059-01<br>042-S-B040-01<br>042-S-B042-01 | benzo(b)fluoranthene | + | J |
| 042-S-B040-01 | benzo(b)fluoranthene | + | J |
| 039-S-B055-01<br>039-S-B056-01 | bis(2-ethyhexyl)phthalate | + | J |
| 039-S-B054-01 | N-nitroso-di-n-propylamine | - | UJ |
| 039-S-B052-01<br>039-S-B053-01<br>042-S-B041-01<br>042-S-B042-01<br>042-S-B043-01 | N-nitroso-di-n-propylamine | - | UJ |
| 042-S-B040-01 | all acid compounds | - | UR |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

# DATA ASSESSMENT NARRATIVE
# METALS

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDGs # EN009

A validation was performed on the Metals Data from SDG EN009. The data was evaluated based on the following parameters.

| | | |
|---|---|---|
| * | • | Data Completeness |
| * | • | Holding Times |
| * | • | Calibrations |
| | • | Blanks |
| * | • | Interferences |
| | • | Matrix Spike Recovery |
| * | • | Matrix Duplicates |
| * | • | Field Duplicates |
| * | • | Laboratory Control Samples |
| * | • | Serial Dilutions |

* - All criteria were met for this parameter.

## Preparation and Field Blanks

The preparation blanks exhibited contamination for the following elements.

| Elements | Conc. | Samples affected |
|---|---|---|
| Chromium | 0.74 mg/kg | all soil samples below 3.7 mg/kg |
| Copper | 0.24 mg/kg | all soil samples below 1.2 mg/kg |
| Iron | 3.43 mg/kg | no impact |
| Lead | 0.20 mg/kg | no impact |
| Manganese | 0.36 mg/kg | no impact |
| Sodium | 2.65 mg/kg | no impact |
| Zinc | 0.45 mg/kg | no impact |

The equipment blanks exhibited contamination for the following elements.

| Elements | Conc. | Samples affected |
|---|---|---|
| Calcium | 1050 ug/l | all soil samples below 1050 mg/kg |
| Manganese | 3.6 ug/l | no impact |
| Potassium | 222 ug/l | all soil samples below 222 mg/kg |
| Sodium | 513 ug/l | all soil samples below 513 mg/kg |
| Zinc | 6.4 ug/l | all soil samples below 6.4 mg/kg |

The USEPA requires that all sample values below five times the preparation or calibration blank contamination be qualified as non-detect, "U".

## Matrix Spike Recovery results

The Matrix Spike recoveries for soils for Antimony (58%) and Selenium (47%) were below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

## SUMMARY OF DATA QUALIFICATIONS

| Sample ID | Analyte | DL | QL |
|---|---|---|---|
| all soil samples below 3.7 mg/kg | Cr. | + | U |
| all soil samples below 1.2 mg/kg | Cu. | | |
| all soil samples below 1050 mg/kg | Ca. | | |
| all soil samples below 222 mg/kg | K. | | |
| all soil samples below 513 mg/kg | Na. | | |
| all soil samples below 6.4 mg/kg | Zn. | | |
| all soil samples | Sb and Se. | +/U | J/UJ |
| all "B" results | all analytes | B | J |

# DATA ASSESSMENT NARRATIVE
# TCLP METALS

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDGs # EN009

A validation was performed on the TCLP Metals Data from SDG EN009. The data was evaluated based on the following parameters.

- * ● Data Completeness
- * ● Holding Times
- * ● Calibrations
- * ● Blanks
- * ● Interferences
- ● Matrix Spike Recovery
- * ● Matrix Duplicates
- * ● Field Duplicates
- * ● Laboratory Control Samples
- * ● Serial Dilutions

* - All criteria were met for this parameter.

## Matrix Spike Recovery results

The Matrix Spike recoveries for waters for Cadmium (71%), Chromium (68%), Lead (74%) and Silver (65%) were below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

# SUMMARY OF DATA QUALIFICATIONS

| Sample ID | Analyte | DL | QL |
|---|---|---|---|
| all water samples | Cd, Cr, Pb and Ag. | +/U | J/UJ |
| all "B" results | all analytes | B | J |

# DATA ASSESSMENT NARRATIVE
# SPLP METALS

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDGs # EN009

A validation was performed on the SPLP Metals Data from SDG EN009. The data was evaluated based on the following parameters.

- * ● Data Completeness
- * ● Holding Times
- * ● Calibrations
- ● Blanks
- * ● Interferences
- ● Matrix Spike Recovery
- * ● Matrix Duplicates
- * ● Field Duplicates
- * ● Laboratory Control Samples
- * ● Serial Dilutions

* - All criteria were met for this parameter.

## Preparation and Field Blanks

The preparation and calibration blanks exhibited negative bias for the following elements.

| Elements | Conc. | Samples affected |
|---|---|---|
| Arsenic | -24.1 ug/l | all water samples below 241 ug/l |
| Lead | -24.1 ug/l | all water samples below 241 ug/l |
| Selenium | -43.9 ug/l | all water samples below 439 ug/l |

This reviewer qualifies all samples results below ten times the negative bias as estimated, "J" or "UJ".

## Matrix Spike Recovery results

The Matrix Spike recovery for waters for Silver (74%) was below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

# SUMMARY OF DATA QUALIFICATIONS

| Sample ID | Analyte | DL | QL |
|---|---|---|---|
| all water samples below 241 ug/l | As. | +/U | J/UJ |
| all water samples below 241 ug/l | Pb. | | |
| all water samples below 439 ug/l | Se. | | |
| all water samples | Ag. | +/U | J/UJ |
| all "B" results | all analytes | B | J |

**HEARTLAND**
**ENVIRONMENTAL SERVICES, INC.**

## Data Validation Report

| | |
|---|---|
| SDG#: | ECZA01 |
| Date: | November 20, 1998 |
| Client Name: | Ensafe |
| Project/Site Name: | Charleston Zone A |
| Date Sampled: | October 12 & 13, 1998 |
| Number of Samples: | 2 Aqueous Sample(s) with 0 MS/MSD(s)<br>14 Non-aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Savannah Laboratories |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fractions: | Volatiles |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Sexton
Paul B. Humburg, President

11-24-98.
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

SDG# ECZA01

## Samples and Fractions Reviewed

Sample Identifications    Analytical Fractions

| ENSAFE ID | MATRIX | VOA | |
|---|---|---|---|
| 039SB04701 | SOIL | | X |
| 039SB04801 | SOIL | | X |
| 039SB04901 | SOIL | | X |
| 039SB05001 | SOIL | | X |
| 039SB05101 | SOIL | | X |
| 039SB05201 | SOIL | | X |
| 039SB05301 | SOIL | | X |
| 039TB05301 | WATER | X | |
| 039EB05301 | WATER | X | |
| 039SB05401 | SOIL | | X |
| 039SB05501 | SOIL | | X |
| 039SB05601 | SOIL | | X |
| 039SB05701 | SOIL | | X |
| 039SB06001 | SOIL | | X |
| 039CB06001 | SOIL | | X |
| 039SB06101 | SOIL | | X |
| Total Billable Samples (Water/Soil) | | 2 | 14 |

VOA= SW846 Volatiles

# DATA ASSESSMENT NARRATIVE

# VOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8260 for Volatiles; the National Functional Guidelines for Organic Data Validation, September 1994; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

**SDG # ECZA01**

A validation was performed on the Volatile Data from SDG ECZA01. The data was evaluated based on the following parameters:

| | | |
|---|---|---|
| * | • | Data Completeness |
| * | • | Holding Times |
| * | • | GC/MS Tuning |
| | • | Calibration |
| | • | Blanks |
| | • | Internal Standard Performance |
| | • | Surrogate Recoveries |
| * | • | Matrix Spike/Matrix Spike Duplicates |
| * | • | Field Duplicates |
| * | • | Compound Identification |
| | • | Compound Quantitation |

* - All criteria were met for this parameter.

## DATA ASSESSMENT NARRATIVE
## VOLATILE ORGANICS



### Initial Calibrations

The initial calibration curve analyzed 09/16/98 exhibited one (1) compound with an average RRF less than 0.05. For the following samples and compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

| | |
|---|---|
| 039SB04701 | 2-chloroethyl vinyl ether (0.010) |
| 039SB04801 | |
| 039SB04901 | |
| 039SB05001 | |
| 039SB05101 | |
| 039SB06001 | |
| 039CB06001 | |
| 039SB06101 | |
| 039SB05601 | |
| 039SB05401 | |
| 039SB05201 | |
| 039SB05301 | |
| 039SB05701 | |
| 039SB05501 | |

### Continuing Calibration

The continuing calibration standard HQ931 exhibited one (1) compound with a RRF less than 0.05. For the following samples and compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

| | |
|---|---|
| 039SB04701 | 2-chloroethyl vinyl ether (0.009) |
| 039SB04801 | |
| 039SB04901 | |
| 039SB05001 | |
| 039SB05101 | |
| 039SB06001 | |
| 039CB06001 | |
| 039SB06101 | |
| 039SB05601 | |
| 039SB05401 | |
| 039SB05201 | |
| 039SB05301 | |

**Continuing Calibration (continued)**

The continuing calibration standard HQ939 exhibited one (1) compound with a RRF less than 0.05. For the following samples and compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

| | |
|---|---|
| 039SB05701 | 2-chloroethyl vinyl ether (0.009) |
| 039SB05501 | |

**Field QC Blanks**

The trip blank and rinseate blank associated with samples in this SDG exhibited contamination. The field samples required qualification. The end-user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into consideration when applying the 5X or 10X criteria to field samples.

| Associated Blanks | Compound | Conc. | Action Level |
|---|---|---|---|
| 039TB05301 | toluene | 0.81J $\mu$g/L | 4.05 $\mu$g/L or $\mu$g/Kg |
| 039EB05301 | acetone | 9.2 $\mu$g/L | 92 $\mu$g/L or $\mu$g/Kg |
| | chloroform | 9.9 $\mu$g/L | 49.5 $\mu$g/L or $\mu$g/Kg |

| Samples | Compound | Qualification |
|---|---|---|
| 039SB05501 | toluene | CRQL |
| 039SB04701 | acetone | U |
| 039SB04801 | | |
| 039SB05301 | | |
| 039SB05501 | | |

**Internal Standards**

The following samples exhibited non-compliant internal standard area recoveries below the QC limits. For the following samples and associated compounds, the reported positive and non-detect results are qualified as estimated, J/UJ.

| | |
|---|---|
| 039SB05001 | 1,4-dichlorobenzene-d4 |
| 039SB05101 | chlorobenzene-d5 |

## DATA ASSESSMENT NARRATIVE
## VOLATILE ORGANICS



**Surrogate Recoveries**

The following sample exhibited non-compliant surrogate recoveries above the QC limits. The reported positive results are qualified as estimated, J.

| | |
|---|---|
| 039SB05001 | p-bromofluorobenzene 157% |
| 039SB05101 | p-bromofluorobenzene 263% |

**Compound Quantitation**

For the following sample, the results are not used in favor of the results reported from the original analysis. The sample and RE exhibited similar surrogate and internal standard area recoveries.

039SB05001RE

For the following sample, the E flagged results are qualified as estimated, J, because they were reported above the calibration range.

039SB05101

**System Performance and Overall Assessment**

The data, as reported, required qualifications/rejections.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

U = Not detected

J = Estimated value

L = Biased low value

K = Biased high value

UJ = Reported Quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

| | |
|---|---|
| **CRQL =** | The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common lab contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported. |
| **U =** | The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common lab contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported. |
| **No Action =** | The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common lab contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers. |

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| 039SB04701 | 2-chloroethyl vinyl ether | +/- | J/UR |
| 039SB04801 | | | |
| 039SB04901 | | | |
| 039SB05001 | | | |
| 039SB05101 | | | |
| 039SB06001 | | | |
| 039CB06001 | | | |
| 039SB06101 | | | |
| 039SB05601 | | | |
| 039SB05401 | | | |
| 039SB05201 | | | |
| 039SB05301 | | | |
| 039SB05701 | | | |
| 039SB05501 | | | |
| 039SB04701 | 2-chloroethyl vinyl ether | +/- | J/UR |
| 039SB04801 | | | |
| 039SB04901 | | | |
| 039SB05001 | | | |
| 039SB05101 | | | |
| 039SB06001 | | | |
| 039CB06001 | | | |
| 039SB06101 | | | |
| 039SB05601 | | | |
| 039SB05401 | | | |
| 039SB05201 | | | |
| 039SB05301 | | | |
| 039SB05701 | 2-chloroethyl vinyl ether | +/- | J/UR |
| 039SB05501 | | | |
| 039SB05501 | toluene | + | CRQL |
| 039SB04701 | acetone | + | U |
| 039SB04801 | | | |
| 039SB05301 | | | |
| 039SB05501 | | | |

## SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| | *All Associated With* | | |
| 039SB05001 | 1,4-dichlorobenzene-d4 | +/- | J/UJ |
| 039SB05101 | chlorobenzene-d5 | | |
| 039SB05001 | All compounds | + | J |
| 039SB05101 | | | |
| 039SB05001RE | All compounds | +/- | Do Not Use |
| 039SB05101 | All compounds | +E | J |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

**ENSAFE**

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

PAGE 1 OF 1
PROJECT/JOB NO: 2901-0[illegible]08-014
COC NO:
PO NO: 1840
REL NO: 10
LAB NAME: Laucks

CLIENT: Naval Base Charleston
PROJECT MANAGER: Ted Blahnik
LOCATION: Zone A CMS
TELE/FAX NO. 972.791.3220
SAMPLERS: (SIGNATURE) Krista Collins

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | T. metals | TCLP metals | SPLP metals | SVOCs | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NBCA039SB04701 (12-18" | 10/12/98 | 1310 | Soil | 2 16-oz Glass | 4°C | | 2 | X | | | X | | | | | | |
| NBCA039SB04801 (12-18) | 10/12/98 | 1330 | Soil | 2 16-oz Glass | 4°C | | 2 | X | | | X | | | | | | |
| NBCA039SB04901 (12-18" | 10/12/98 | 1350 | Soil | Glass 4oz | 4°C | | 4 | X | | | X | | | | | | |
| NBCA039SB05001 (12-18) | 10/12/98 | 1410 | Soil | Glass 4oz | 4°C | | 4 | X | | | X | | | | | | |
| NBCA039SB05[illegible]01 (12-18' | 10/12/98 | 1420 | Soil | 8 4-oz Glass | 4°C | | 8 | X | X | X | X | | | | | | |

| RELINQUISHER: Krista Collins | DATE 10/12/98 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
|---|---|---|---|---|---|---|---|
| PRINTED: KRISTA Collins | TIME [illegible] | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: Fed Ex
SHIPMENT NO. 801881451381
SEND RESULTS TO: Ted

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

ENSAFE

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MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

PAGE 1 OF 1
PROJECT/JOB NO: 2901-0[illegible]-09-014-0C
COC NO: 2
PO NO:
REL NO: 52
LAB NAME: Savannah

CLIENT: Naval Base Charleston
LOCATION: Zone A CMS
SAMPLERS: (SIGNATURE) Krista Collins / Fred Erdmann
PROJECT MANAGER: Ted ~~[illegible]~~ KC Blahnik
TELE/FAX NO. 972. 791. 3220

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | VOCS | | | | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NBCA0395B04701 (12-18") | 10/12/98 | 1310 | Soil | EnCore | 4°C | | 1 | X | | | | | | | | | | |
| NBCA0395B04801 (12-18") | 10/12/98 | 1330 | Soil | EnCore | 4°C | | 1 | X | | | | | | | | | | |
| NBCA0395B04901 (12-18") | 10/12/98 | 1350 | Soil | EnCore | 4°C | | 1 | X | | | | | | | | | | |
| NBCA0395B05001 (12-18") | 10/12/98 | 1410 | Soil | EnCore | 4°C | | 2 | X | | | | | | | | | | |
| NBCA0395B05101 (12-18") | 10/12/98 | 1420 | Soil | EnCore | 4°C | | 2 | X | | | | | | | | | | |

| RELINQUISHER: Krista Collins | DATE 10/12/98 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
|---|---|---|---|---|---|---|---|
| PRINTED: Krista Collins | TIME 1700 | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: Fed EX
SHIPMENT NO. 801881451267
SEND RESULTS TO:

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

# ENSAFE

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

## CHAIN OF CUSTODY RECORD



PROJECT/JOB NO: 2901[illegible]1-09-014
COC NO:
PO NO: 2
REL NO: 52
LAB NAME: Savannah

CLIENT: Naval Base Charleston
PROJECT MANAGER: Tom
LOCATION: Zone A CMS
TELE/FAX NO.: 972. 741. 3220
SAMPLERS: (SIGNATURE) Kris Collins

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | VOCS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| NBCA1039SB06001 | 10/13/98 | 810 | Soil | Encore | 4°C | None | 2 | X | |
| NBCA1039CB06001 | | 810 | | | | | 2 | X | |
| NBCA1039SB06101 | | 840 | | | | | 2 | X | |
| ~~NBCA1039SB05901~~ | | ~~900~~ | | | | | 2 | X | |
| NBCA1039SB05701 | | 910 | | | | | 2 | X | |
| NBCA1039SB05601 | | 930 | | | | | 2 | X | |
| NBCA1039SB05501 | | 940 | | | | | 2 | X | |
| NBCA1039SB05401 | | 950 | | | | | 2 | X | |
| NBCA1039SB05201 | | 1000 | | | | | 2 | X | |
| NBCA1039SB05301 | | 1020 ~~1130~~ | water | Glass-~~500~~ 40 ml | | HCL ~~H2SO4~~ | 3 | X | |
| NBCA1039EB05301 | | 1130 | water | Glass 40mL | | ~~H2SO4~~ HCL | 3 | X | |

| RELINQUISHER: Kris Collins | DATE 10.13.98 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
|---|---|---|---|---|---|---|---|
| PRINTED: KRISTA Collins | TIME 1700 | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: Fed EX
SHIPMENT NO. 805907792264
SEND RESULTS TO: Tod Blohnik

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

**ENSAFE**
800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

PAGE 1 OF 2
PROJECT/JOB NO: 2901-[illegible]09-014
COC NO:
PO NO: 1840
REL NO: 10
LAB NAME: LAUCKS

CLIENT: Naval Base Charleston
LOCATION: Zone A CMS
PROJECT MANAGER: Ted Blahnik
TELE/FAX NO. 972.791.3220
SAMPLERS: (SIGNATURE) Krista Collins/Fred Cadwell/Ed Means/Ted Blahnik

ANALYSIS REQUIRED

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | Ar/Bex | TCLP Metals | SPLP Metals | SVOCs | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NBCA/042SB02601 | 10/13/98 | 1320 | Soil | Glass 1 8 oz | 4°C | None | 4 | X | X | X | X | |
| NBCA/042SB02701 | | 1330 | | | | | 2 | X | | | X | |
| NBCA/042SB02801 | | 1340 | | | | | 2 | X | | | X | |
| NBCA/042SB02901 | | 1350 | | | | | 2 | X | | | X | |
| NBCA/042SB03001 | | 1400 | | | | | 2 | X | | | X | |
| NBCA/042SB03101 | | 1405 | | | | | 2 | X | | | X | |
| NBCA/042SB03201 | | 1410 | | | | | 2 | X | | | X | |
| NBCA/042CB03201 | | 1410 | | | | | 2 | X | | | X | |
| NBCA/042SB03301 | | 1420 | | | | | 4 | X | X | X | X | |
| NBCA/042SB03401 | | 1430 | | | | | 2 | X | | | X | |
| NBCA/042SB03501 | | 1435 | | | | | 2 | X | | | X | |
| NBCA/042SB03601 | | 1440 | | | | | 2 | X | | | X | |
| NBCA/042SB03701 | | 145 ~~1445~~ | | | | | 4 | X | X | X | X | |
| NBCA/042SB03801 | | 1455 | | | | | 2 | X | | | X | |
| NBCA/042SB03901 | | 1500 | | | | | 2 | X | | | X | |
| NBCA/042SB04001 | | 1510 | | | | 4 | ~~2~~ | X | X | X | X | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RELINQUISHER: Krista Collins | DATE 10/13/98 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
| PRINTED: Krista Collins | TIME 1700 | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: Fed Ex
SHIPMENT NO. 805907792264
SEND RESULTS TO: Ted Blahnik

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

ENSAFE
800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

PAGE 1 OF 1
PROJECT/JOB NO: 2901-[illegible]-009-014
COC NO:
PO NO: 1840
REL NO: 10
LAB NAME: Lawks

CLIENT: Naval Base Charleston
PROJECT MANAGER: Ted Blahnik
LOCATION: Zone A CMS
TELE/FAX NO. 972. 791. 3220
SAMPLERS: (SIGNATURE) Krista Collins

ANALYSIS REQUIRED

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | Metals | TCLP metals | SPLP metals | SVOCs | ~~[illegible]~~ | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NBCA/039SB06001 | 10/13/98 | 810 | Soil | Glass / 8oz | 4°C | none | 2 | X | | | X | | | | | | | |
| NBCA/039SB06001 | | 810 | | Glass/ 8oz 4oz | | | 3 | X | | | X | | | | | | | |
| NBCA/039SB06101 | | 840 | | Glass/ 4oz | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB05901 | | 900 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB05701 | | 910 | | | | | 8 | X | X | X | X | | | | | | | |
| NBCA/039SB05601 | | 930 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB05501 | | 940 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB05401 | | 950 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB5201 | | 1000 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039SB5301 | | 1020 | | | | | 4 | X | | | X | | | | | | | |
| NBCA/039EB05301 E | | 1130 | water | 500ml plastic 500ml Glass | | $HNO_3$ | 2 | X | | | X | | | | | | | no TCLP/SPLP = no VOCs |
| ~~NBCA/039TW~~ KC | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

RELINQUISHER: Krista Collins DATE 10.13.98
PRINTED: KRISTA Collins TIME 1700
COMPANY: EnSafe

RECEIVER: DATE
PRINTED: TIME
COMPANY:

RELINQUISHER: DATE
PRINTED: TIME
COMPANY:

RECEIVER: DATE
PRINTED: TIME
COMPANY:

METHOD OF SHIPMENT: Fed EX
SHIPMENT NO. 805907792264
SEND RESULTS TO: Ted Blahnik

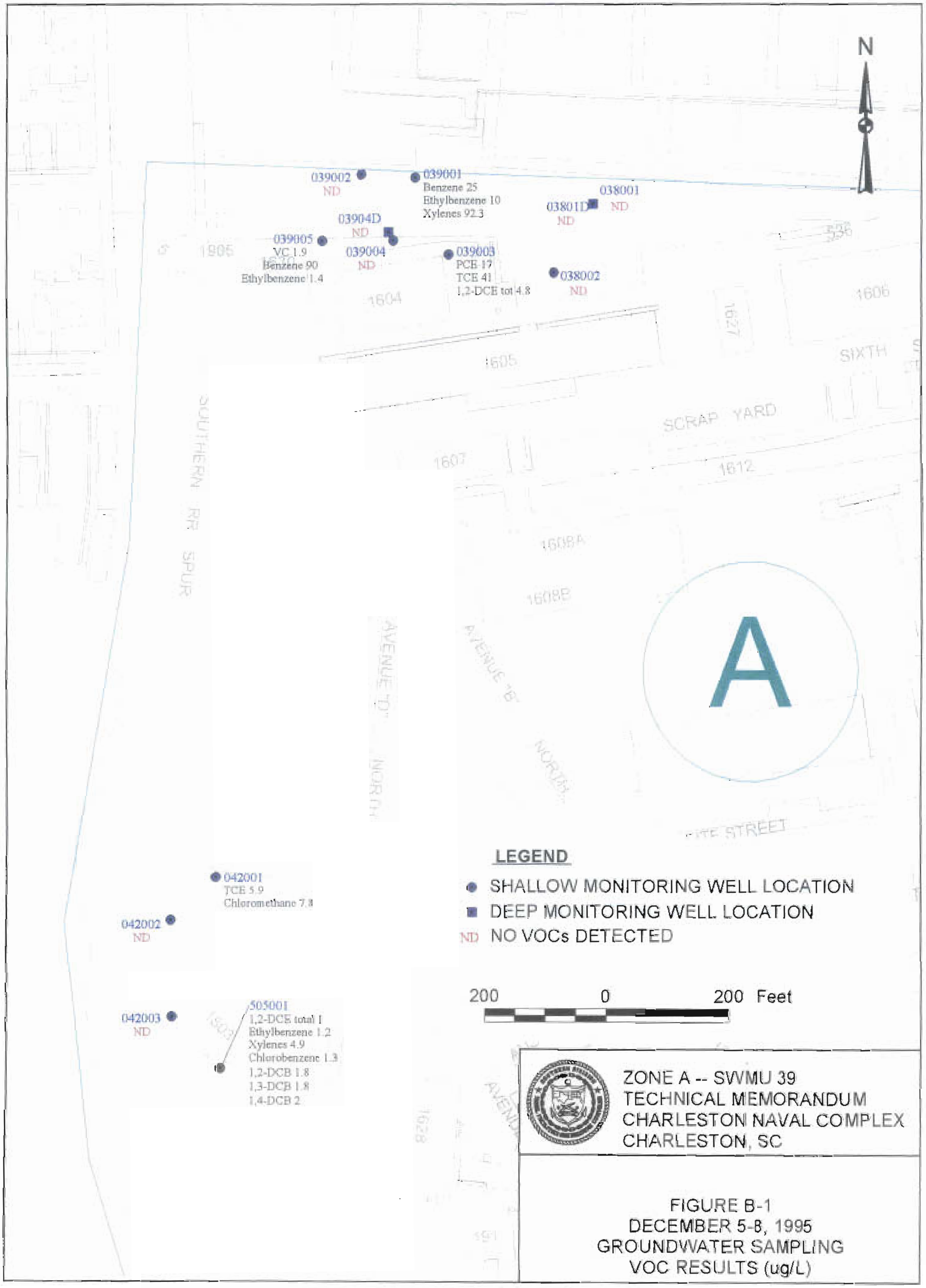
COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2

# ATTACHMENT B

# GROUNDWATER SAMPLING DATA AND HISTORICAL FIGURES

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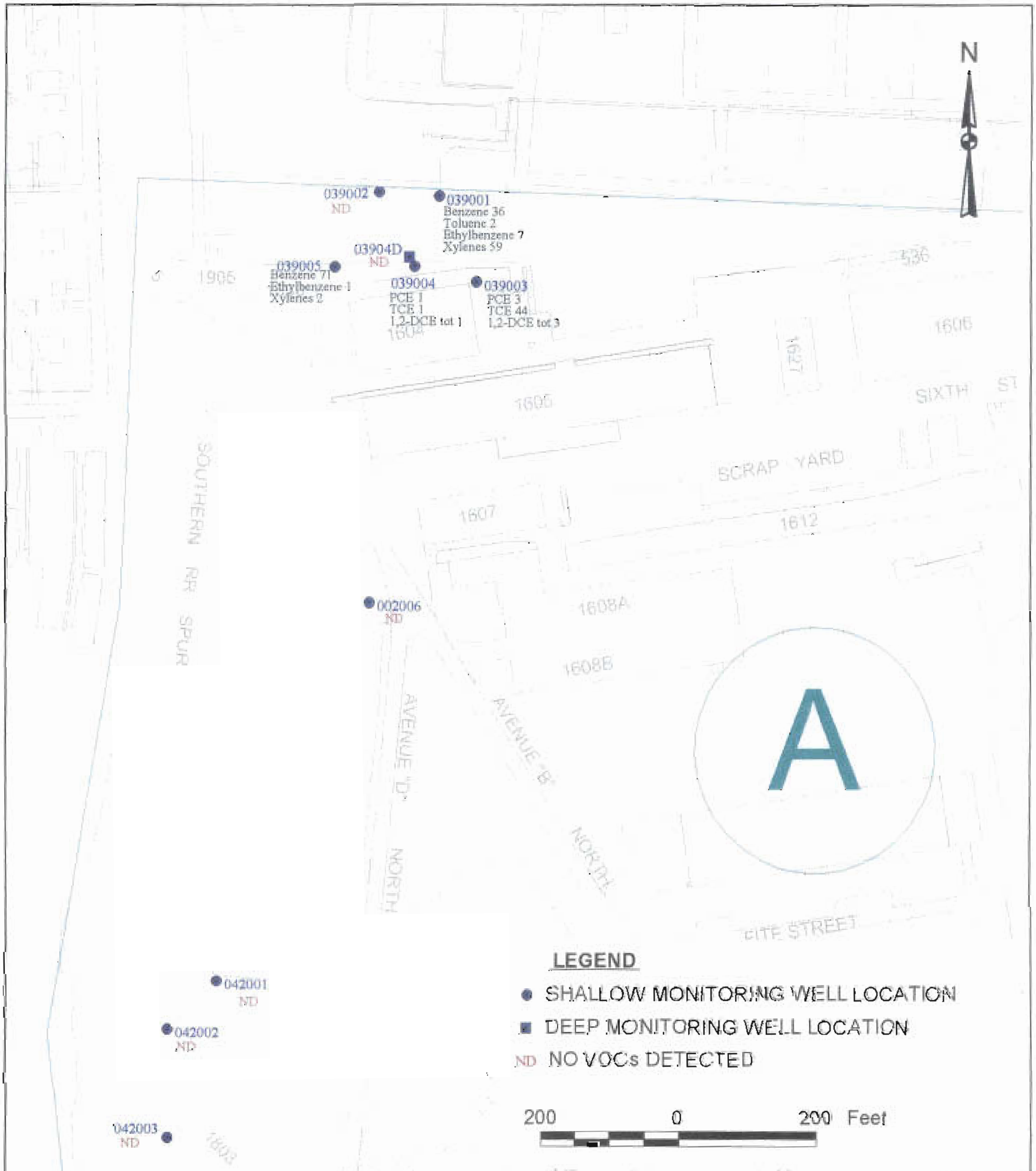
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-1
DECEMBER 5-8, 1995
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

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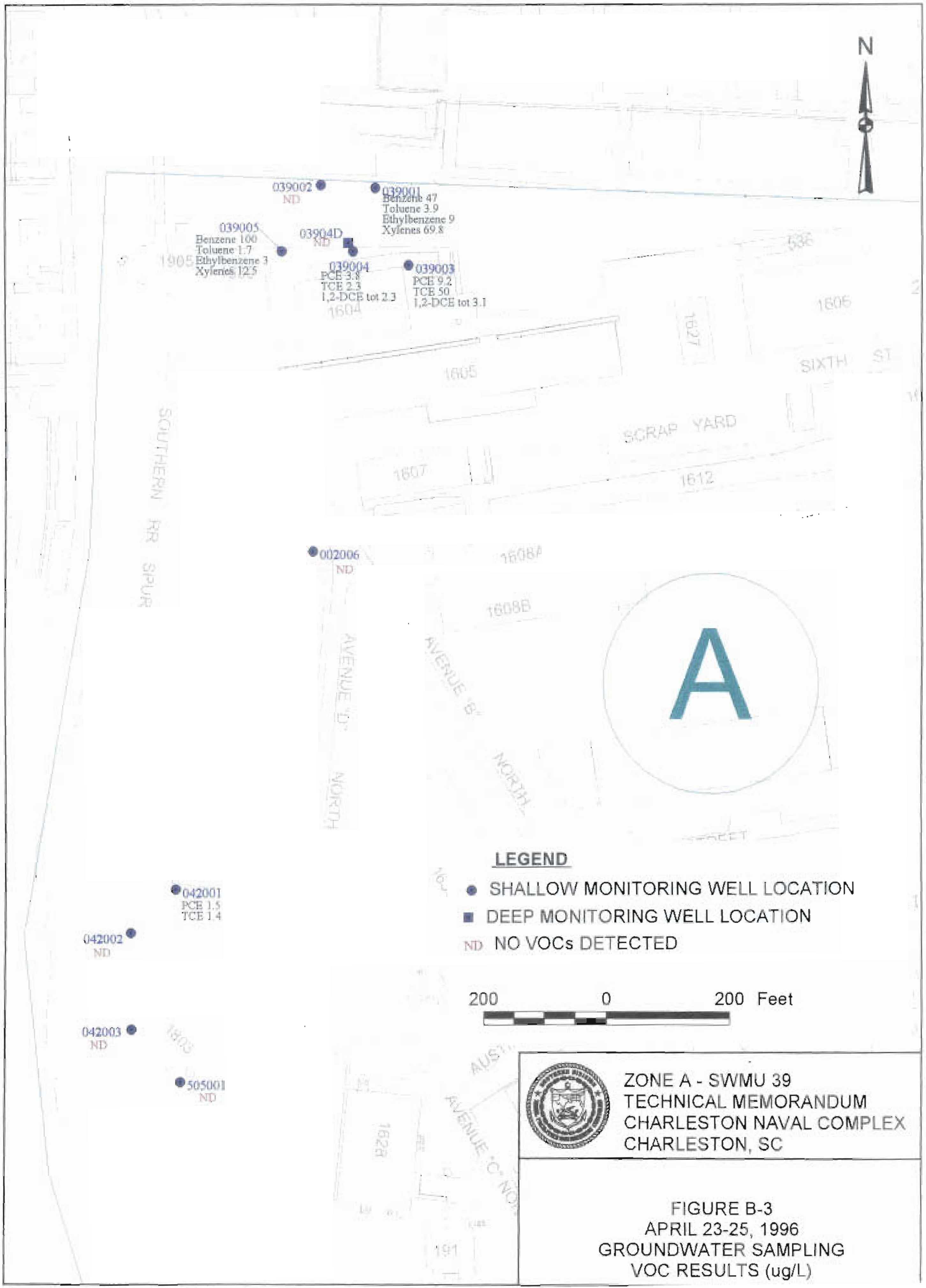
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-2
APRIL 3, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

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CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-3
APRIL 23-25, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

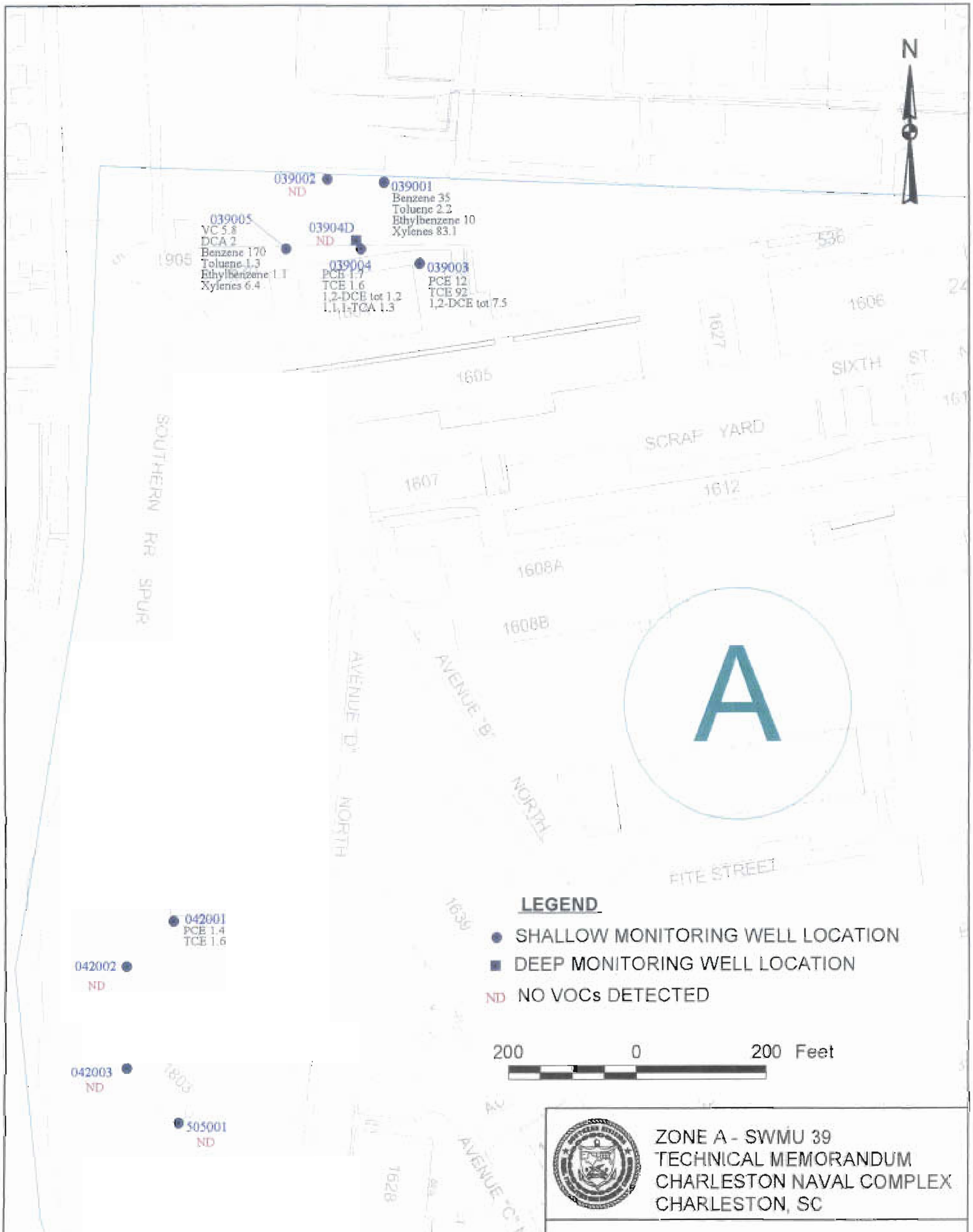
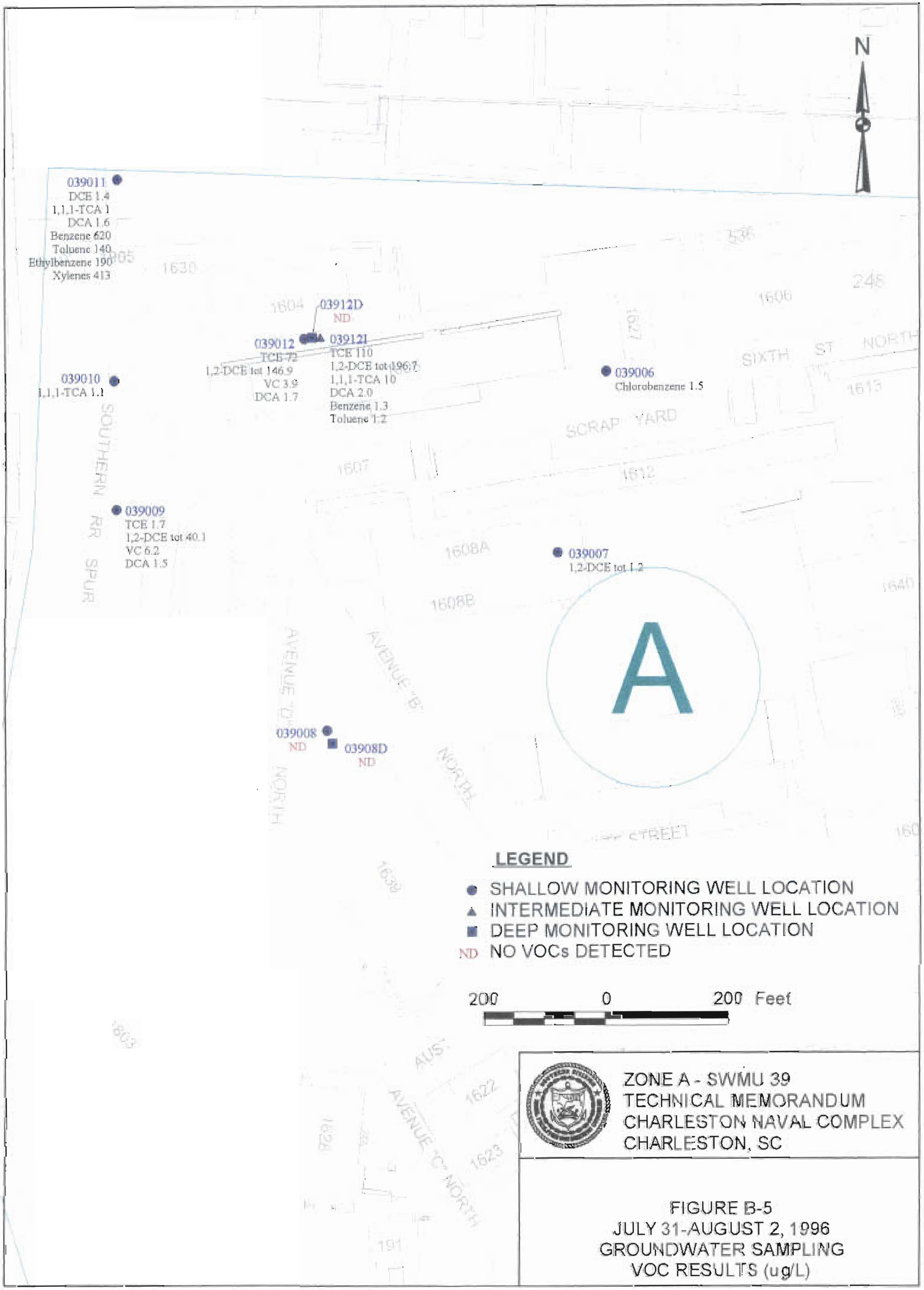



FIGURE B-4
JUNE 20-26, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

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CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-5
JULY 31-AUGUST 2, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

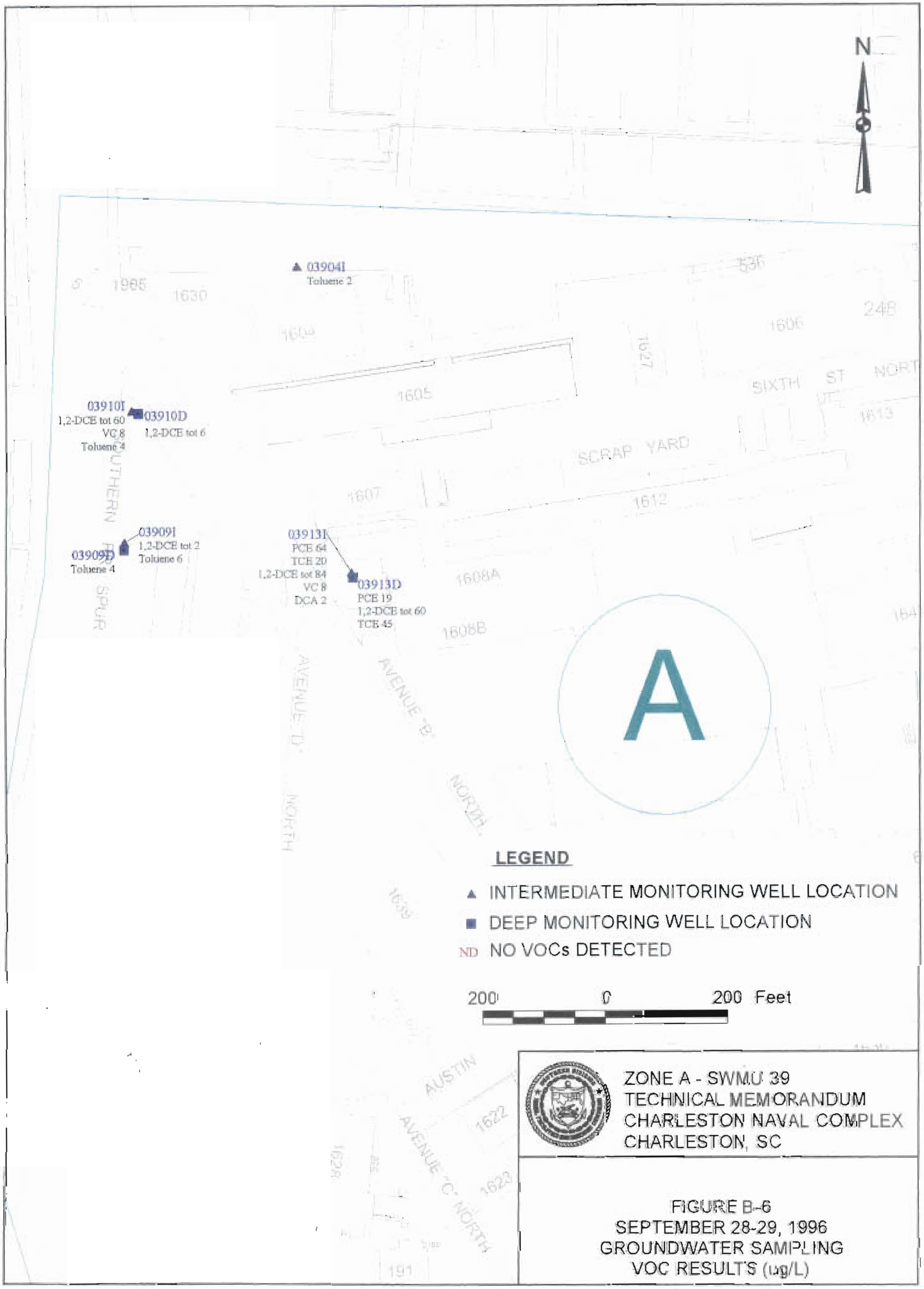


FIGURE B-6
SEPTEMBER 28-29, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

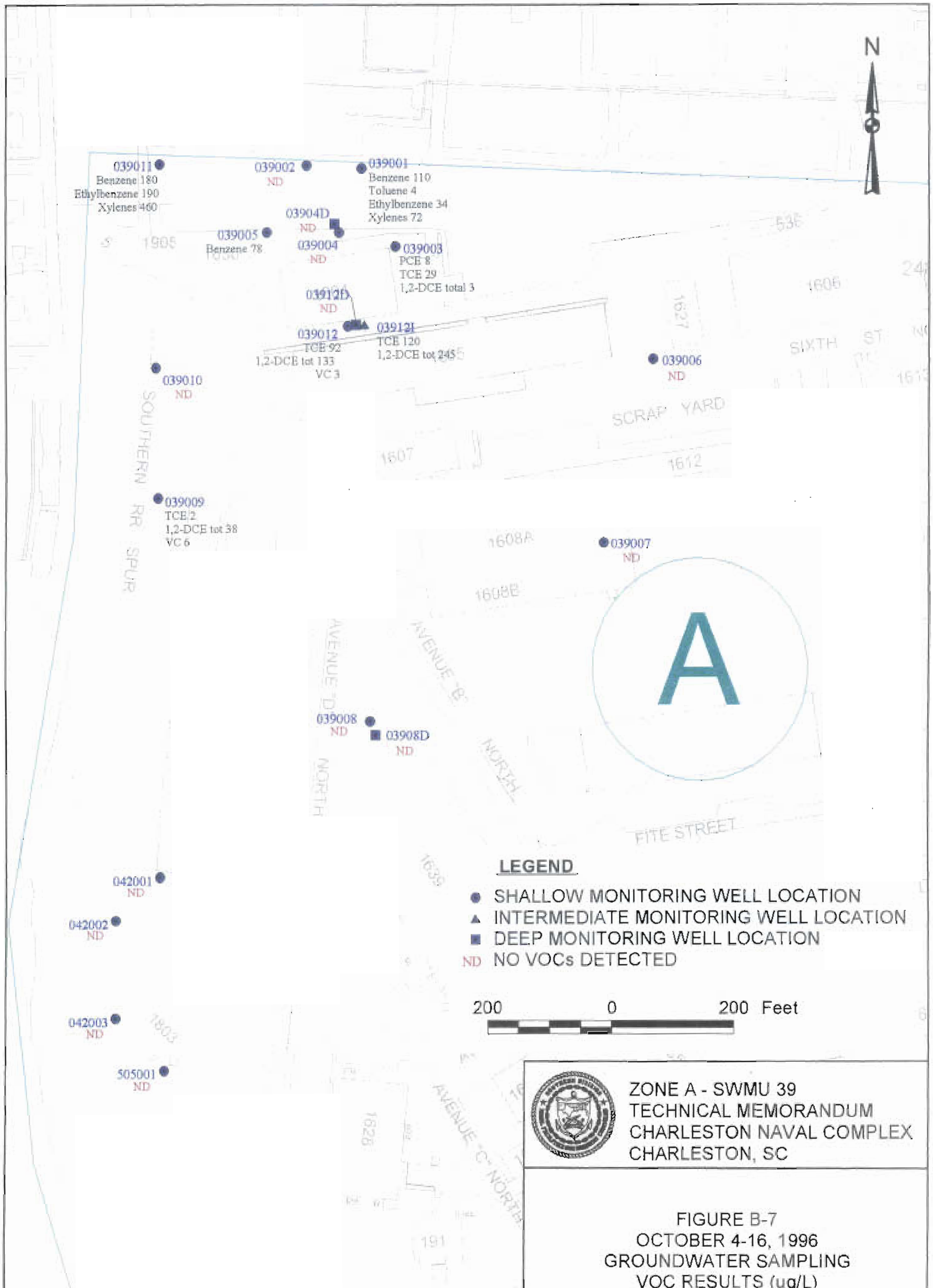


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FIGURE B-7
OCTOBER 4-16, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

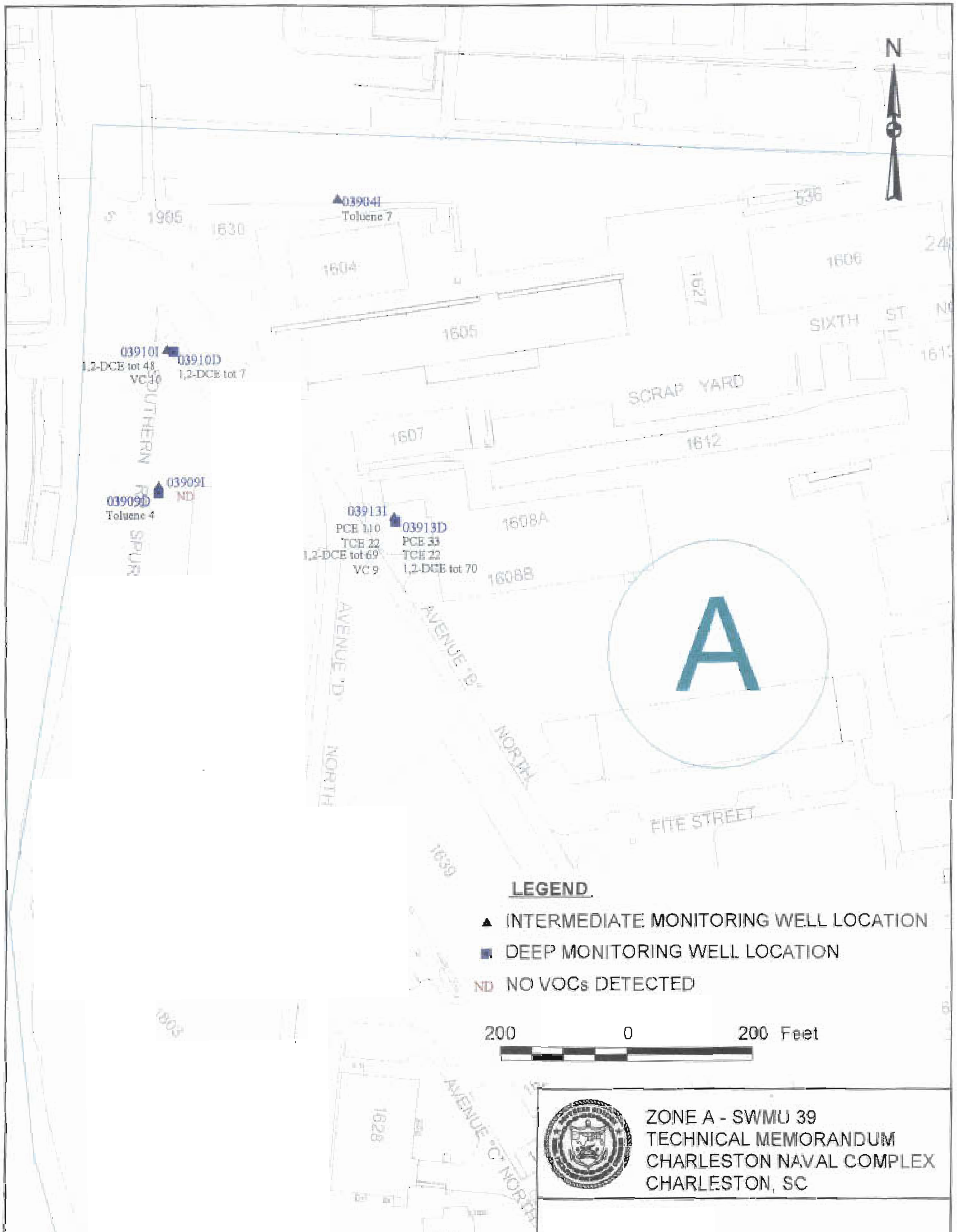
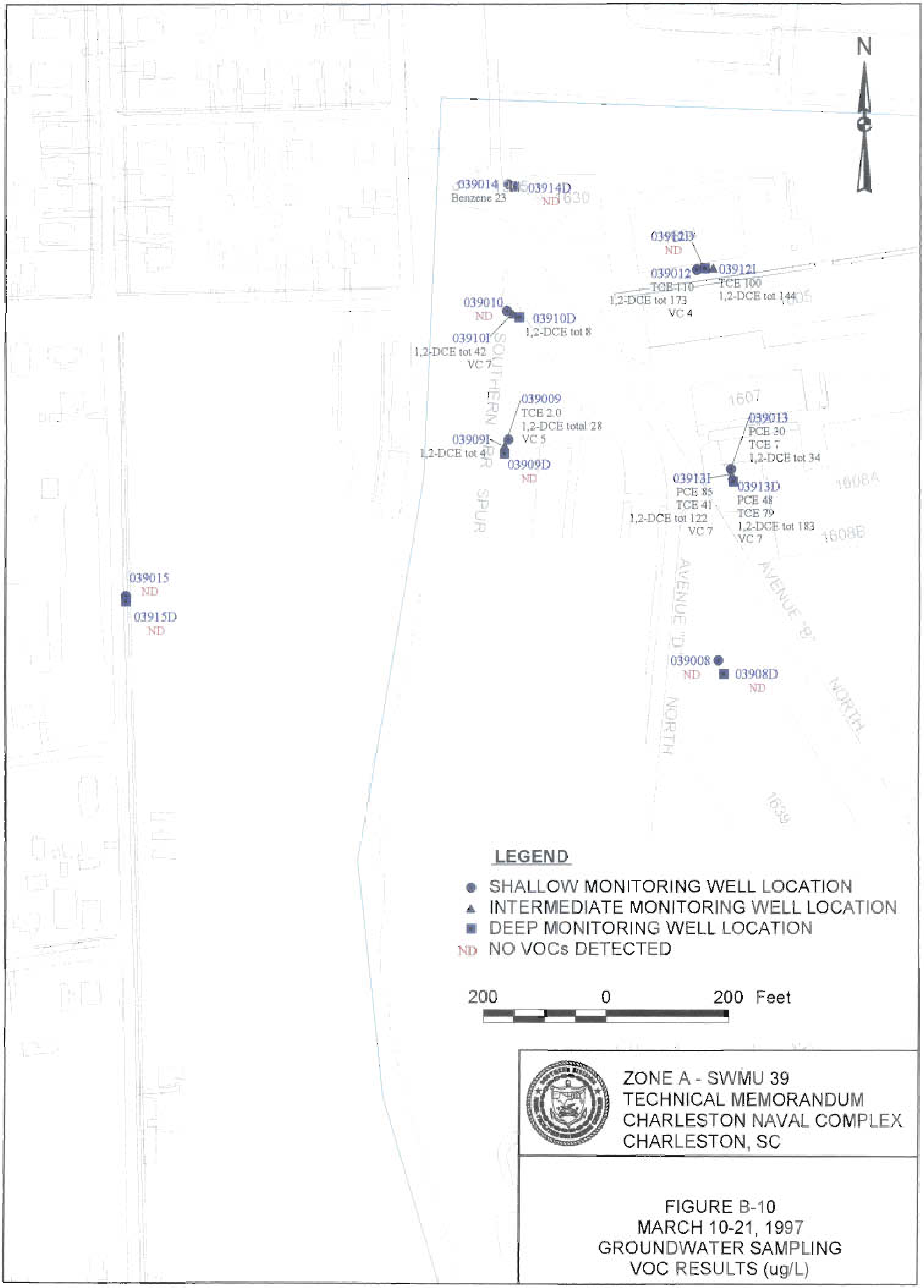



FIGURE B-8
NOVEMBER4-6, 1996
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

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CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-10
MARCH 10-21, 1997
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

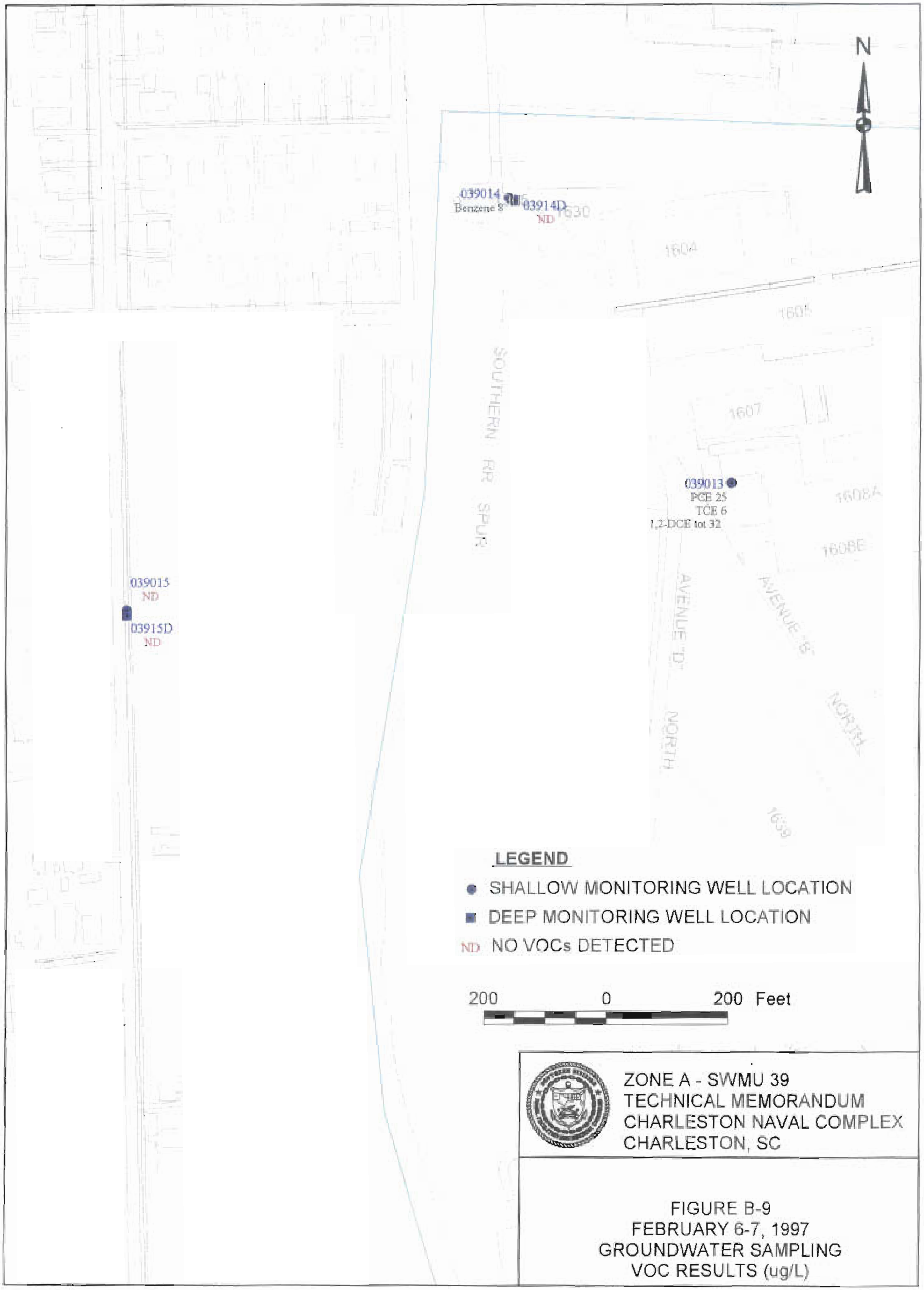


FIGURE B-9
FEBRUARY 6-7, 1997
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

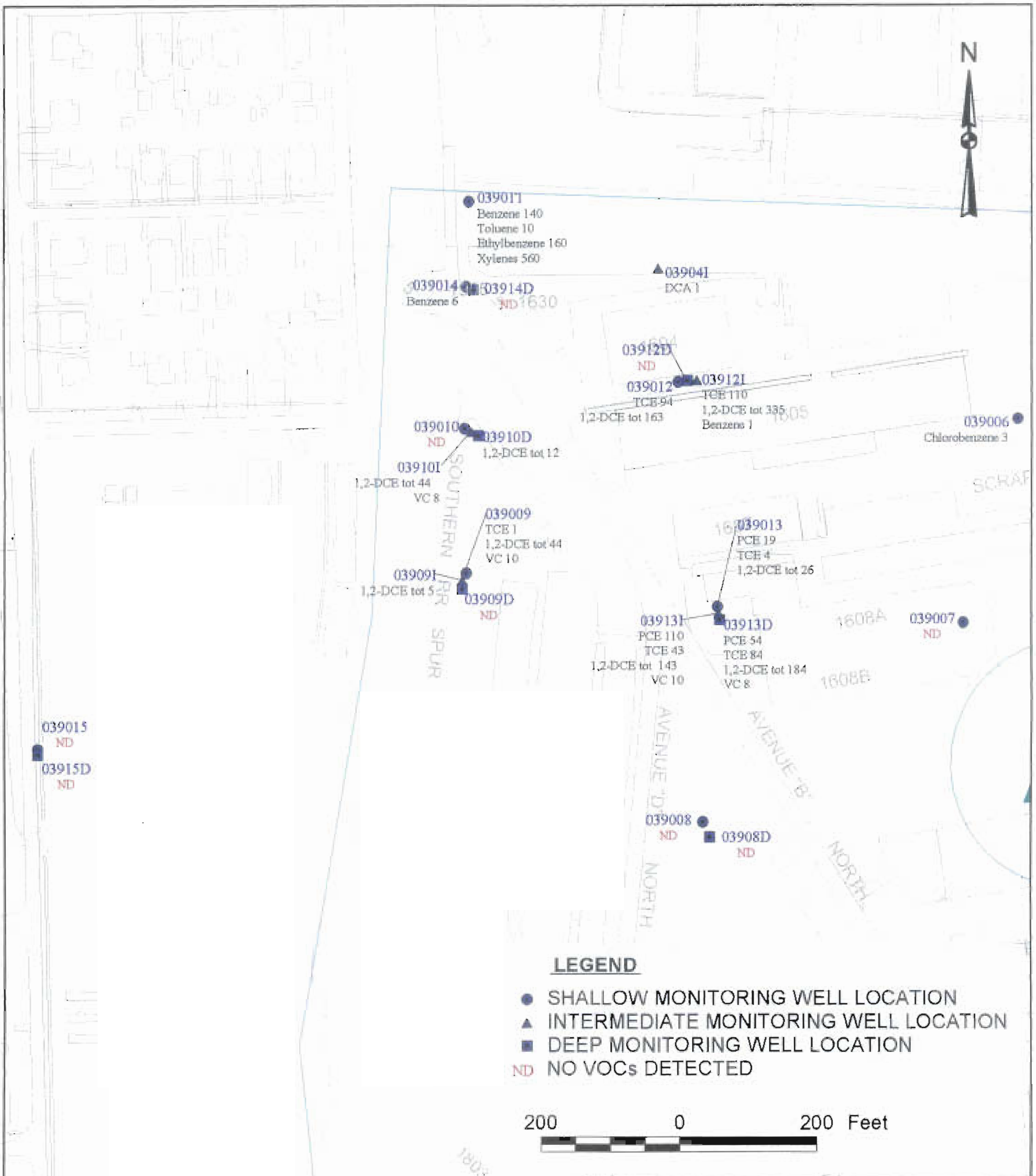


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FIGURE B-11
JULY 7-31, 1997
GROUNDWATER SAMPLING
VOC RESULTS (ug/L)

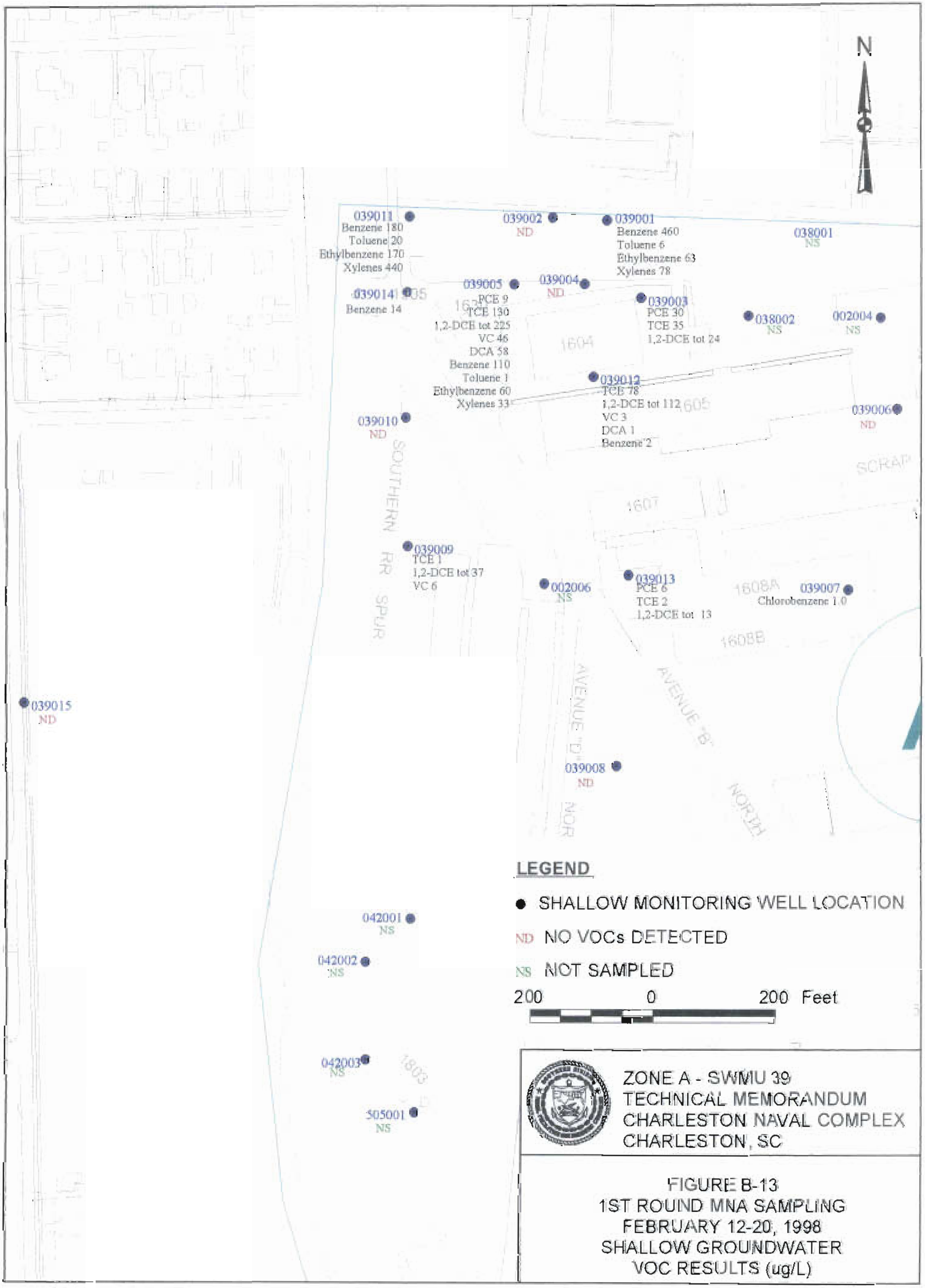


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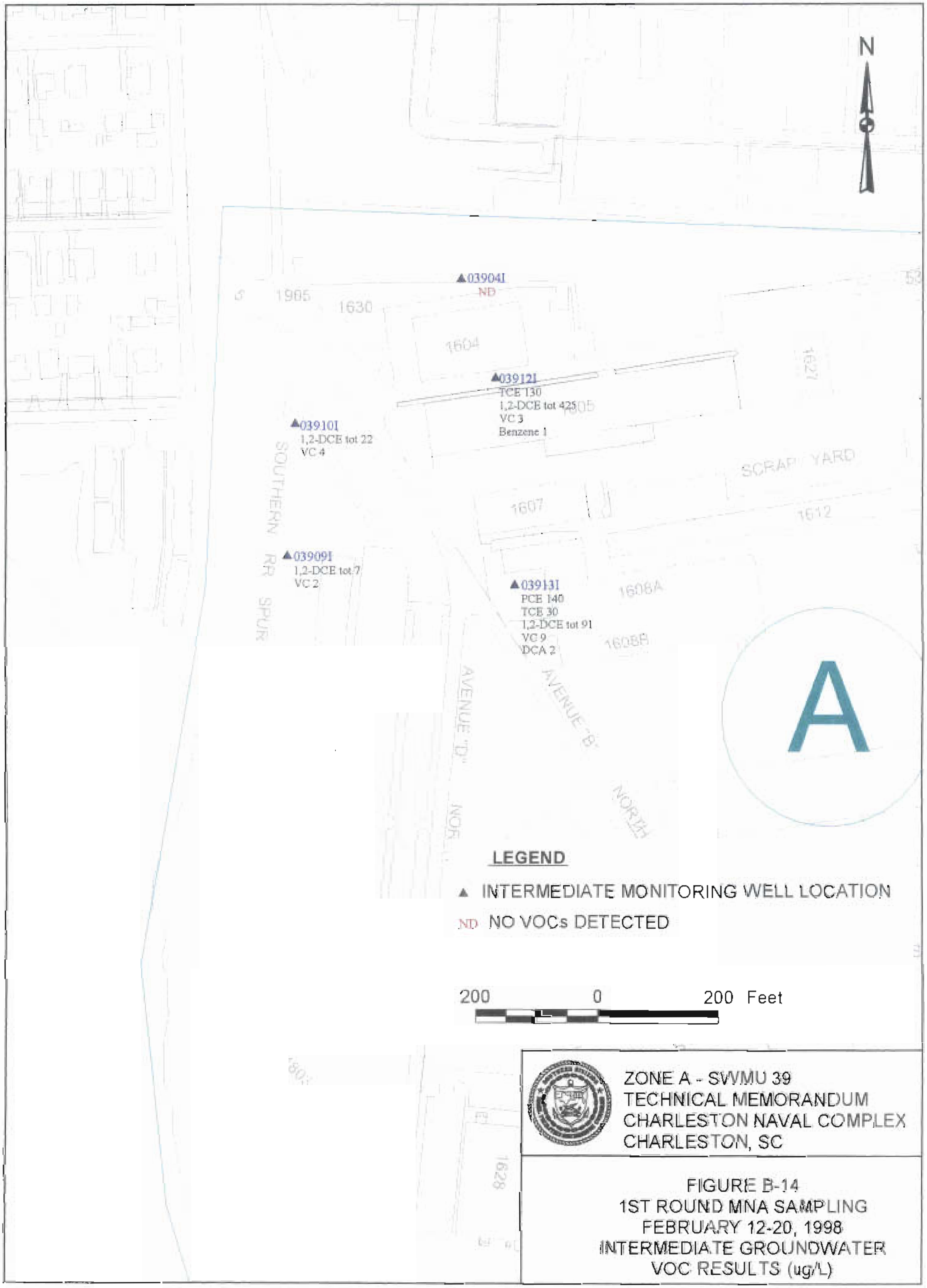
FIGURE B-13
1ST ROUND MNA SAMPLING
FEBRUARY 12-20, 1998
SHALLOW GROUNDWATER
VOC RESULTS (ug/L)

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CHARLESTON, SC

FIGURE B-14
1ST ROUND MNA SAMPLING
FEBRUARY 12-20, 1998
INTERMEDIATE GROUNDWATER
VOC RESULTS (ug/L)

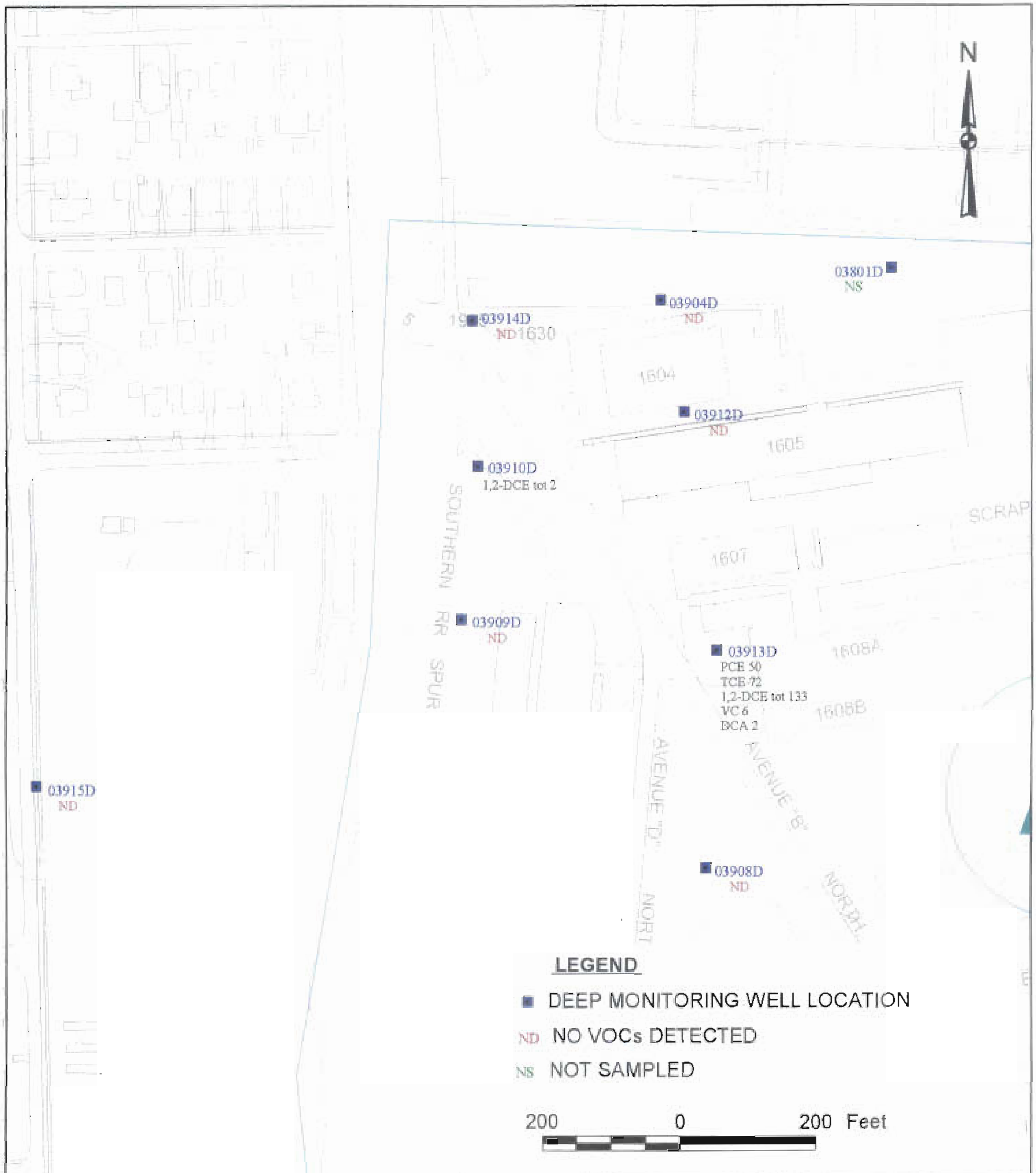


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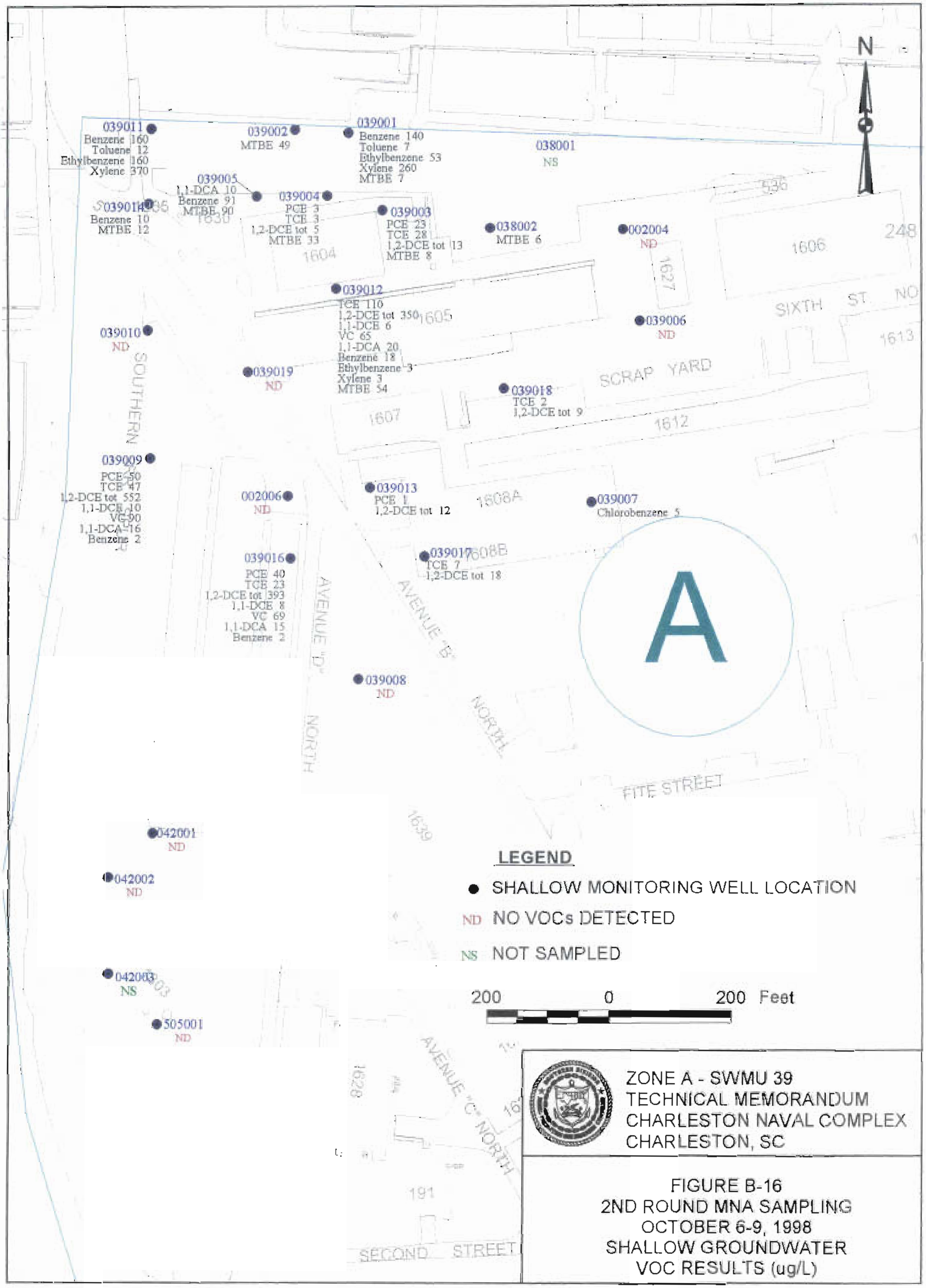
FIGURE B-15
1ST ROUND MNA SAMPLING
FEBRUARY 12-20, 1998
DEEP GROUNDWATER
VOC RESULTS (ug/L)

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CHARLESTON NAVAL COMPLEX
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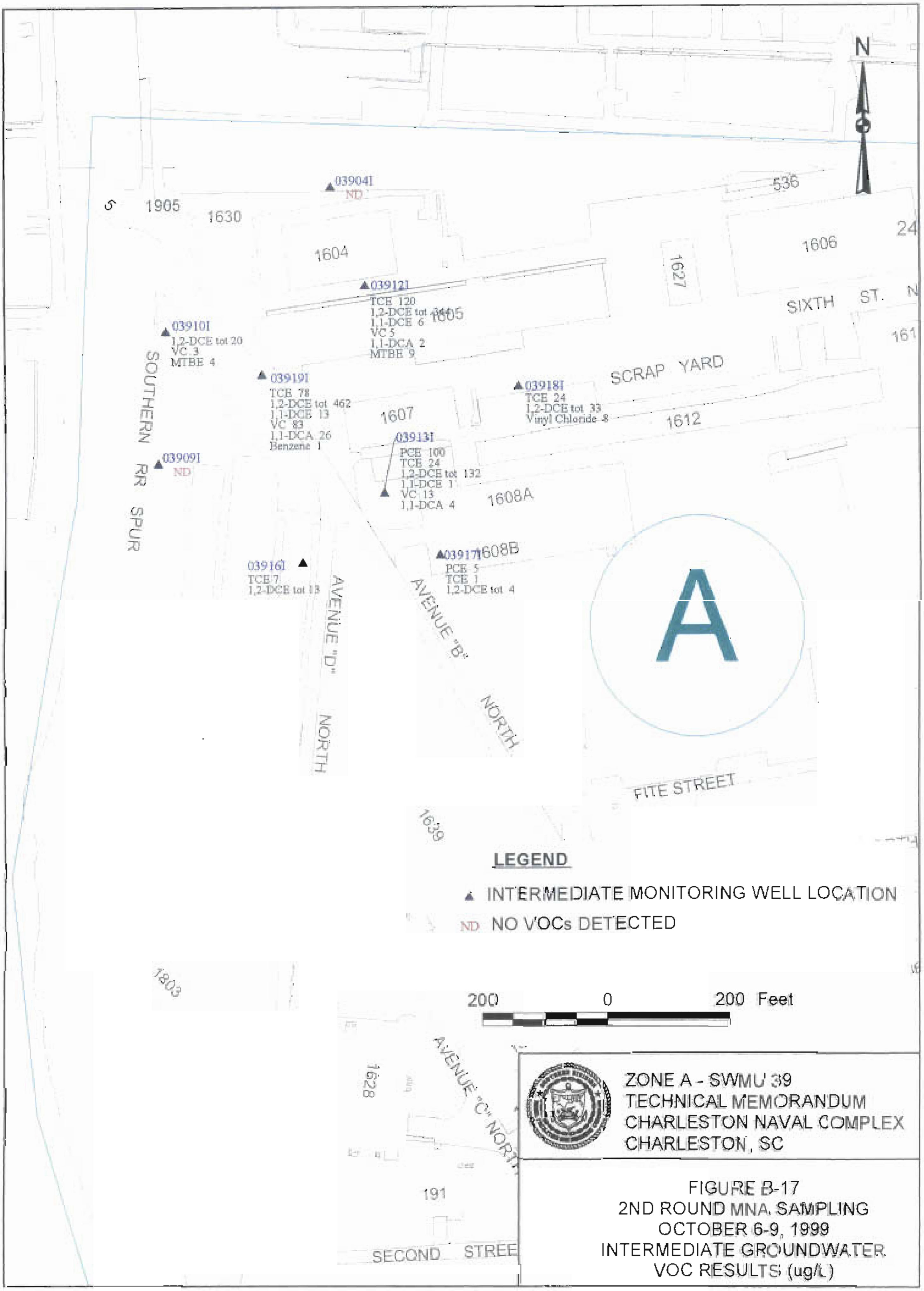
FIGURE B-16
2ND ROUND MNA SAMPLING
OCTOBER 6-9, 1998
SHALLOW GROUNDWATER
VOC RESULTS (ug/L)

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CHARLESTON, SC

FIGURE B-17
2ND ROUND MNA SAMPLING
OCTOBER 6-9, 1999
INTERMEDIATE GROUNDWATER
VOC RESULTS (ug/L)

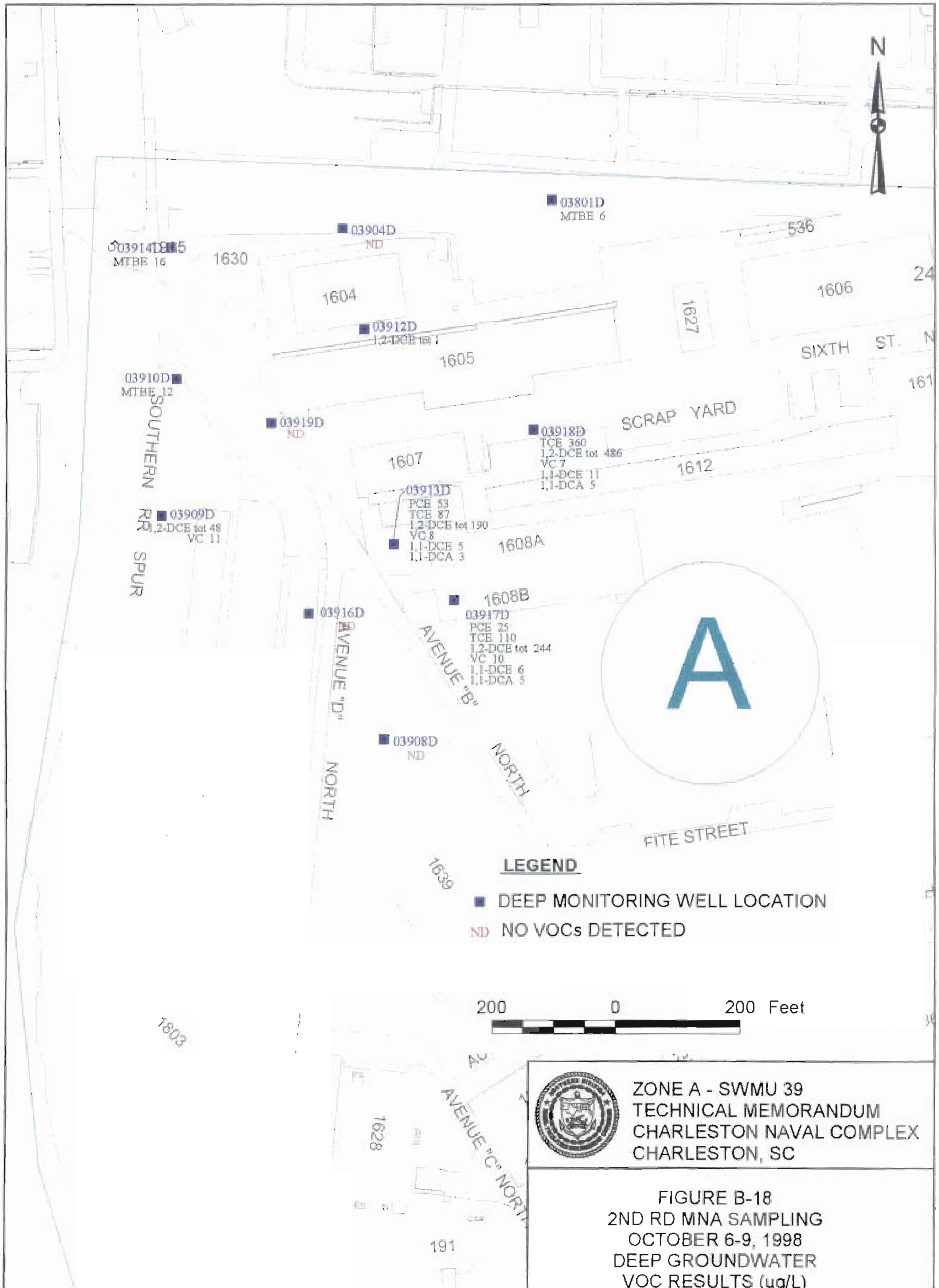


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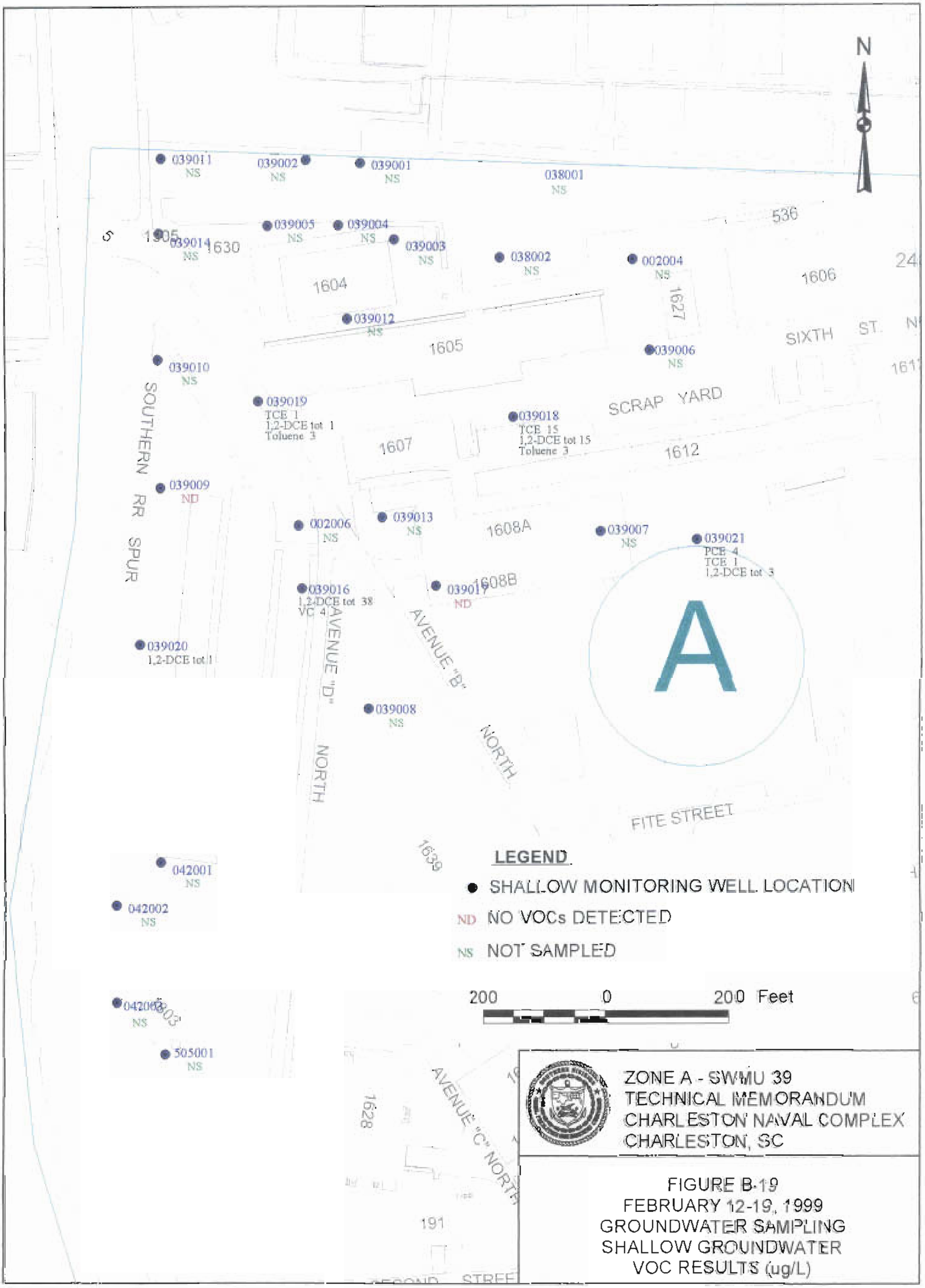
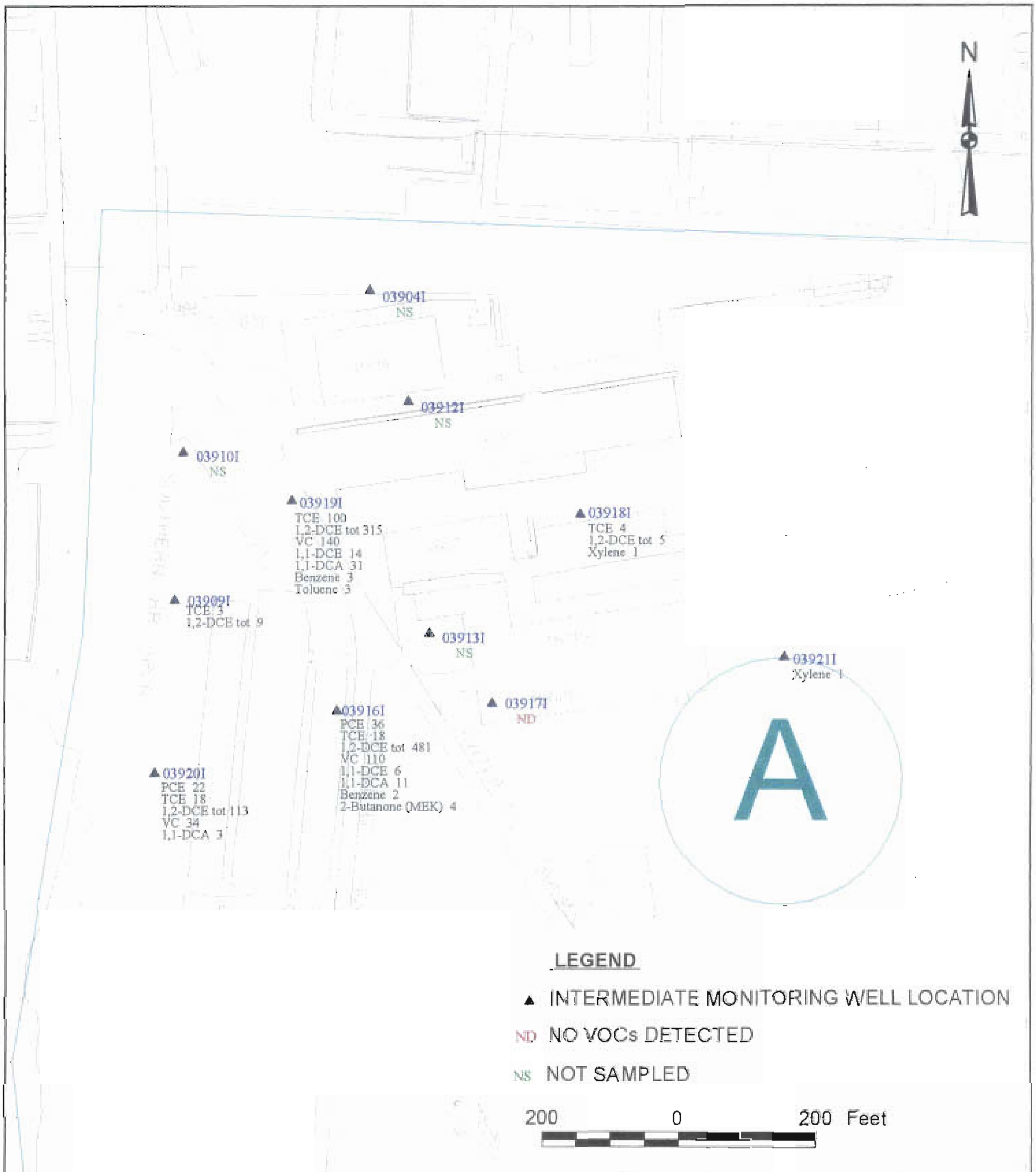
FIGURE B-18
2ND RD MNA SAMPLING
OCTOBER 6-9, 1998
DEEP GROUNDWATER
VOC RESULTS (ug/L)


N
039011
NS
039002
NS
039001
NS
038001
NS
039005
NS
039004
NS
039003
NS
039014
NS
1630
1604
038002
NS
002004
NS
536
1606
1627
039012
NS
1605
039006
NS
SIXTH ST.
039010
NS
SOUTHERN RR SPUR
039019
TCE 1
1,2-DCE tot 1
Toluene 3
039018
TCE 15
1,2-DCE tot 15
Toluene 3
SCRAP YARD
1607
1612
039009
ND
002006
NS
039013
NS
1608A
039007
NS
039021
PCE 4
TCE 1
1,2-DCE tot 3
039016
1,2-DCE tot 38
VC 4
039017
ND
1608B
AVENUE "D" NORTH
AVENUE "B" NORTH
A
039020
1,2-DCE tot 1
039008
NS
FITE STREET
1639
042001
NS
042002
NS
042003
NS
505001
NS
1628
AVENUE "C" NORTH
191
LEGEND
SHALLOW MONITORING WELL LOCATION
ND NO VOCs DETECTED
NS NOT SAMPLED
200 0 200 Feet
ZONE A - SWMU 39
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC
FIGURE B-19
FEBRUARY 12-19, 1999
GROUNDWATER SAMPLING
SHALLOW GROUNDWATER
VOC RESULTS (ug/L)

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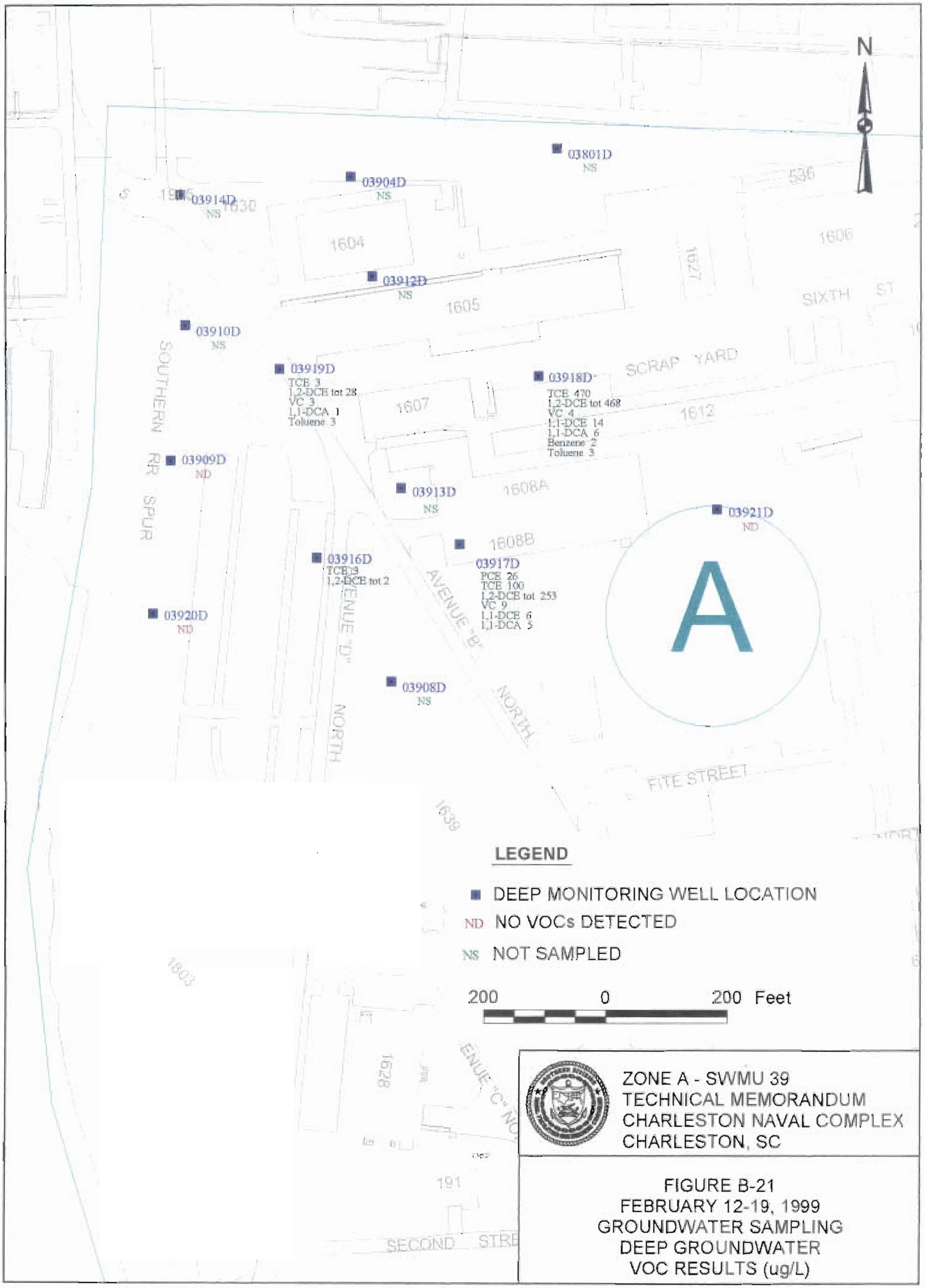
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-20
FEBRUARY 12-19, 1999
GROUNDWATER SAMPLING
INTERMEDIATE GROUNDWATER
VOC RESULTS (ug/L)

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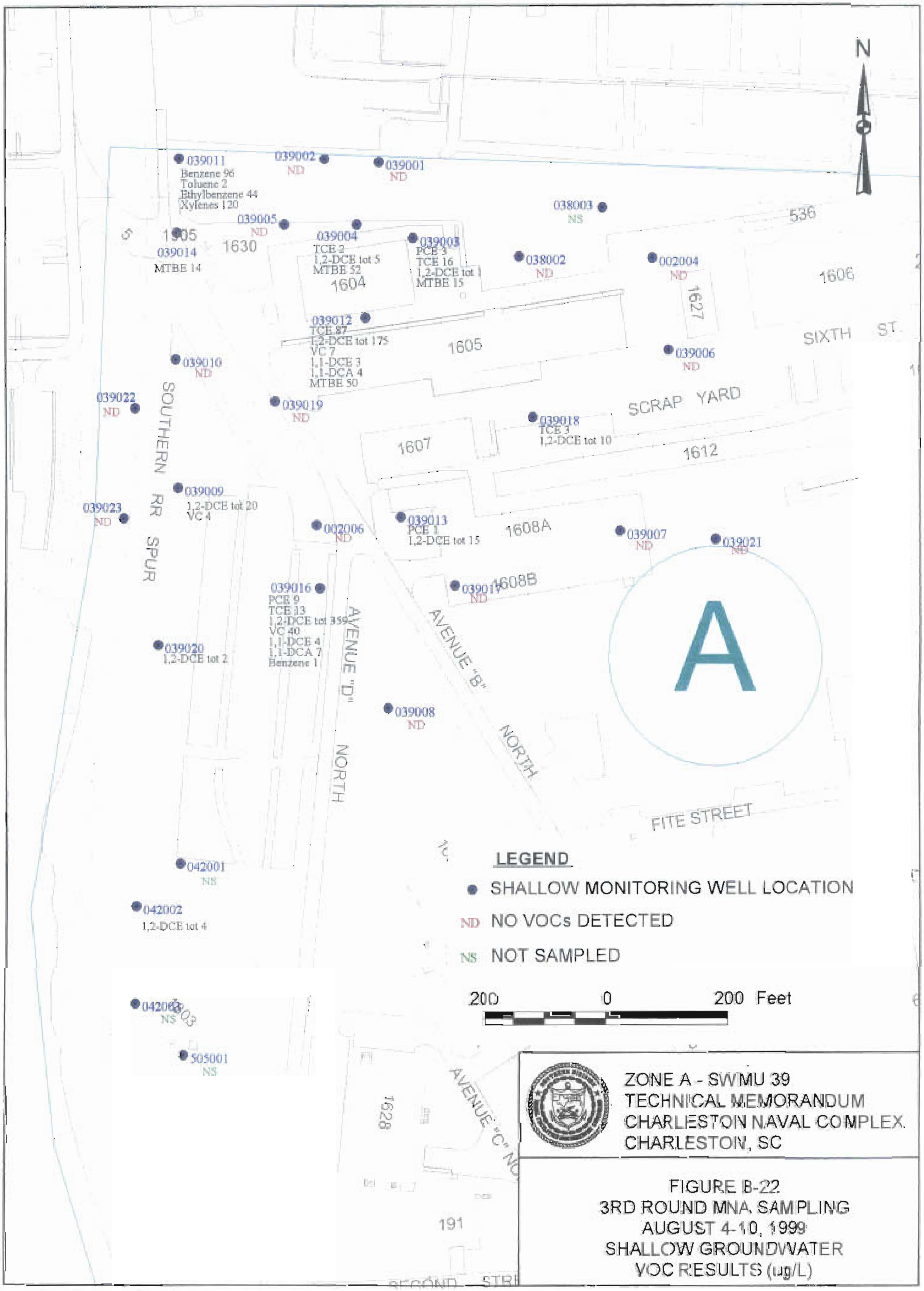
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-21
FEBRUARY 12-19, 1999
GROUNDWATER SAMPLING
DEEP GROUNDWATER
VOC RESULTS (ug/L)

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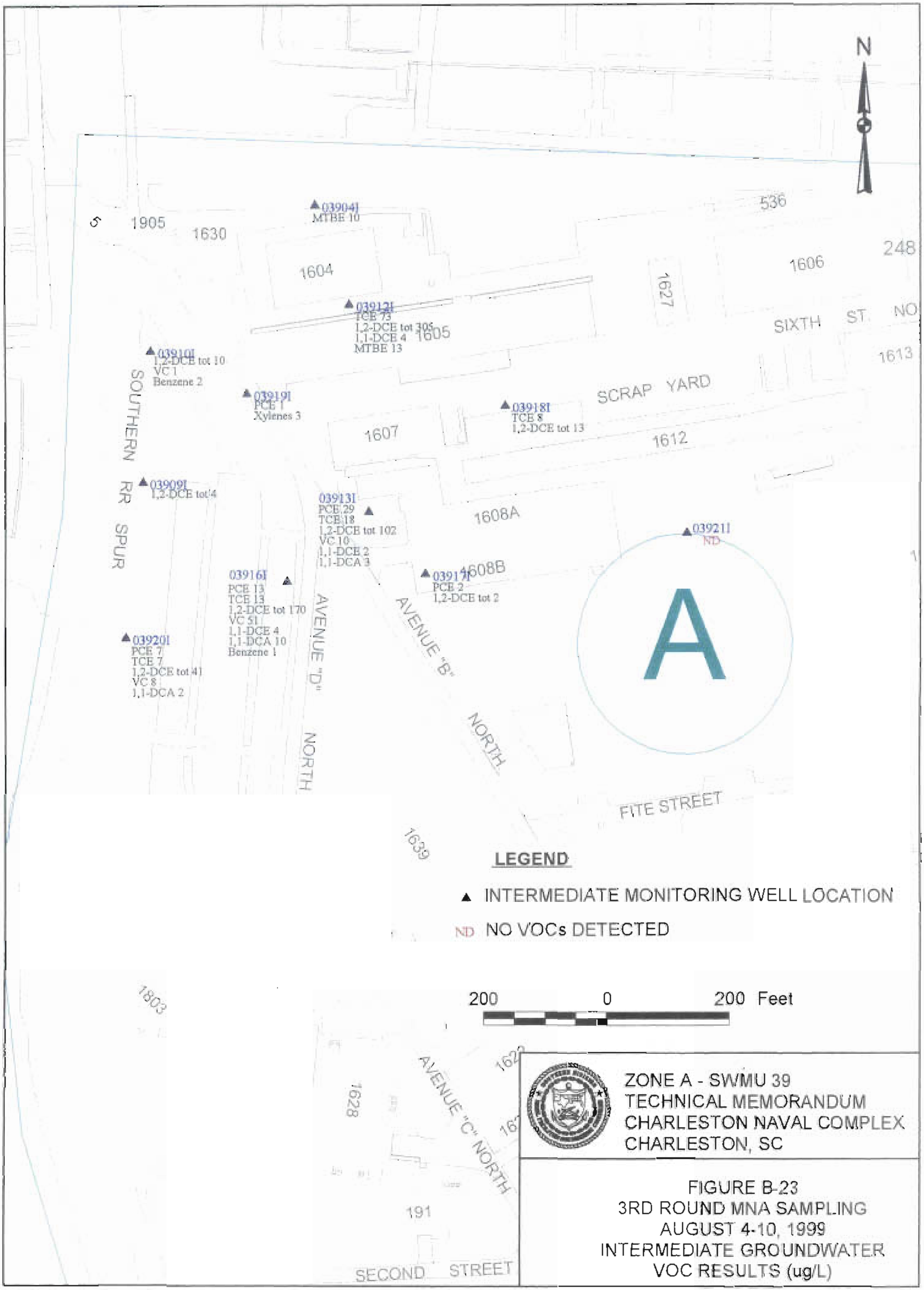
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-22
3RD ROUND MNA SAMPLING
AUGUST 4-10, 1999
SHALLOW GROUNDWATER
VOC RESULTS (ug/L)

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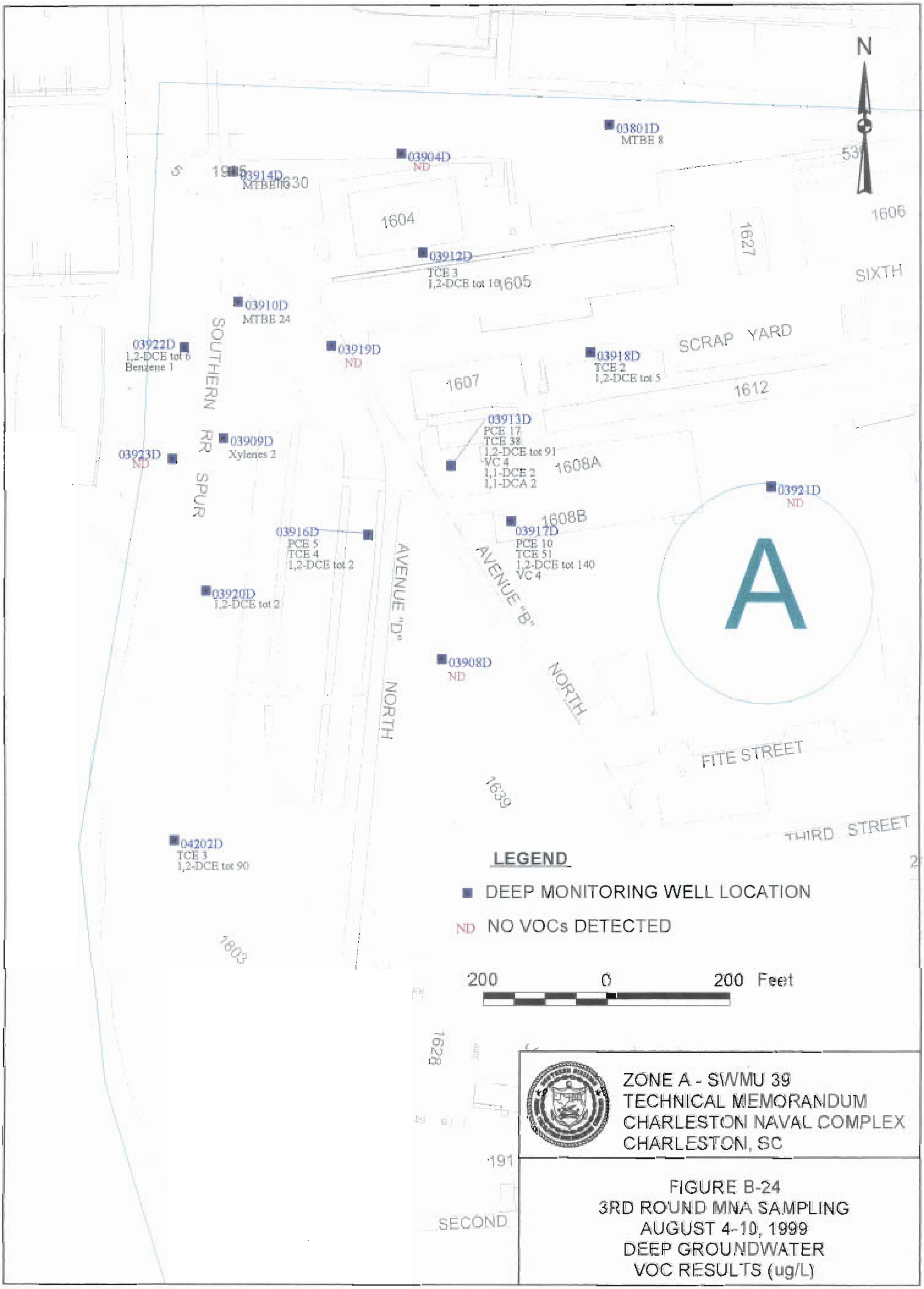
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE B-23
3RD ROUND MNA SAMPLING
AUGUST 4-10, 1999
INTERMEDIATE GROUNDWATER
VOC RESULTS (ug/L)

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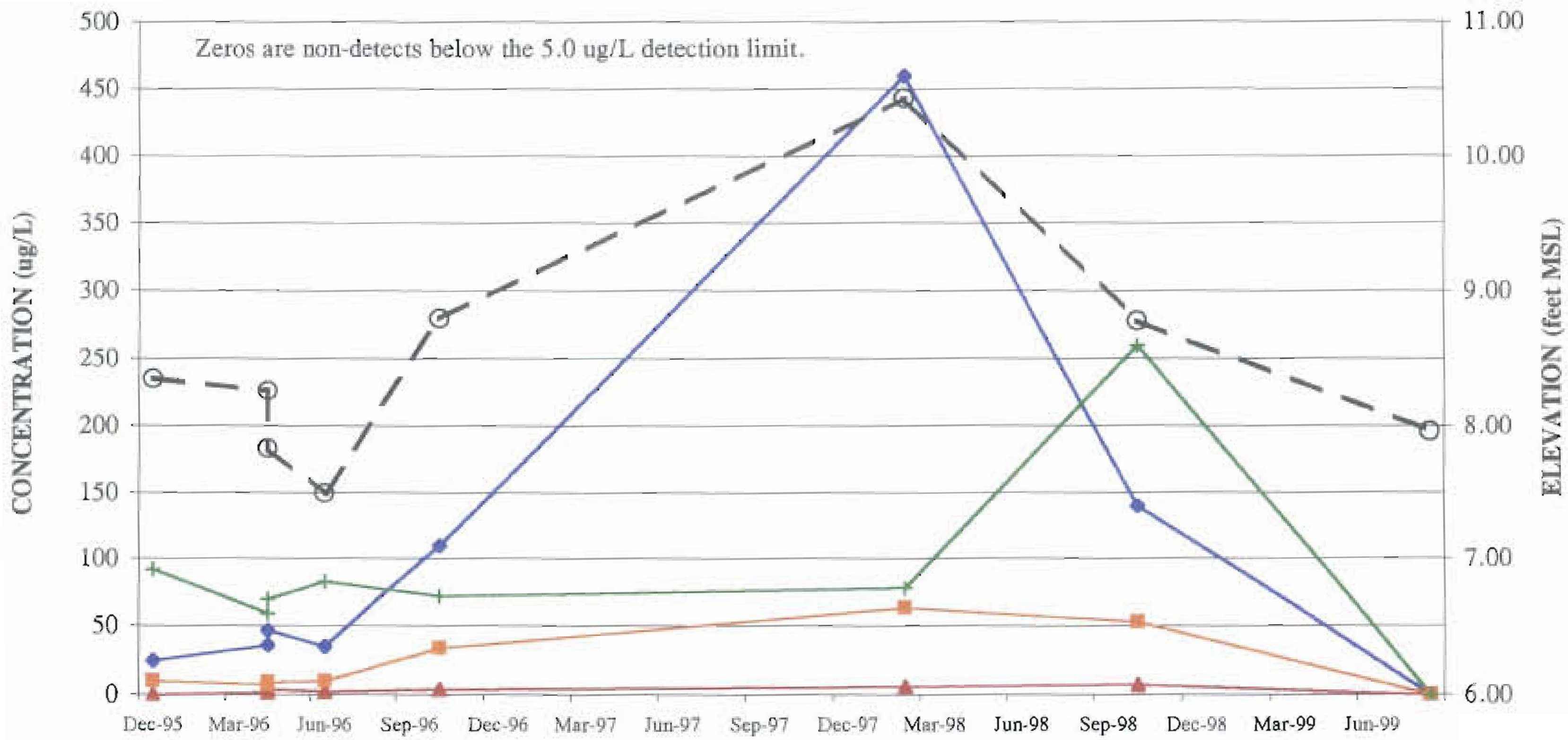
TECHNICAL MEMORANDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

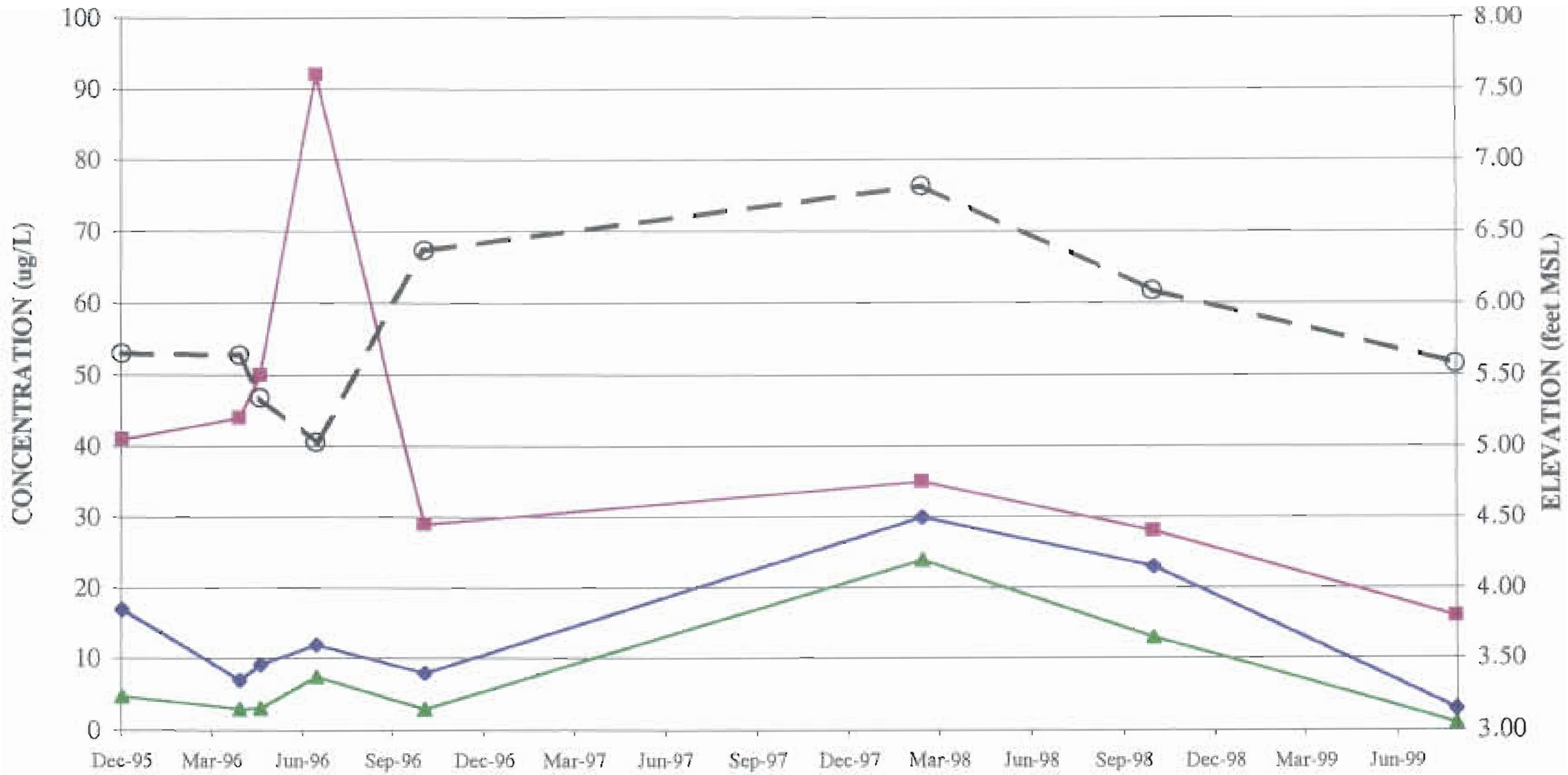
FIGURE B-24
3RD ROUND MNA SAMPLING
AUGUST 4-10, 1999
DEEP GROUNDWATER
VOC RESULTS (ug/L)

**Figure B-25**
**039001 VOC HISTORY**



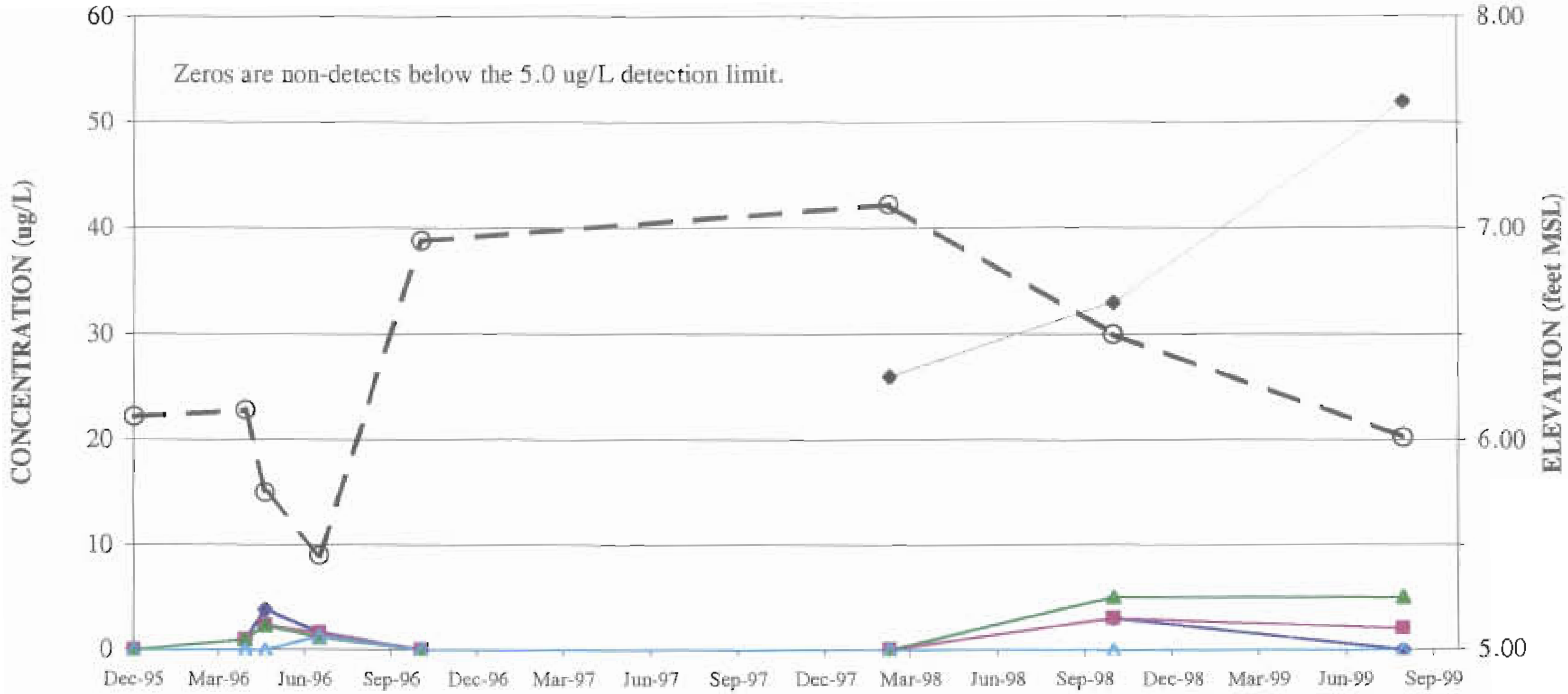

| | 12/6/95 | 4/3/96 | 4/23/96 | 6/20/96 | 10/7/96 | 02/17/98 | 10/6/98 | 8/4/99 |
|---|---|---|---|---|---|---|---|---|
| BENZ | 25 | 36 | 47 | 35 | 110 | 460 | 140 | 0 |
| TOL | 0 | 2.0 | 3.9 | 2.2 | 4.0 | 6.0 | 7.0 | 0 |
| ETHYLBZ | 10 | 7.0 | 9.0 | 10 | 34 | 63 | 53 | 0 |
| XYL | 92 | 59 | 70 | 83 | 72 | 78 | 260 | 0 |
| WL ELV | 8.35 | 8.26 | 7.83 | 7.50 | 8.80 | 10.43 | 8.78 | 7.96 |

**Figure B-26**
**039003 VOC HISTORY**



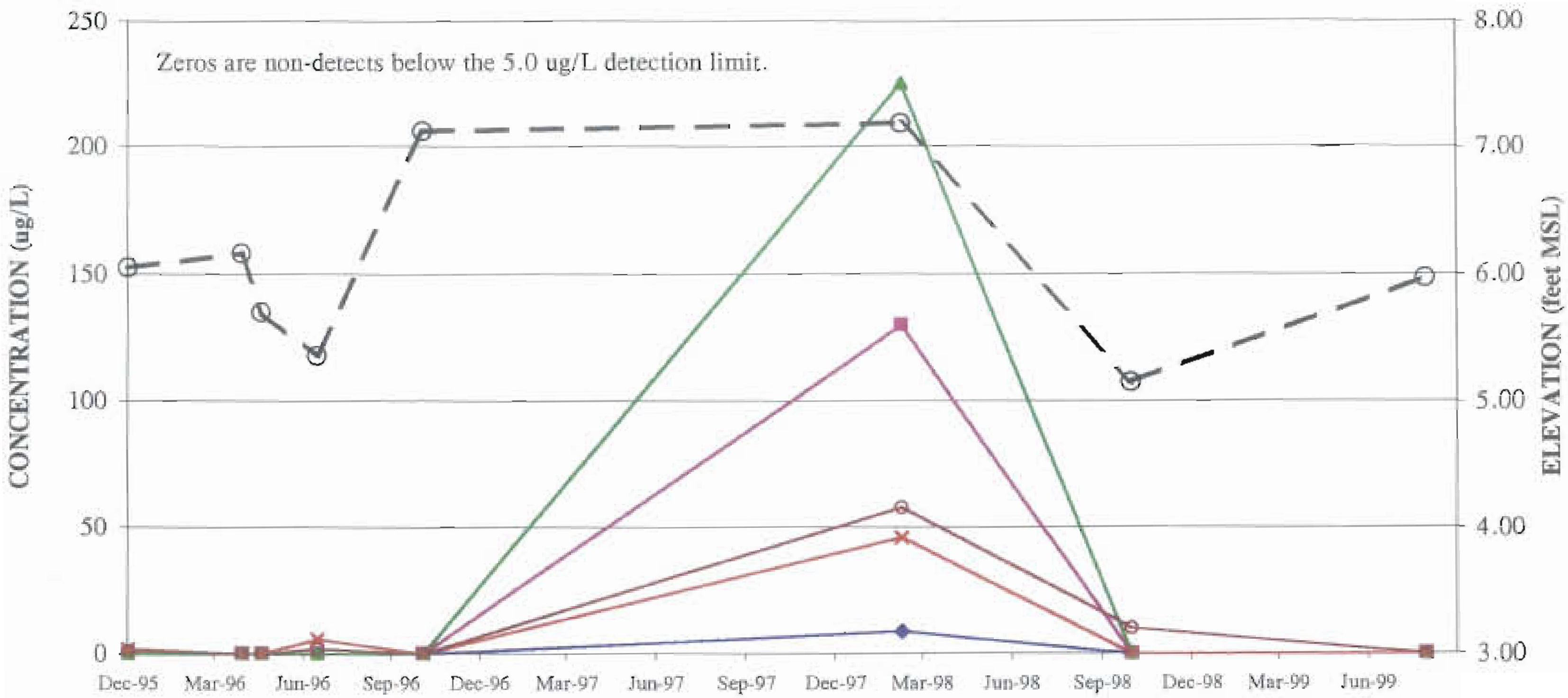

| | 12/6/95 | 4/3/96 | 4/24/96 | 6/20/96 | 10/8/96 | 2/17/98 | 10/6/98 | 8/4/99 |
|---|---|---|---|---|---|---|---|---|
| PCE | 17 | 7.0 | 9.2 | 12 | 8.0 | 30 | 23 | 3.0 |
| TCE | 41 | 44 | 50 | 92 | 29 | 35 | 28 | 16 |
| DCEtot | 4.8 | 3.0 | 3.1 | 7.5 | 3.0 | 24 | 13 | 1.0 |
| WL ELV | 5.65 | 5.64 | 5.34 | 5.03 | 6.37 | 6.82 | 6.09 | 5.58 |

**Figure B-27**
**039004 VOC HISTORY**



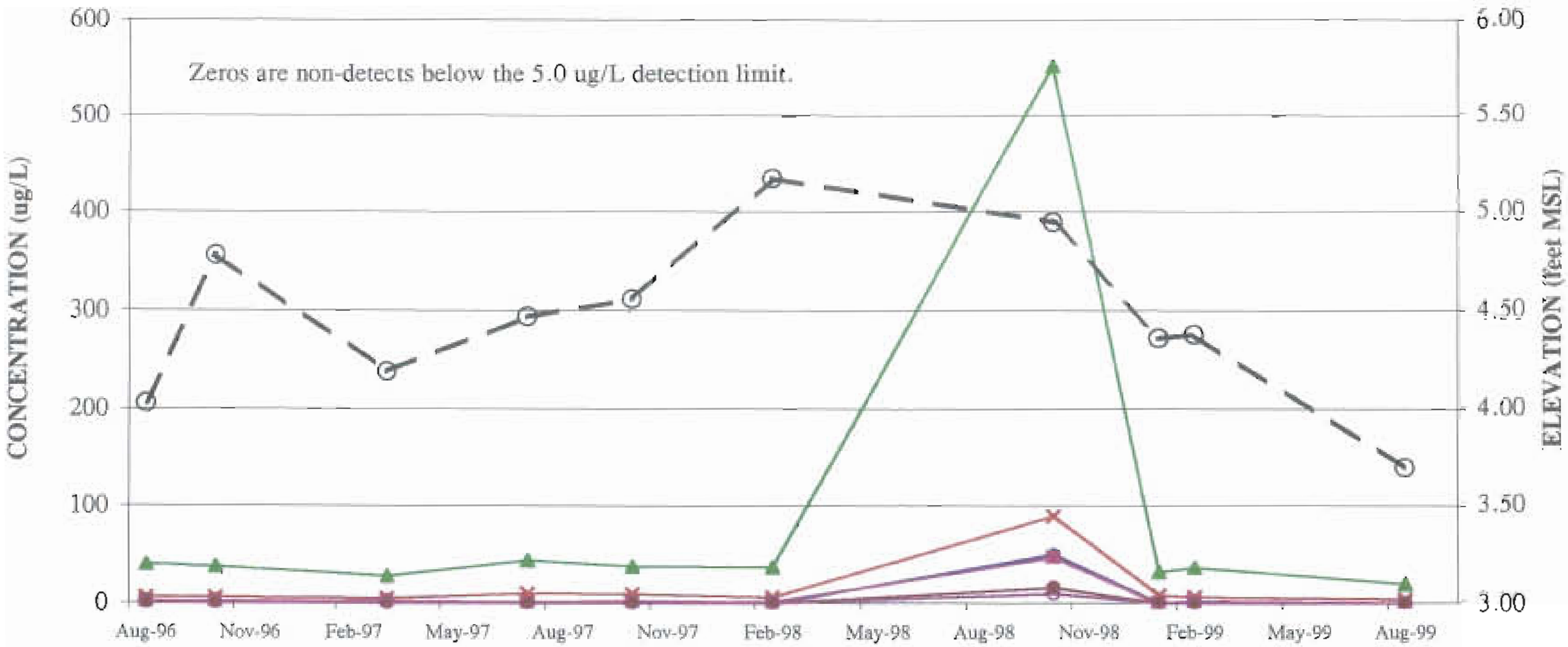

| | 12/6/95 | 4/3/96 | 4/24/96 | 6/21/96 | 10/8/96 | 2/12/98 | 10/6/98 | 8/5/99 |
|---|---|---|---|---|---|---|---|---|
| PCE | 0 | 1.0 | 3.8 | 1.7 | 0 | 0 | 3.0 | 0 |
| TCE | 0 | 1.0 | 2.3 | 1.6 | 0 | 0 | 3.0 | 2.0 |
| DCEtot | 0 | 1.0 | 2.3 | 1.2 | 0 | 0 | 5.0 | 5.0 |
| 1,1,1-TCA | 0 | 0 | 0 | 1.3 | 0 | 0 | 0 | 0 |
| MTBE | | | | | | 26 | 33 | 52 |
| WL ELEV | 6.11 | 6.14 | 5.75 | 5.45 | 6.94 | 7.11 | 6.50 | 6.01 |

**Figure B-28**
**039005 VOC HISTORY**



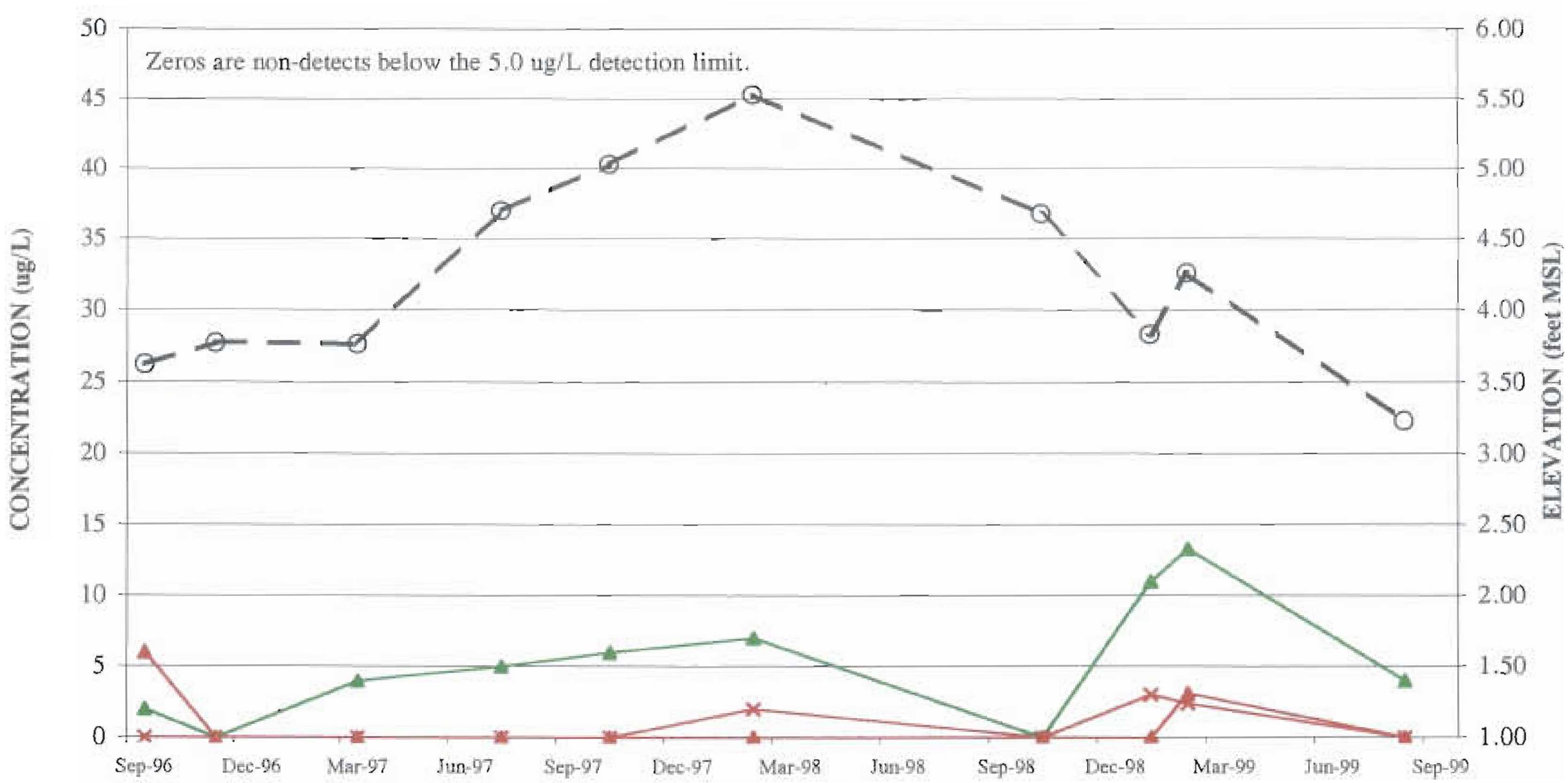

| | 12/6/95 | 4/3/96 | 4/24/96 | 6/21/96 | 10/9/96 | 2/13/98 | 10/6/98 | 8/4/99 |
|---|---|---|---|---|---|---|---|---|
| PCE | 0 | 0 | 0 | 0 | 0 | 9.0 | 0 | 0 |
| TCE | 0 | 0 | 0 | 0 | 0 | 130 | 0 | 0 |
| DCEtot | 0 | 0 | 0 | 0 | 0 | 225 | 0 | 0 |
| VC | 1.9 | 0 | 0 | 5.8 | 0 | 46 | 0 | 0 |
| DCA | 1.1 | 0 | 0 | 2.0 | 0 | 58 | 10 | 0 |
| WL ELEV | 6.05 | 6.16 | 5.70 | 5.36 | 7.12 | 7.18 | 5.15 | 5.97 |

**Figure B-29**
**039009 VOC HISTORY**



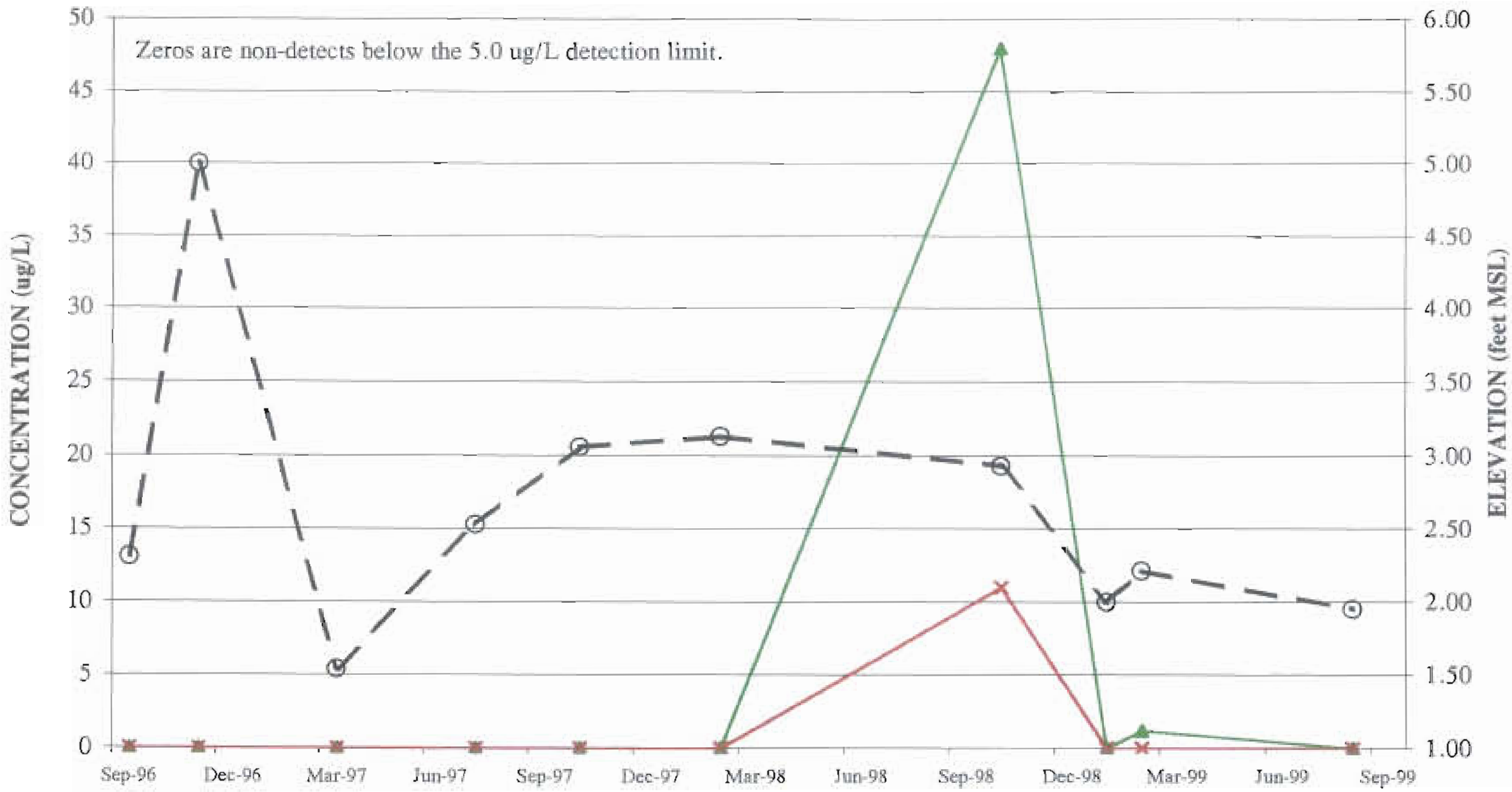

| | 8/1/96 | 10/11/96 | 3/10/97 | 7/9/97 | 10/4/97 | 2/19/98 | 10/8/98 | 1/18/99 | 2/18/99 | 8/8/99 |
|---|---|---|---|---|---|---|---|---|---|---|
| PCE | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 |
| TCE | 1.7 | 2.0 | 2.0 | 1.0 | 2.0 | 1.0 | 47 | 0 | 1.8 | 0 |
| DCEtot | 40 | 38 | 28 | 44 | 38 | 37 | 552 | 32 | 37 | 20 |
| VC | 6.2 | 6.0 | 5.0 | 10 | 9.0 | 6.0 | 90 | 8.0 | 6.1 | 4.0 |
| DCA | 1.5 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 |
| 1,1-DCE | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 |
| WL ELV | 4.03 | 4.78 | 4.19 | 4.47 | 4.56 | 5.17 | 4.95 | 4.36 | 4.38 | 3.70 |

**Figure B-30**
**03909I VOC HISTORY**



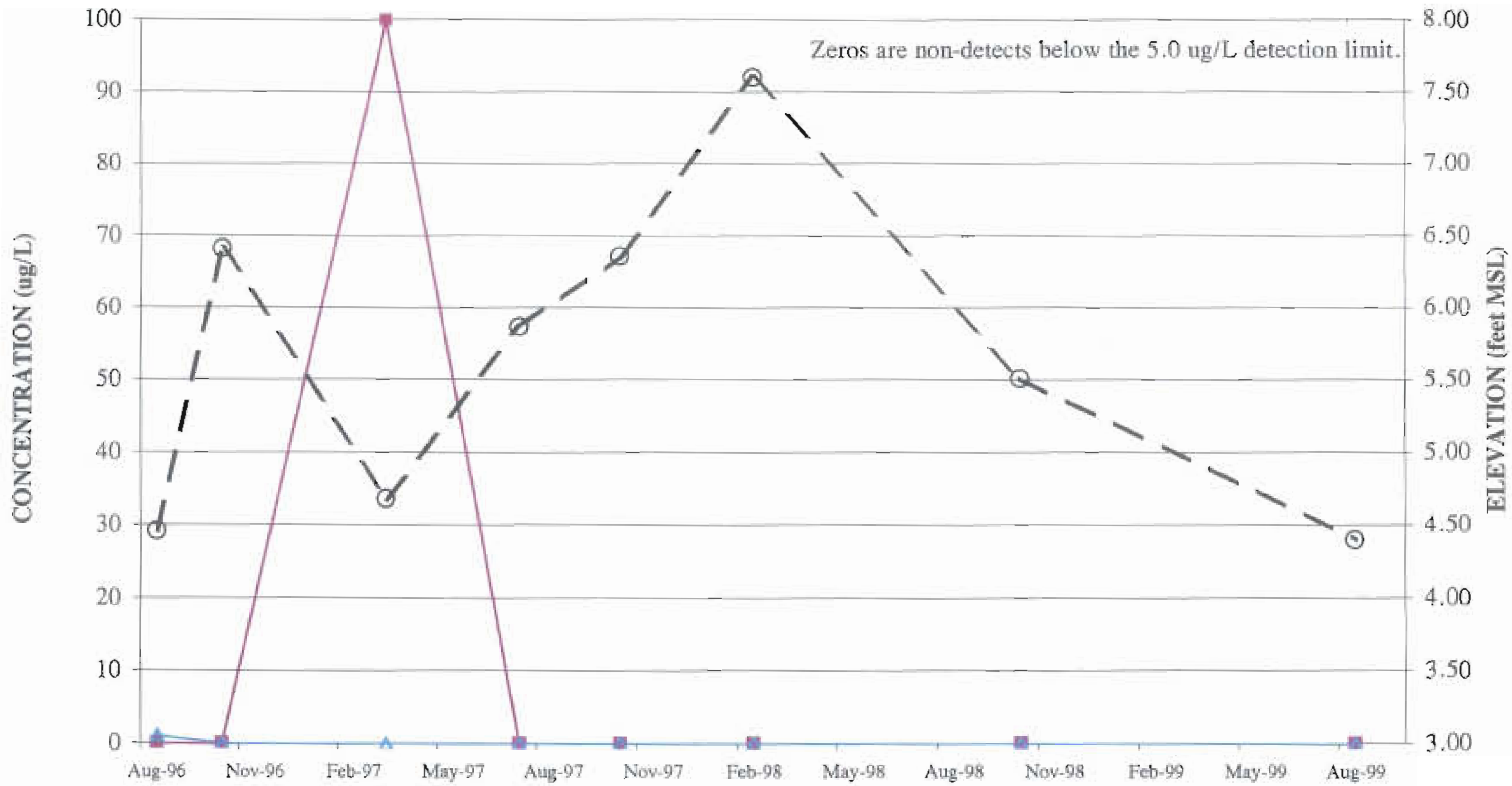

| | 9/28/96 | 11/4/96 | 3/10/97 | 7/9/97 | 10/4/97 | 2/19/98 | 10/8/98 | 1/18/99 | 2/18/99 | 8/8/99 |
|---|---|---|---|---|---|---|---|---|---|---|
| DCEtot | 2.0 | 0 | 4.0 | 5.0 | 6.0 | 7.0 | 0 | 11 | 13 | 4.0 |
| VC | 0 | 0 | 0 | 0 | 0 | 2.0 | 0 | 3.0 | 2.4 | 0 |
| TOL | 6.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.1 | 0 |
| WL ELV | 3.62 | 3.77 | 3.76 | 4.70 | 5.03 | 5.53 | 4.68 | 3.83 | 4.26 | 3.23 |

## Figure B-31
## 03909D VOC HISTORY



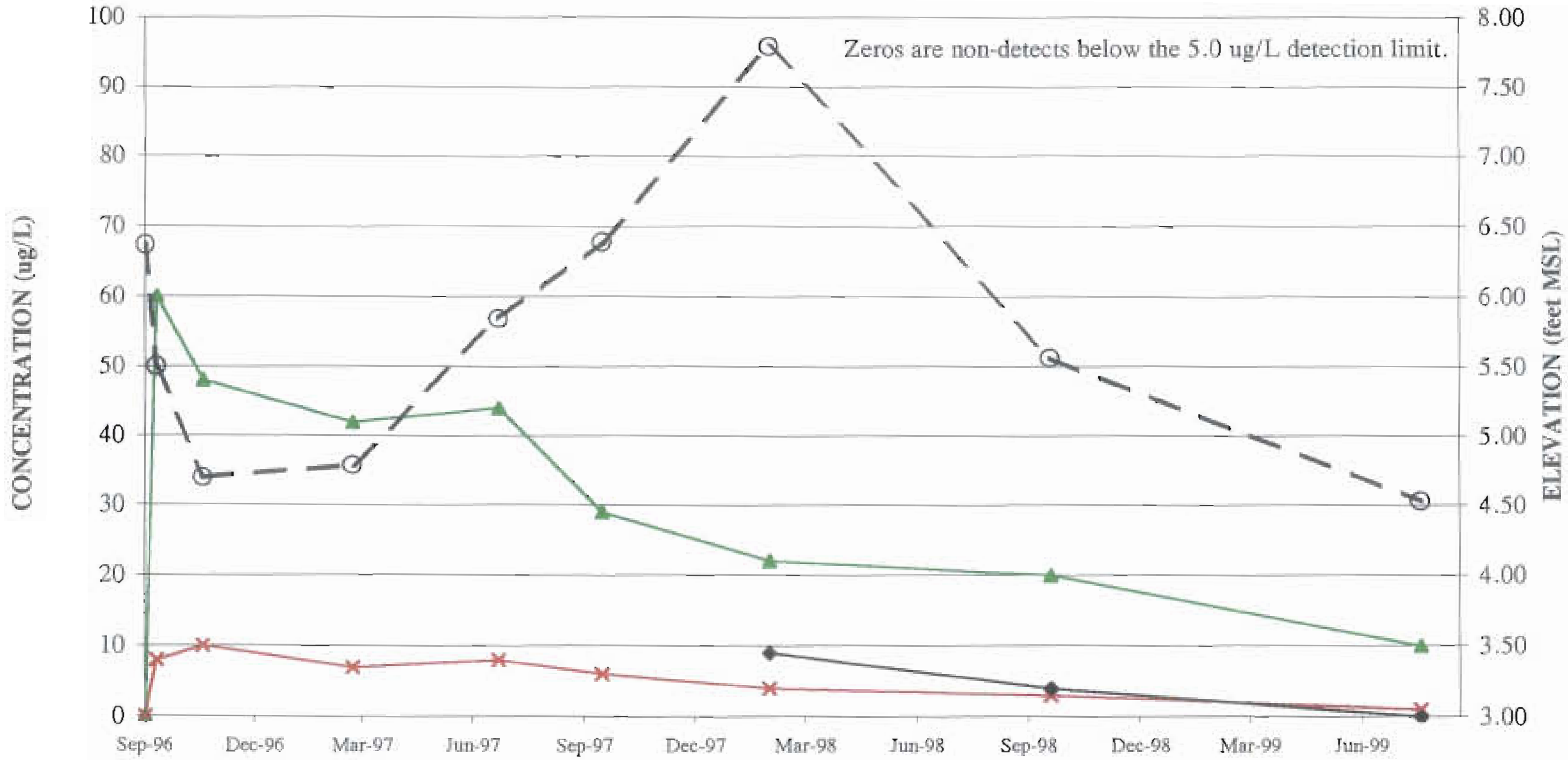

| | 9/28/96 | 11/4/96 | 3/10/97 | 7/9/97 | 10/4/97 | 2/19/98 | 10/8/98 | 1/18/99 | 2/18/99 | 8/8/99 |
|---|---|---|---|---|---|---|---|---|---|---|
| DCE | 0 | 0 | 0 | 0 | 0 | 0 | 48 | 0 | 1.2 | 0 |
| VC | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 |
| WL ELV | 2.31 | 5.00 | 1.54 | 2.53 | 3.06 | 3.13 | 2.93 | 2.00 | 2.21 | 1.95 |

**Figure B-32**
**039010 VOC HISTORY**



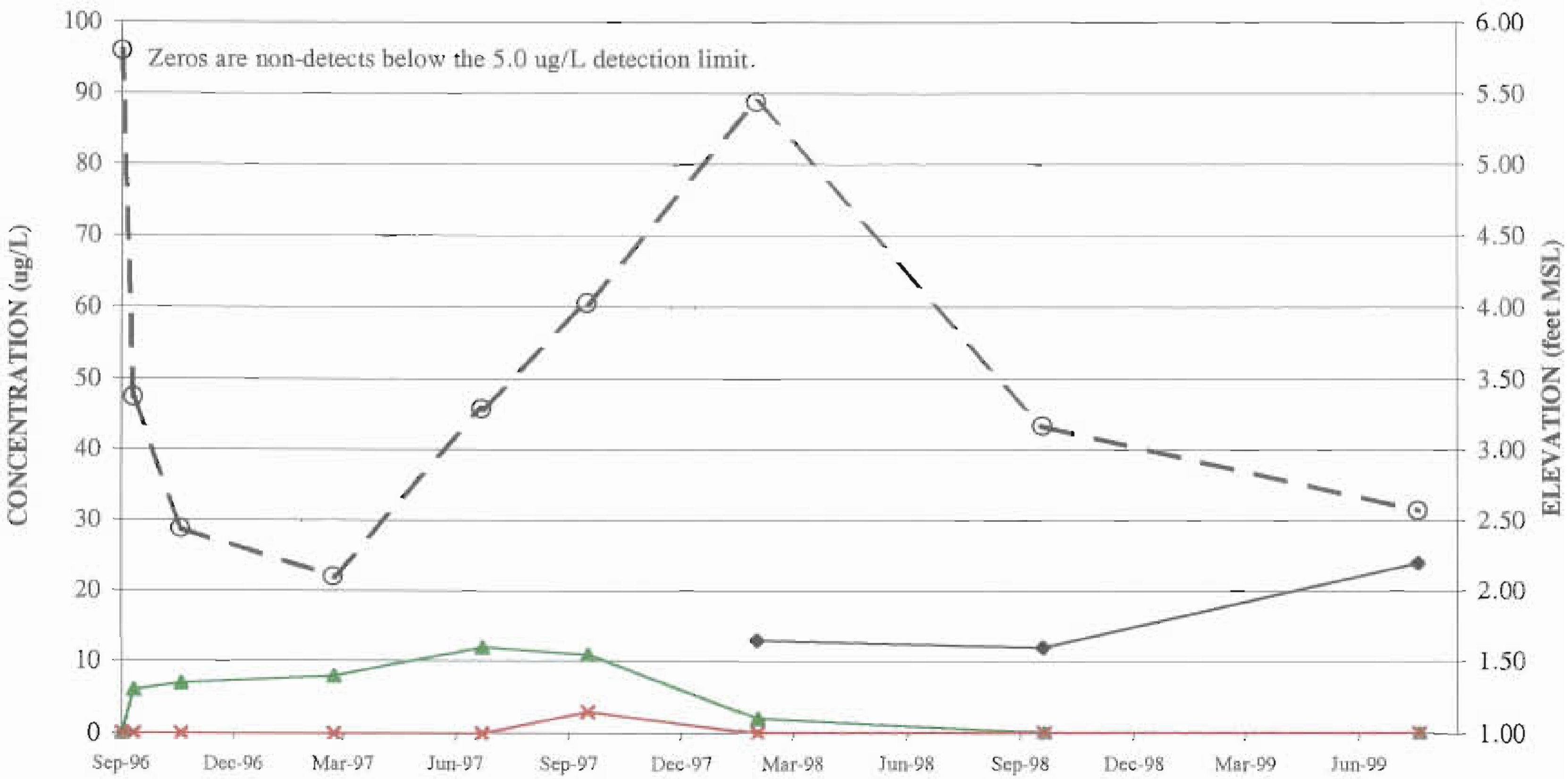

| | 8/1/96 | 10/11/96 | 3/11/97 | 7/10/97 | 10/4/97 | 2/18/98 | 10/7/98 | 8/6/99 |
|---|---|---|---|---|---|---|---|---|
| TCE | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| 1,1,1-TCA | 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WL ELV | 4.46 | 6.41 | 4.68 | 5.87 | 6.36 | 7.60 | 5.51 | 4.40 |

**Figure B-33**
**03910I VOC HISTORY**



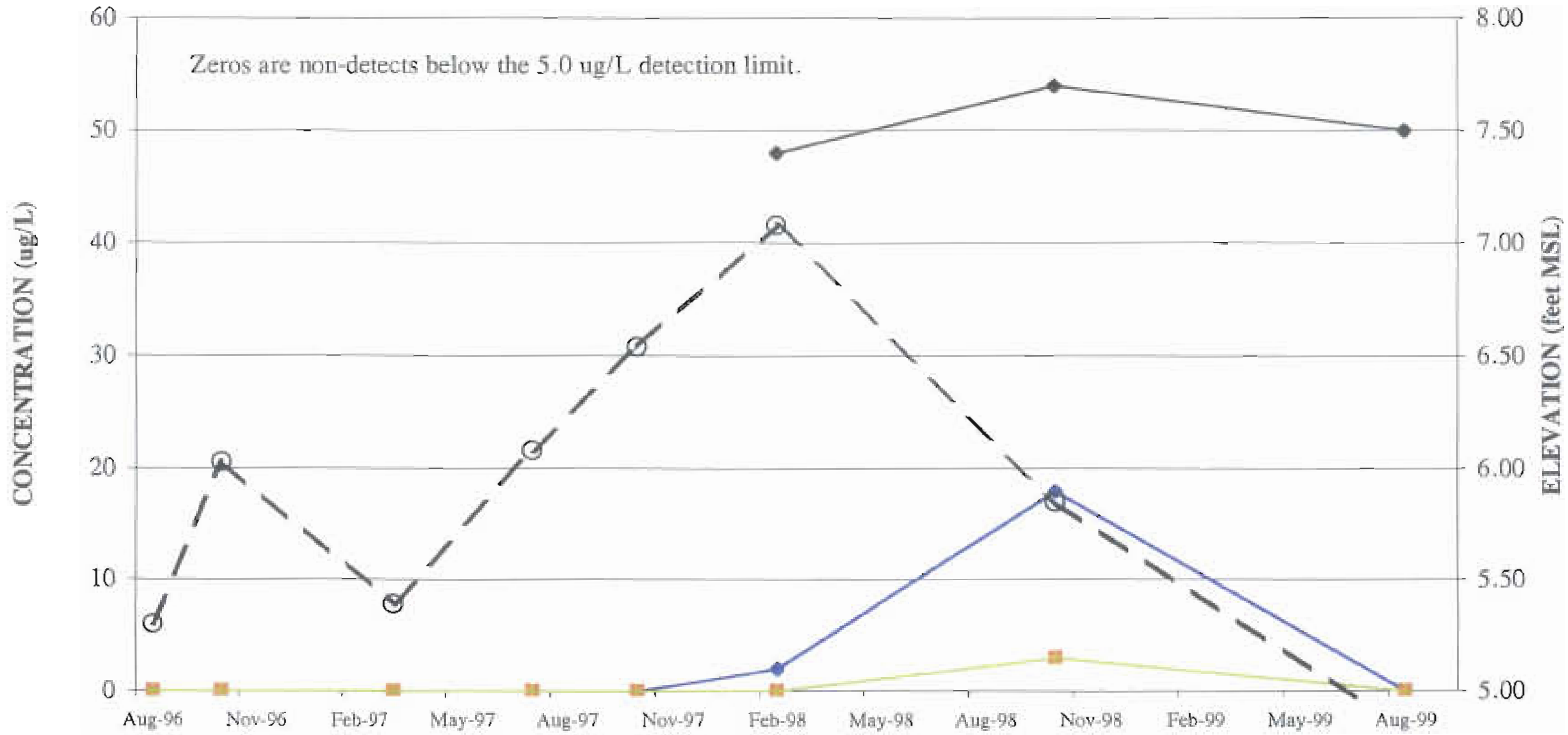

| | 9/19/96 | 9/28/96 | 11/6/96 | 3/11/97 | 7/10/97 | 10/4/97 | 2/18/98 | 10/7/98 | 8/6/99 |
|---|---|---|---|---|---|---|---|---|---|
| DCEtot | 0 | 60 | 48 | 42 | 44 | 29 | 22 | 20 | 10 |
| VC | 0 | 8.0 | 10 | 7.0 | 8.0 | 6.0 | 4.0 | 3.0 | 1.0 |
| MTBE | | | | | | | 9.0 | 4.0 | 0 |
| WL ELV | 6.37 | 5.50 | 4.70 | 4.79 | 5.84 | 6.39 | 7.79 | 5.56 | 4.53 |

**Figure B-34**
**03910D VOC HISTORY**



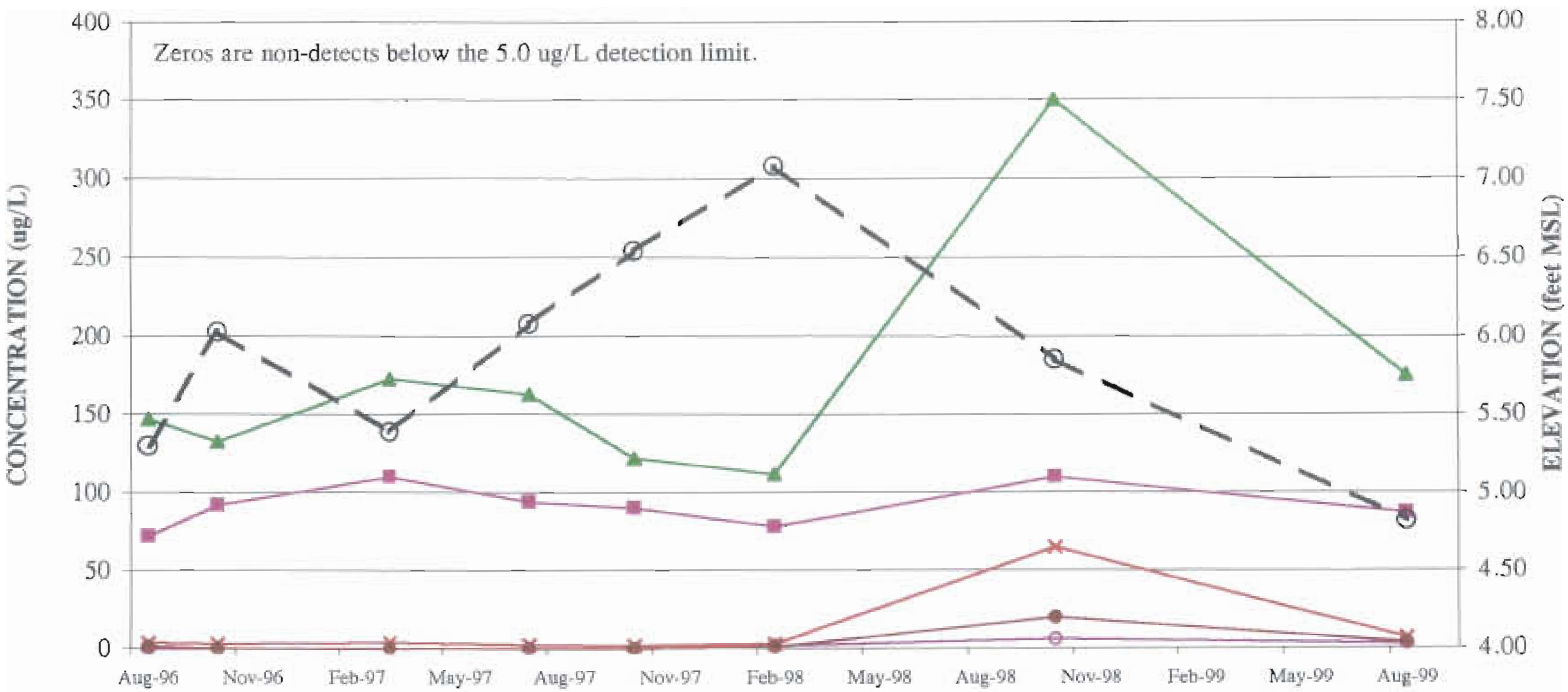

| | 9/19/96 | 9/28/96 | 11/6/96 | 3/11/97 | 7/10/97 | 10/4/97 | 2/18/98 | 10/7/98 | 8/6/99 |
|---|---|---|---|---|---|---|---|---|---|
| DCEtot | 0 | 6.0 | 7.0 | 8.0 | 12 | 11 | 2.0 | 0 | 0 |
| VC | 0 | 0 | 0 | 0 | 0 | 3.0 | 0 | 0 | 0 |
| MTBE | | | | | | | 13 | 12 | 24 |
| WL ELV | 5.80 | 3.37 | 2.44 | 2.10 | 3.29 | 4.03 | 5.44 | 3.17 | 2.57 |

**Figure B-36**
**039012 AROMATIC HYDROCARBON HISTORY**



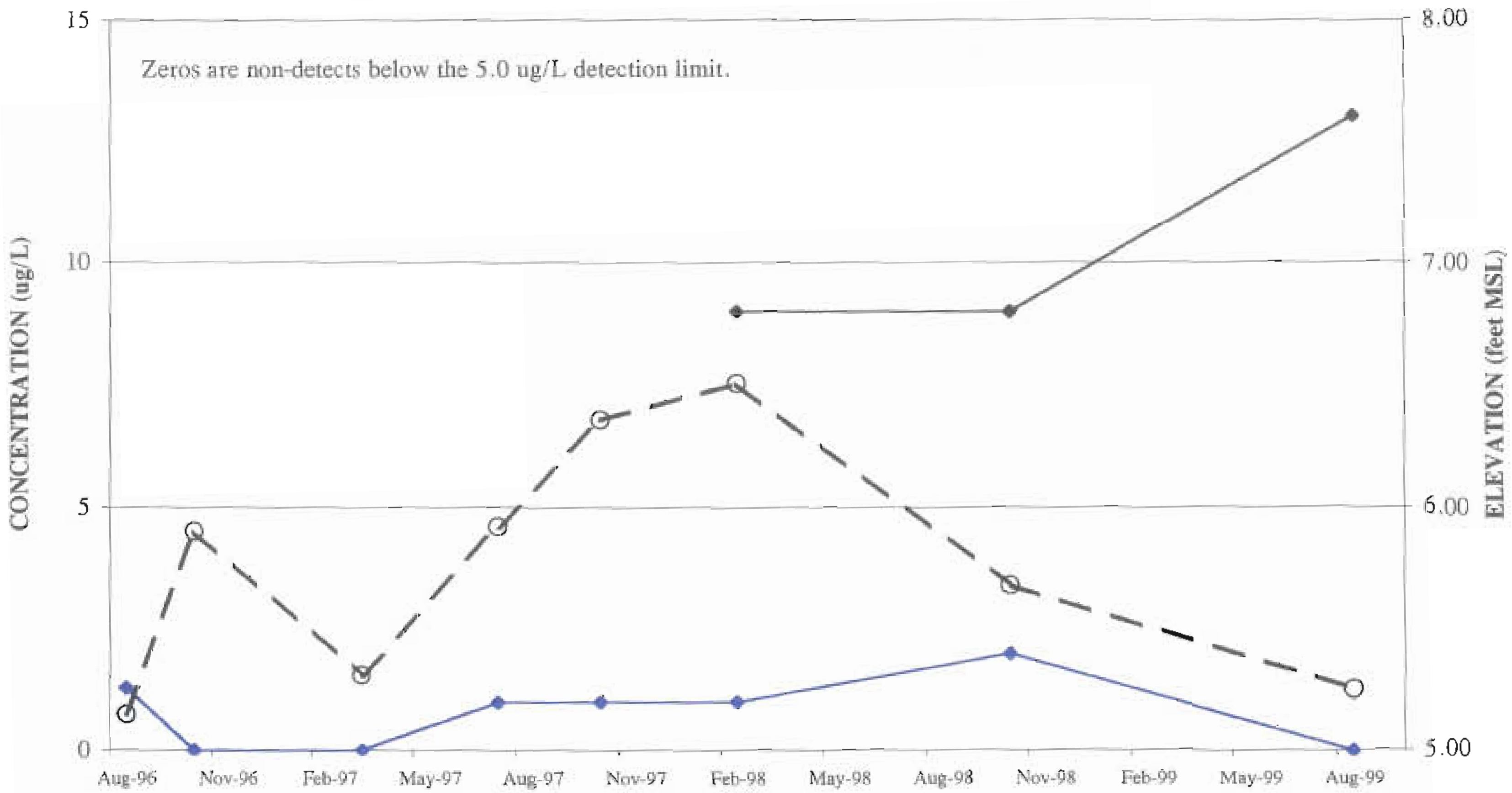

| | 8/1/96 | 10/16/96 | 3/12/97 | 7/11/97 | 10/3/97 | 2/17/98 | 10/7/98 | 8/5/99 |
|---|---|---|---|---|---|---|---|---|
| BENZ | 0 | 0 | 0 | 0 | 0 | 2.0 | 18 | 0 |
| ETHYLBZ | 0 | 0 | 0 | 0 | 0 | 0 | 3.0 | 0 |
| XYL | 0 | 0 | 0 | 0 | 0 | 0 | 3.0 | 0 |
| MTBE | | | | | | 48 | 54 | 50 |
| WL ELV | 5.30 | 6.03 | 5.39 | 6.08 | 6.54 | 7.08 | 5.85 | 4.82 |

**Figure B-37**
**039012 CHLORINATED ALIPHATIC HYDROCARBON HISTORY**



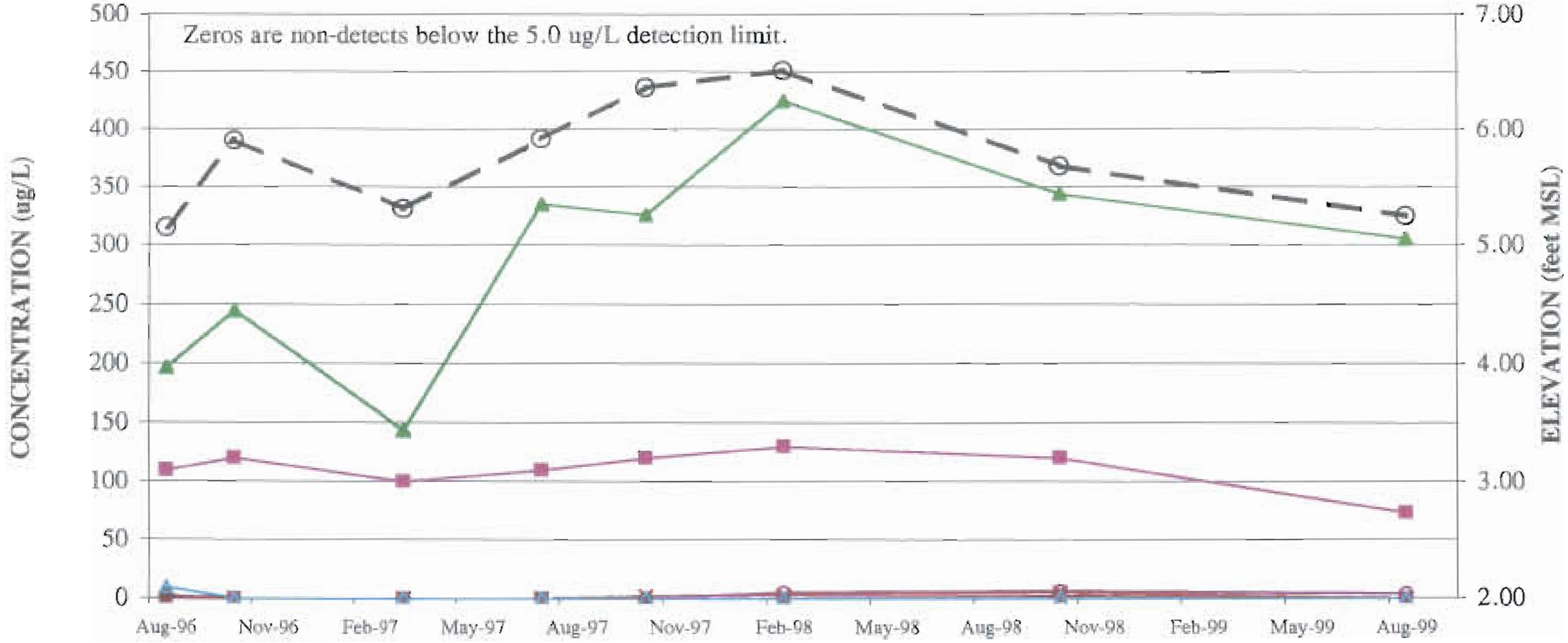

| | 8/1/96 | 10/16/96 | 3/12/97 | 7/11/97 | 10/3/97 | 2/17/98 | 10/7/98 | 8/5/99 |
|---|---|---|---|---|---|---|---|---|
| TCE | 72 | 92 | 110 | 94 | 90 | 78 | 110 | 87 |
| DCEtot | 147 | 133 | 173 | 163 | 122 | 112 | 350 | 175 |
| VC | 3.9 | 3.0 | 4.0 | 2.5 | 2.0 | 3.0 | 65 | 7.0 |
| 1,1-DCE | 0 | 0 | 0 | 0 | 0 | 2.0 | 6 | 3.0 |
| DCA | 1.7 | 0 | 0 | 0 | 0 | 1.0 | 20 | 4.0 |
| WL ELV | 5.30 | 6.03 | 5.39 | 6.08 | 6.54 | 7.08 | 5.85 | 4.82 |

**Figure B-38**
**03912I AROMATIC HYDROCARBON HISTORY**



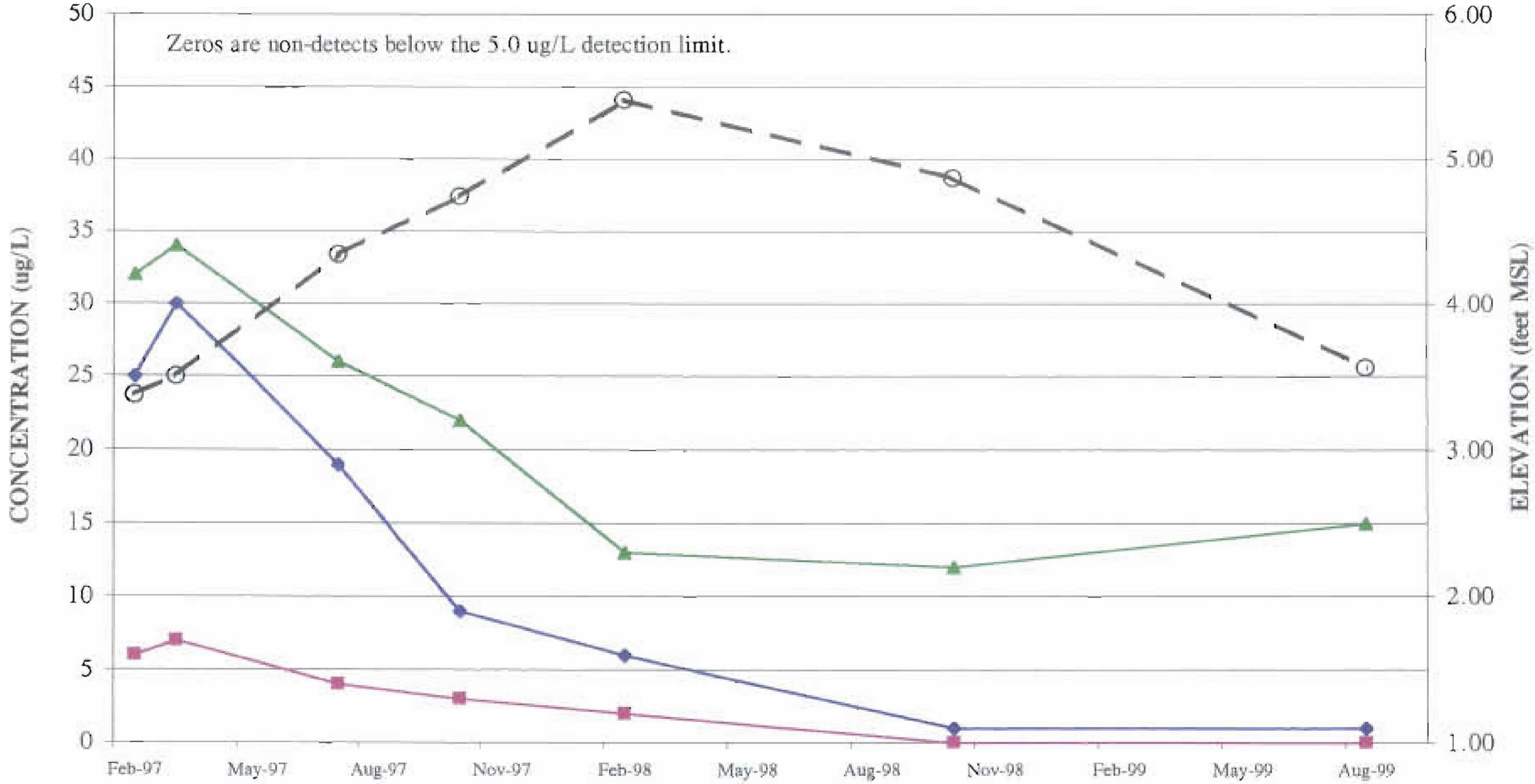

| | 8/1/96 | 10/16/96 | 3/12/97 | 7/11/97 | 10/3/97 | 2/17/98 | 10/7/98 | 8/5/99 |
|---|---|---|---|---|---|---|---|---|
| BENZ | 1.3 | 0 | 0 | 1.0 | 1.0 | 1.0 | 2.0 | 0 |
| MTBE | | | | | | 9.0 | 9.0 | 13 |
| WL ELV | 5.15 | 5.90 | 5.31 | 5.92 | 6.36 | 6.51 | 5.68 | 5.25 |

## Figure B-39
## 03912I CHLORINATED ALIPHATIC HYDROCARBON HISTORY



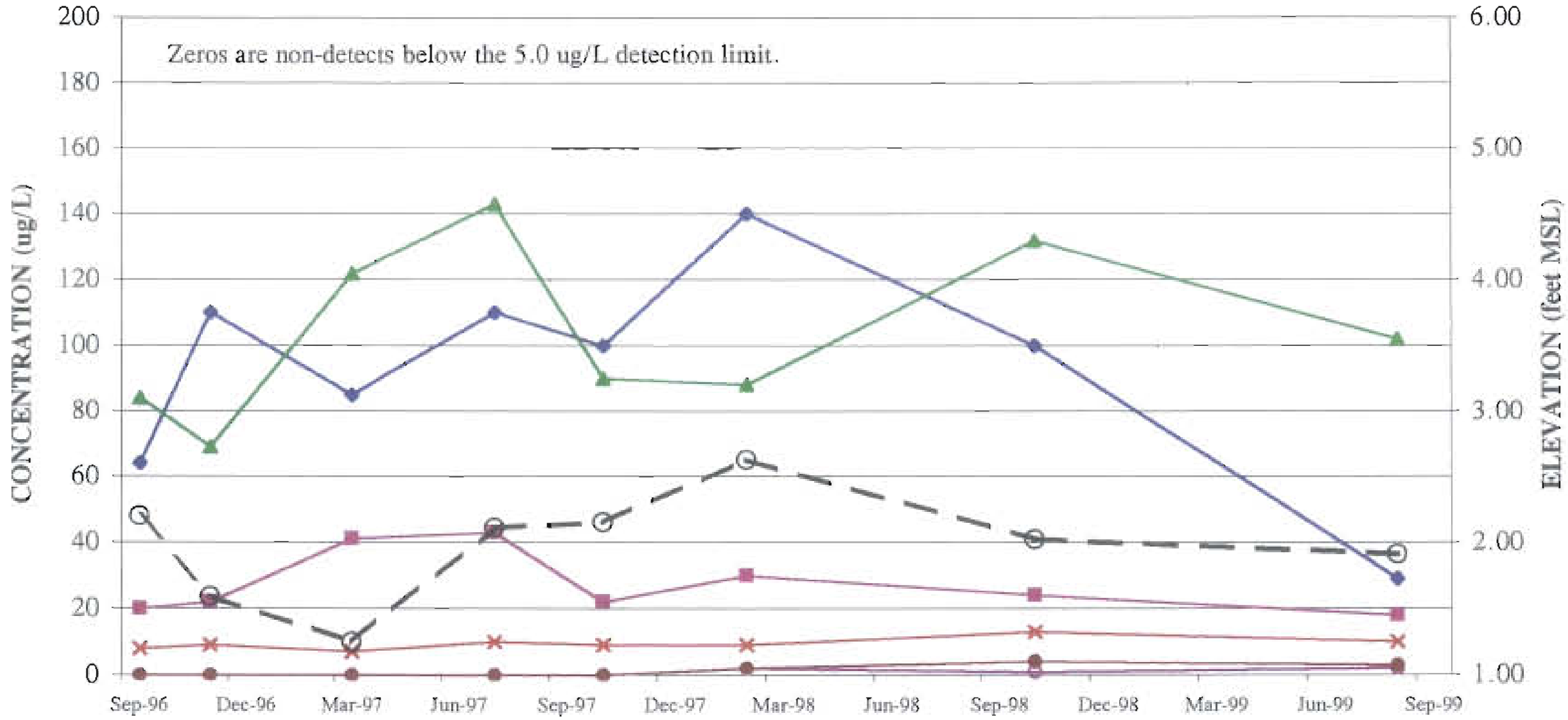

| | 8/1/96 | 10/16/96 | 3/12/97 | 7/11/97 | 10/3/97 | 2/17/98 | 10/7/98 | 8/5/99 |
|---|---|---|---|---|---|---|---|---|
| TCE | 110 | 120 | 100 | 110 | 120 | 130 | 120 | 73 |
| DCEtot | 197 | 245 | 144 | 335 | 326 | 425 | 344 | 305 |
| VC | 0 | 0 | 0 | 0 | 2.0 | 3.0 | 5.0 | 0 |
| 1,1-DCE | 0 | 0 | 0 | 0 | 0 | 5.0 | 6.0 | 4.0 |
| DCA | 2.0 | 0 | 0 | 0 | 0 | 0 | 2.0 | 0 |
| 1,1,1-TCA | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WL ELV | 5.15 | 5.90 | 5.31 | 5.92 | 6.36 | 6.51 | 5.68 | 5.25 |

**Figure B-40**
**039013 VOC HISTORY**



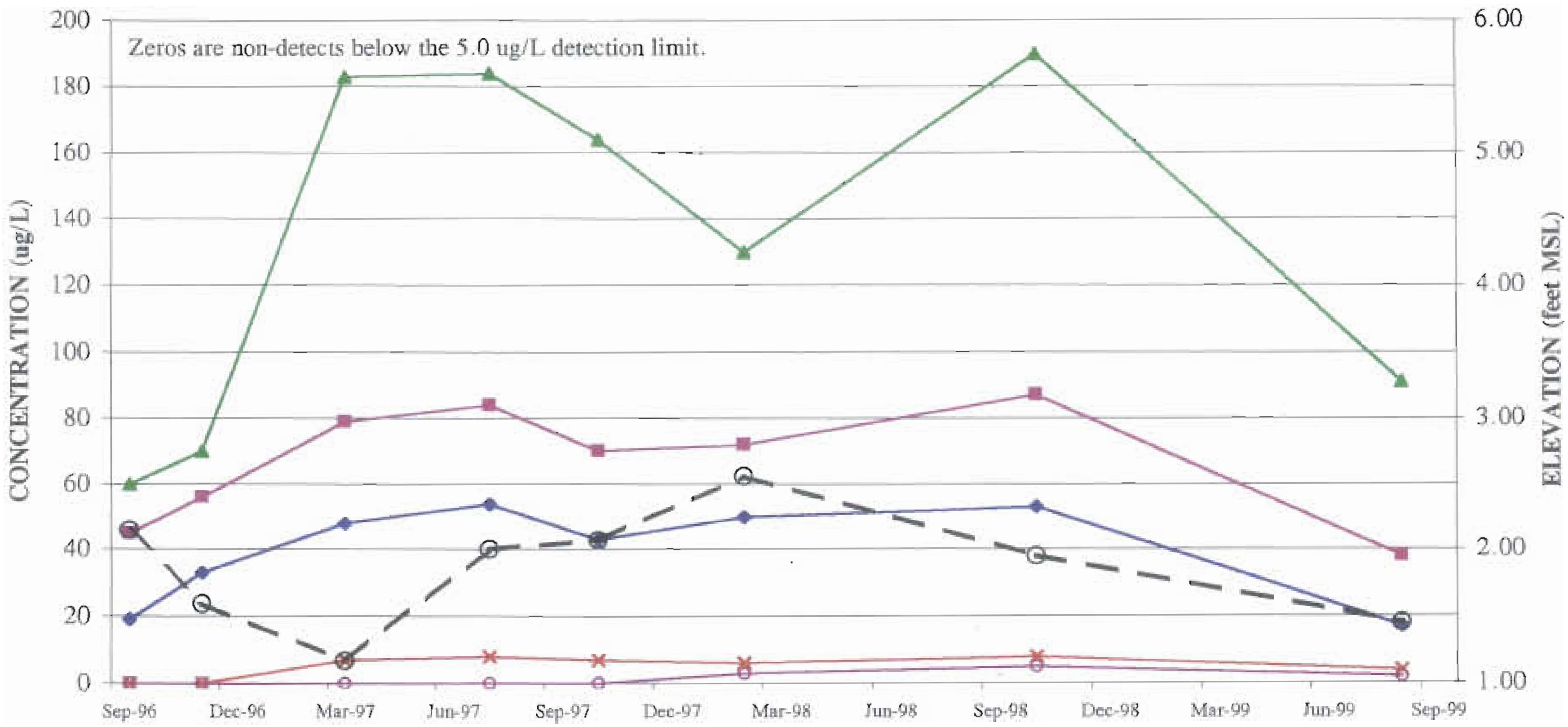

| | 2/7/97 | 3/12/97 | 7/14/97 | 10/5/97 | 2/19/98 | 10/8/98 | 8/7/99 |
|---|---|---|---|---|---|---|---|
| PCE | 25 | 30 | 19 | 9.0 | 6.0 | 1.0 | 1.0 |
| TCE | 6.0 | 7.0 | 4.0 | 3.0 | 2.0 | 0 | 0 |
| DCEtot | 32 | 34 | 26 | 22 | 13 | 12 | 15 |
| WL ELV | 3.37 | 3.50 | 4.34 | 4.74 | 5.41 | 4.87 | 3.56 |

**Figure B-41**
**03913I VOC HISTORY**



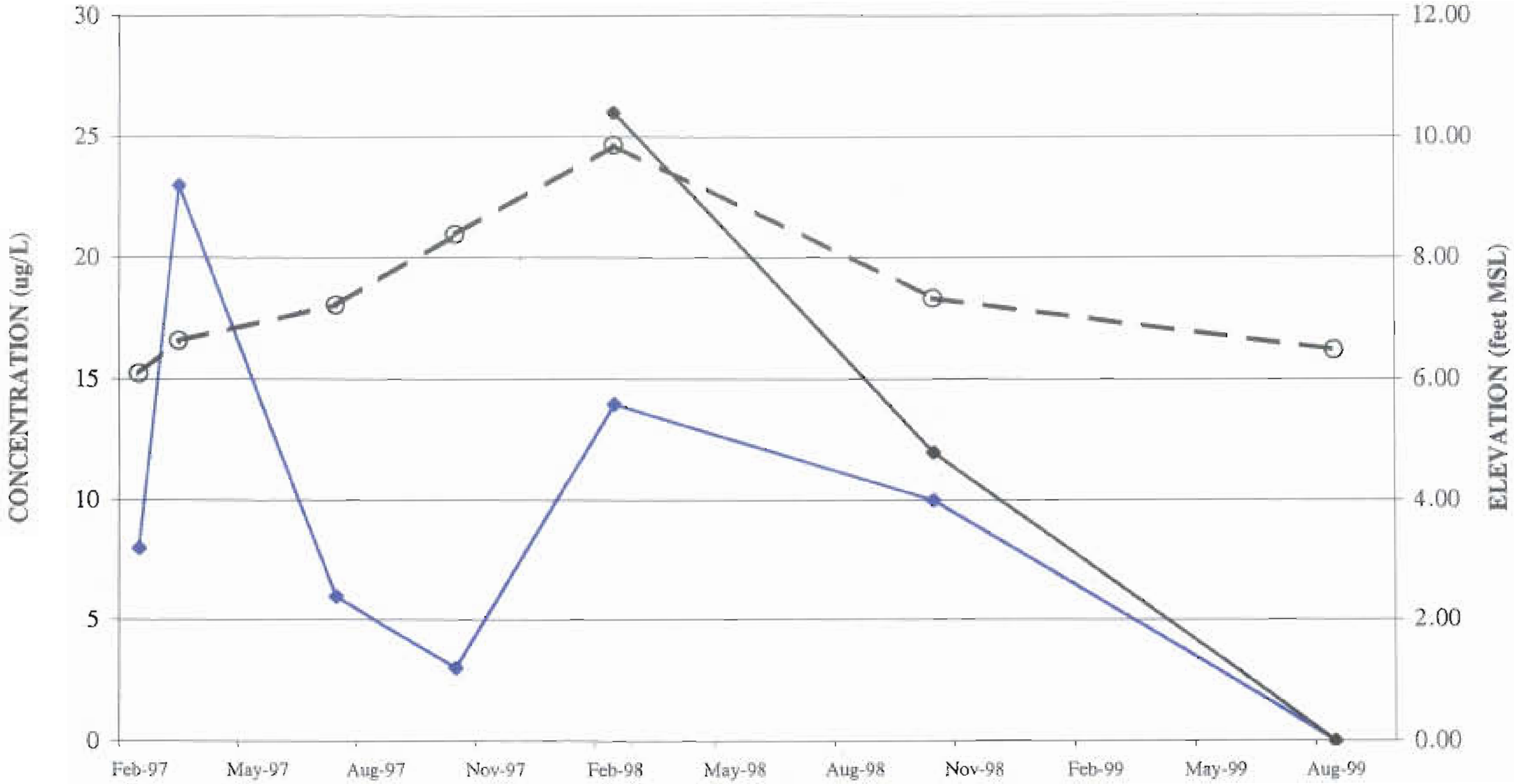

| | 9/29/96 | 11/5/96 | 3/12/97 | 7/14/97 | 10/5/97 | 2/19/98 | 10/8/98 | 8/7/99 |
|---|---|---|---|---|---|---|---|---|
| PCE | 64 | 110 | 85 | 110 | 100 | 140 | 100 | 29 |
| TCE | 20 | 22 | 41 | 43 | 22 | 30 | 24 | 18 |
| DCEtot | 84 | 69 | 122 | 143 | 90 | 88 | 132 | 102 |
| VC | 8.0 | 9.0 | 7.0 | 10 | 9.0 | 9.0 | 13 | 10 |
| 1,1-DCE | 0 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | 2.0 |
| DCA | 0 | 0 | 0 | 0 | 0 | 2.0 | 4.0 | 3.0 |
| WL ELV | 2.20 | 1.59 | 1.25 | 2.11 | 2.15 | 2.63 | 2.02 | 1.91 |

**Figure B-42**
**03913D VOC HISTORY**



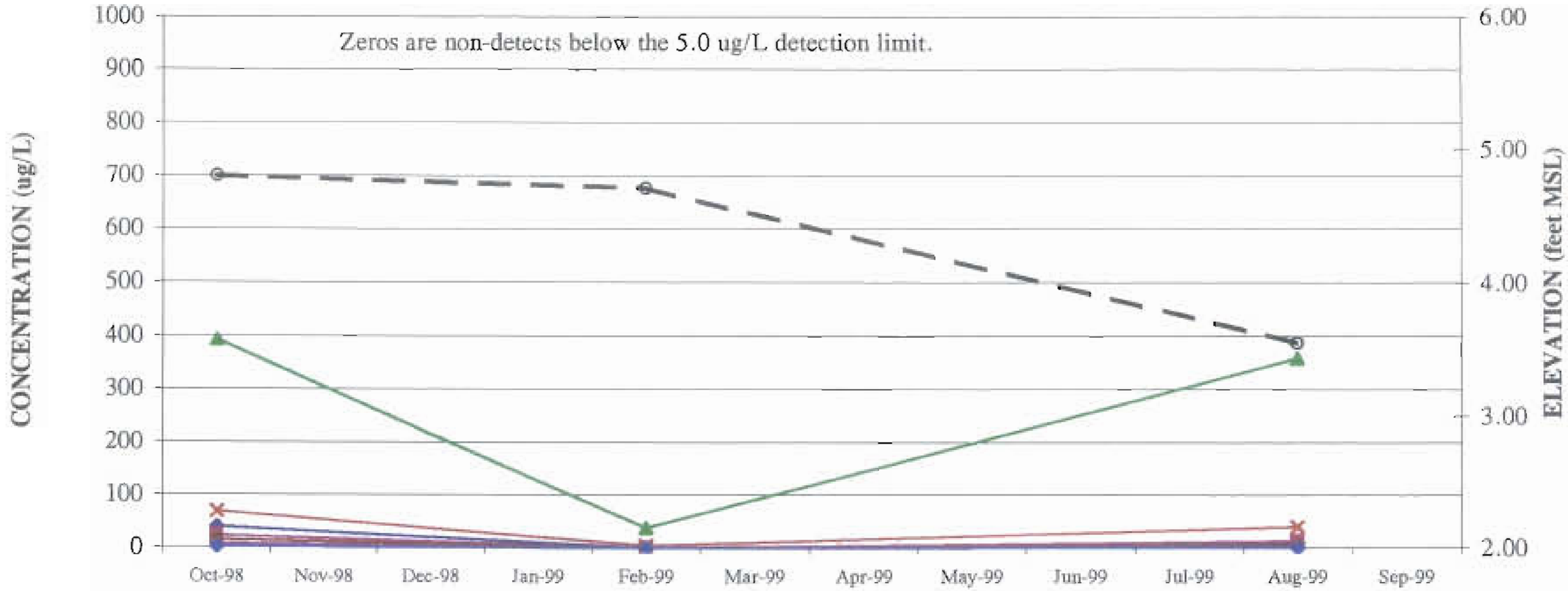

| | 9/29/96 | 11/5/96 | 3/12/97 | 7/14/97 | 10/5/97 | 2/19/98 | 10/8/98 | 8/6/99 |
|---|---|---|---|---|---|---|---|---|
| PCE | 19 | 33 | 48 | 54 | 43 | 50 | 53 | 17 |
| TCE | 45 | 56 | 79 | 84 | 70 | 72 | 87 | 38 |
| DCEtot | 60 | 70 | 183 | 184 | 164 | 130 | 190 | 91 |
| VC | 0 | 0 | 7.0 | 8.0 | 7.0 | 6.0 | 8.0 | 4.0 |
| 1,1-DCE | 0 | 0 | 0 | 0 | 0 | 3.0 | 5.0 | 2.0 |
| WL ELV | 2.15 | 1.59 | 1.17 | 2.00 | 2.07 | 2.56 | 1.95 | 1.45 |

**Figure B-43**
**039014 VOC HISTORY**



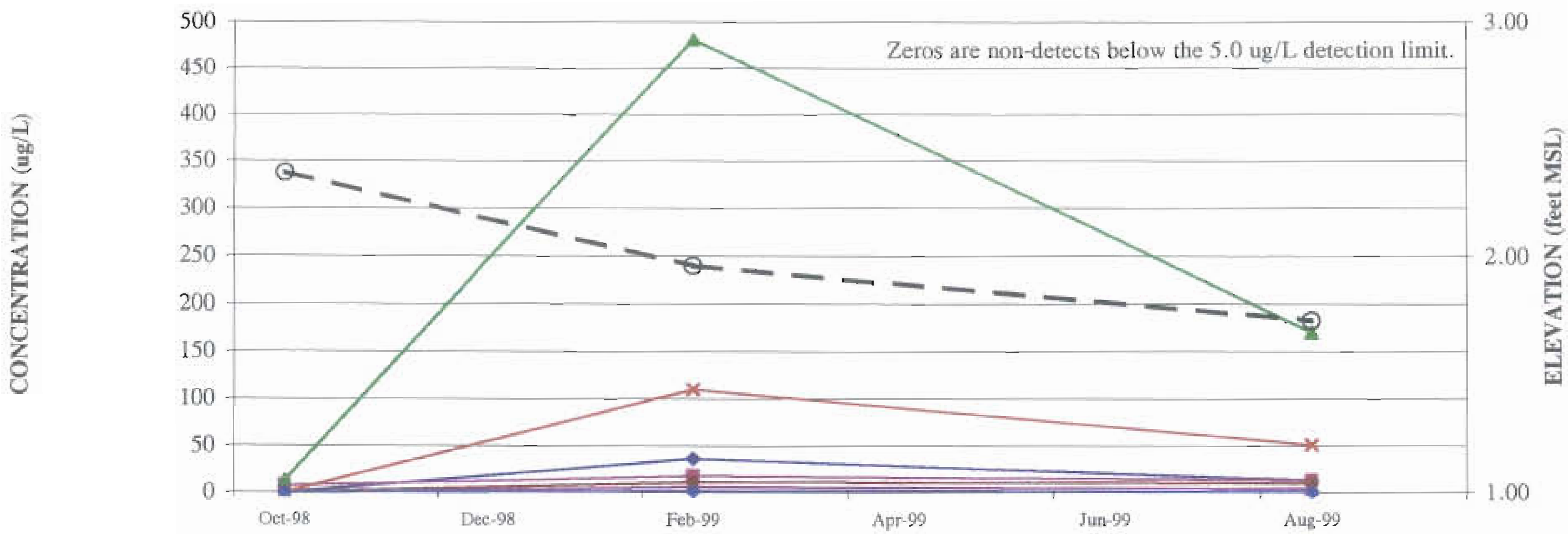

| | 2/6/97 | 3/20/97 | 7/15/97 | 10/5/97 | 2/19/98 | 10/8/98 | 8/4/99 |
|---|---|---|---|---|---|---|---|
| BENZ | 8.0 | 23 | 6.0 | 3.0 | 14 | 10 | 0 |
| MTBE | | | | | 26 | 12 | 0 |
| WL ELV | 6.10 | 6.64 | 7.22 | 8.39 | 9.86 | 7.33 | 6.48 |

**Figure B-44**
**039016 VOC HISTORY**



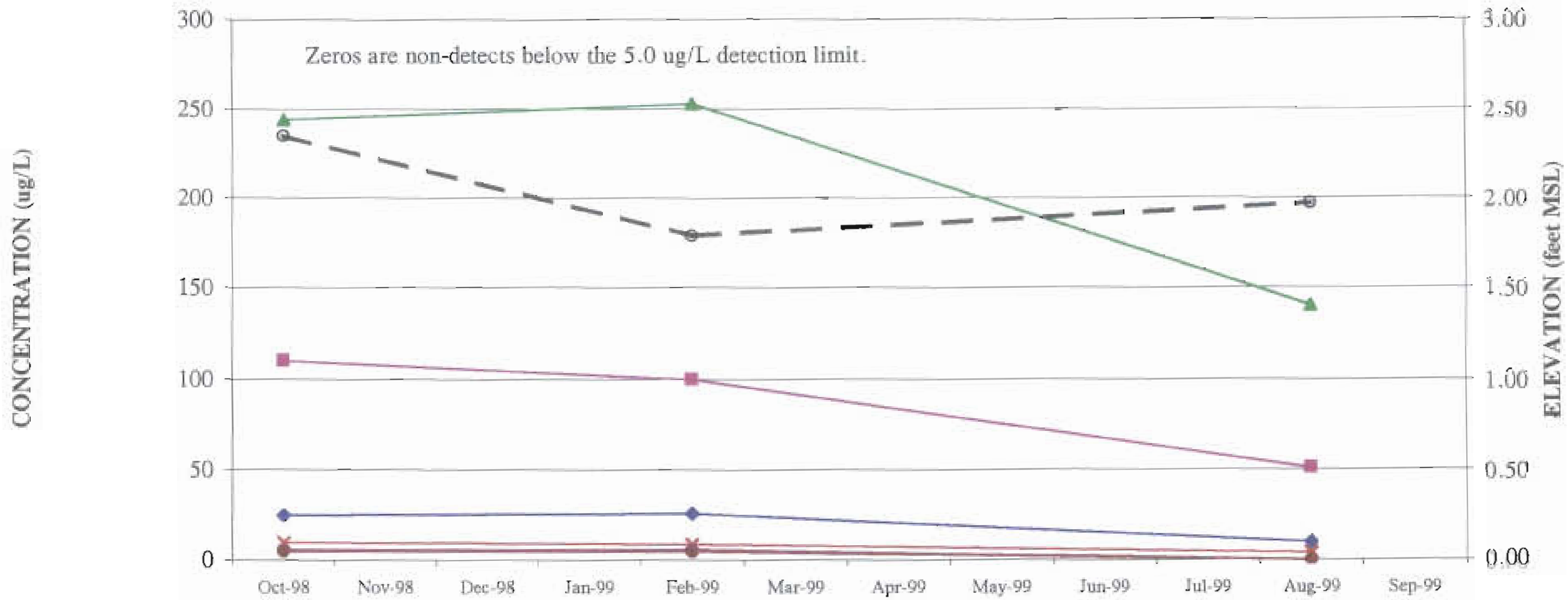

| | 10/8/98 | 2/12/99 | 8/6/99 |
|---|---|---|---|
| PCE | 40 | 0 | 9.0 |
| TCE | 23 | 0 | 13 |
| DCEtot | 393 | 38 | 359 |
| VC | 69 | 4.0 | 40 |
| 1,1-DCE | 8.0 | 0 | 4.0 |
| 1,1-DCA | 15 | 0 | 7.0 |
| BENZ | 2.0 | 0 | 1.0 |
| wl elev | 4.80 | 4.71 | 3.55 |

**Figure B-45**
**03916I VOC HISTORY**



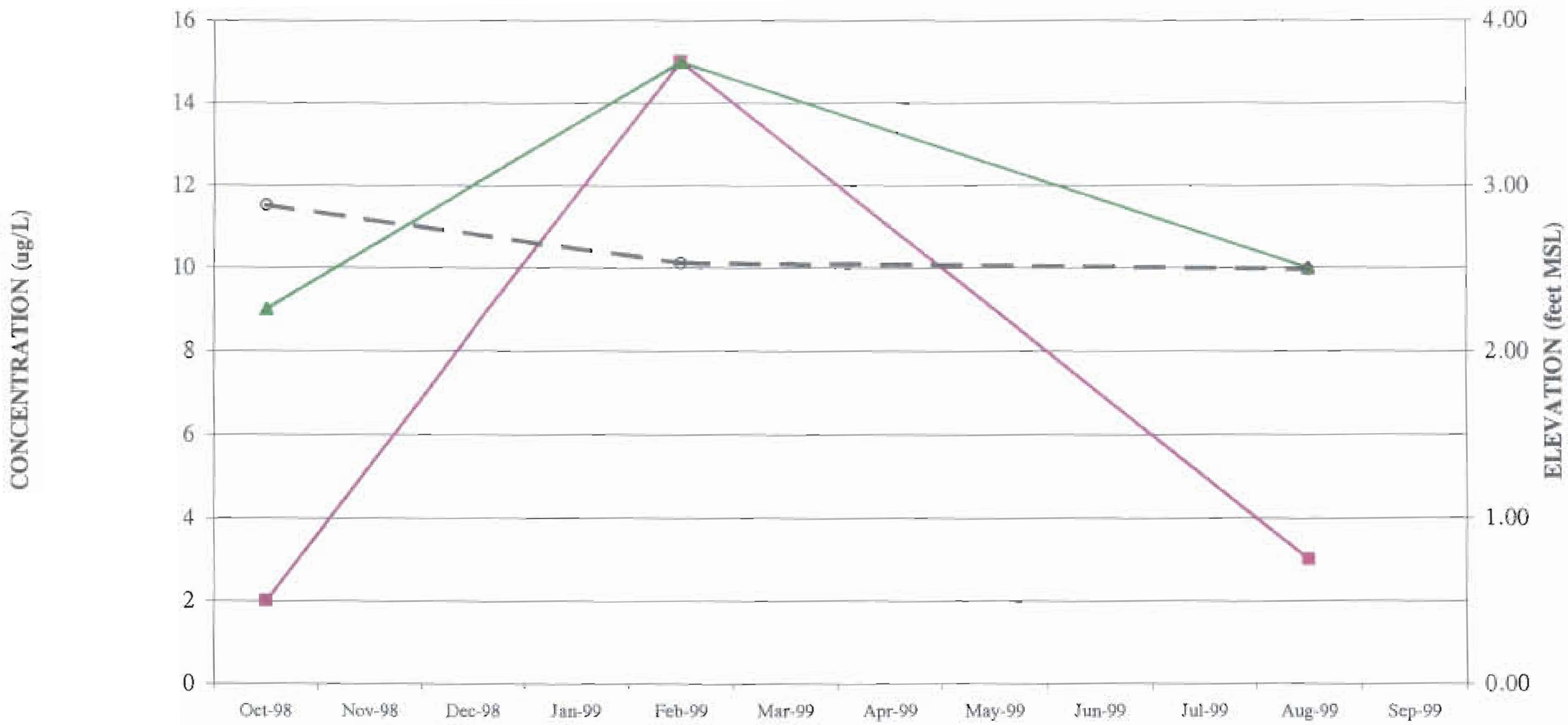

| | 10/8/98 | 2/12/99 | 8/6/99 |
|---|---|---|---|
| PCE | 0 | 36 | 13 |
| TCE | 7.0 | 18 | 13 |
| DCEtot | 13 | 481 | 170 |
| VC | 0 | 110 | 51 |
| 1,1-DCE | 0 | 6.0 | 4.0 |
| 1,1-DCA | 0 | 11 | 10 |
| BENZ | 0 | 2.0 | 1.0 |
| wl elev | 2.35 | 1.96 | 1.73 |

## Figure B-46
## 03917D VOC HISTORY



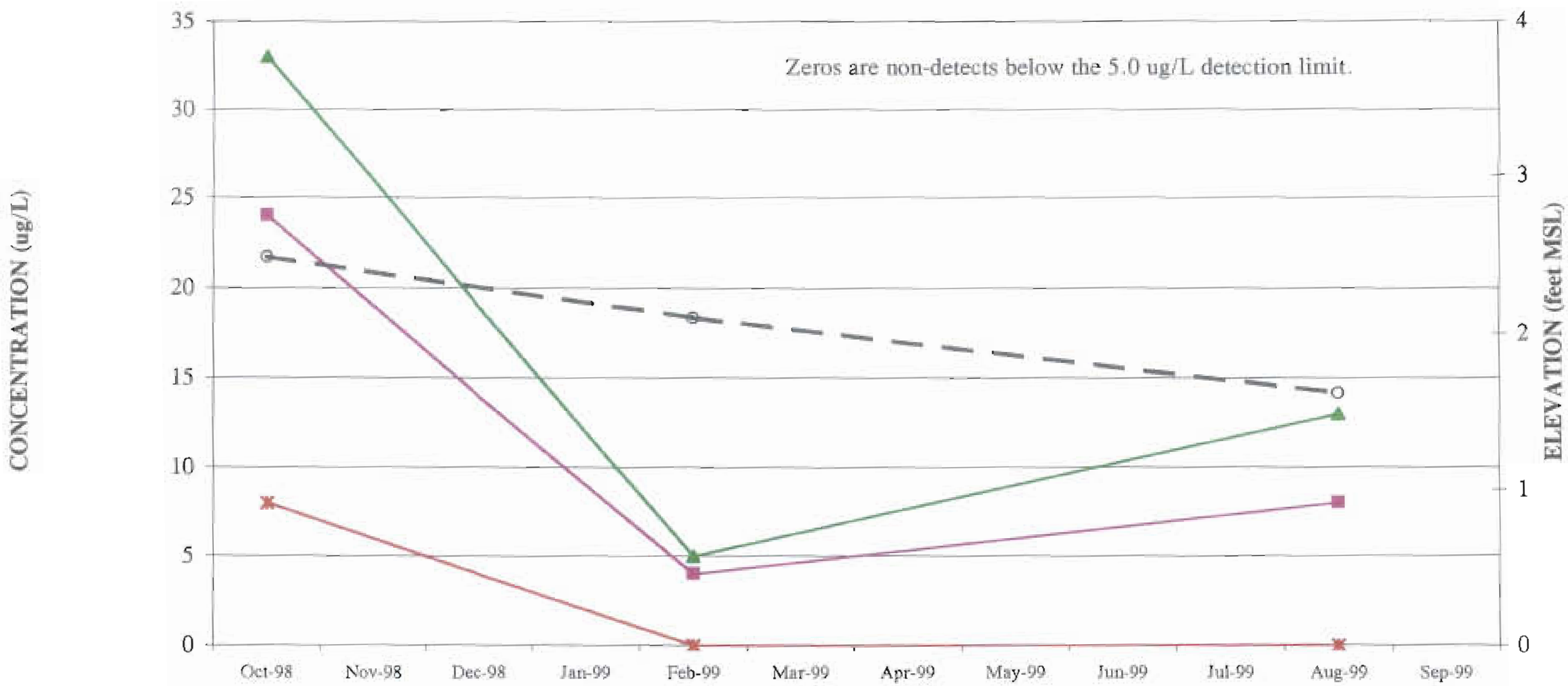

| | 10/8/98 | 2/15/99 | 8/6/99 |
|---|---|---|---|
| PCE | 25 | 26 | 10 |
| TCE | 110 | 100 | 51 |
| DCEtot | 244 | 253 | 140 |
| VC | 10 | 9.0 | 4.0 |
| 1,1-DCE | 6.0 | 6.0 | 0 |
| 1,1-DCA | 5.0 | 5.0 | 0 |
| wl elev | 2.35 | 1.79 | 1.97 |

**Figure B-47**
**039018 VOC HISTORY**



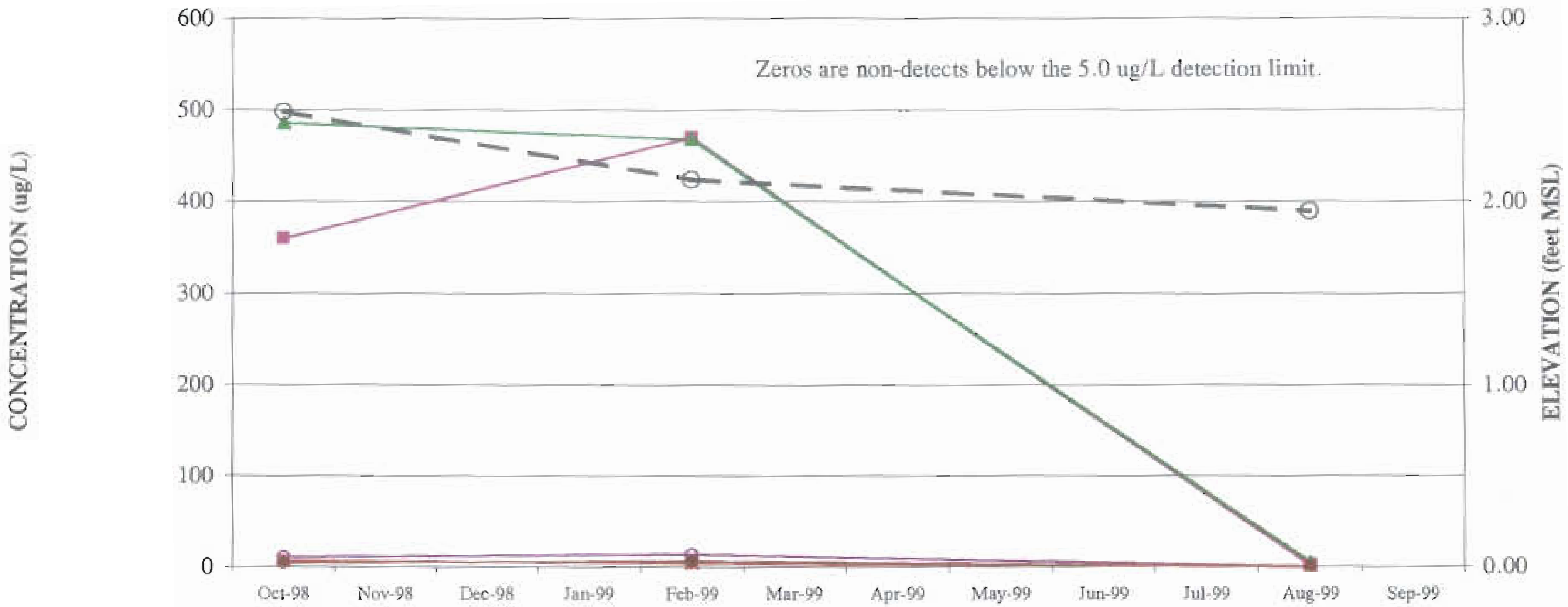

| | 10/7/98 | 2/16/99 | 8/6/99 |
|---|---|---|---|
| TCE | 2.0 | 15 | 3.0 |
| DCEtot | 9.0 | 15 | 10 |
| wl elev | 2.88 | 2.53 | 2.49 |

**Figure B-48**
**03918I VOC HISTORY**



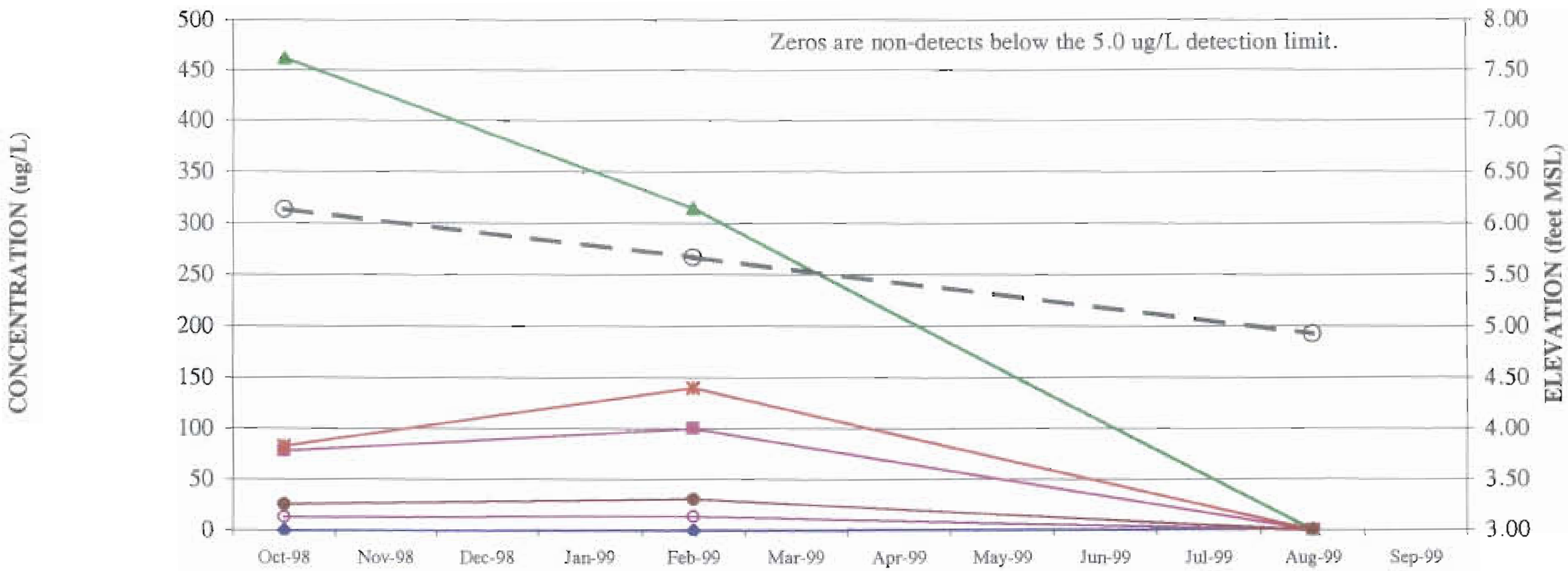

| | 10/7/98 | 2/16/99 | 8/5/99 |
|---|---|---|---|
| TCE | 24 | 4.0 | 8.0 |
| DCEtot | 33 | 5.0 | 13 |
| VC | 8.0 | 0 | 0 |
| wl elev | 2.48 | 2.10 | 1.62 |

**Figure B-49**
**03918D VOC HISTORY**




| | 10/7/98 | 2/16/99 | 8/5/99 |
|---|---|---|---|
| TCE | 360 | 470 | 2.0 |
| DCEtot | 486 | 468 | 5.0 |
| VC | 7.0 | 4.0 | 0 |
| 1,1-DCE | 11 | 14 | 0 |
| 1,1-DCA | 5.0 | 6.0 | 0 |
| wl elev | 2.49 | 2.12 | 1.95 |

**Figure B-50**
**03919I VOC HISTORY**

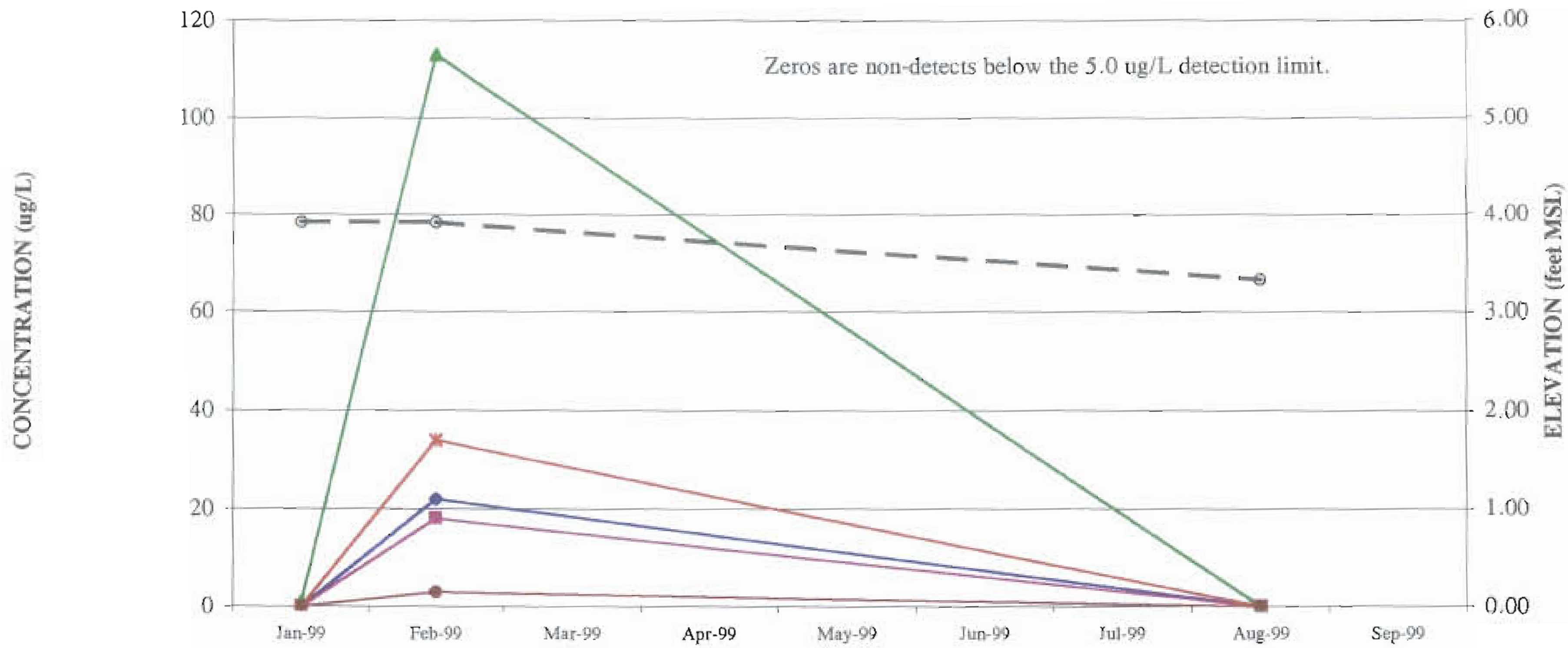



| | 10/8/98 | 2/19/99 | 8/7/99 |
|---|---|---|---|
| PCE | 0 | 0 | 1.0 |
| TCE | 78 | 100 | 0 |
| DCEtot | 462 | 315 | 0 |
| VC | 83 | 140 | 0 |
| 1,1-DCE | 13 | 14 | 0 |
| 1,1-DCA | 26 | 31 | 0 |
| wl elev | 6.14 | 5.67 | 4.93 |

**Figure B-51**
**03919D VOC HISTORY**


| | 10/8/98 | 2/19/99 | 8/7/99 |
|---|---|---|---|
| TCE | 0 | 3.0 | 0 |
| DCEtot | 0 | 28 | 0 |
| VC | 0 | 3.0 | 0 |
| 1,1-DCA | 0 | 1.0 | 0 |
| TOL | 0 | 3.0 | 0 |
| wl elev | 2.06 | 1.86 | 1.54 |

**Figure B-52**
**03920I VOC HISTORY**




| | 1/15/99 | 2/17/99 | 8/8/99 |
|---|---|---|---|
| PCE | 0 | 22 | 0 |
| TCE | 0 | 18 | 0 |
| DCEtot | 1.0 | 113 | 0 |
| VC | 0 | 34 | 0 |
| 1,1-DCA | 0 | 3.0 | 0 |
| wl elev | 3.92 | 3.92 | 3.33 |

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW
## AOC 039 VI SAMPLES



| SW-VOA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-G-W009-V1 | | 039-G-W020-V1 | | 039-G-W021-V1 | | 039-G-W09D-V1 | | 039-G-W09I-V1 | | 039-G-W20D-V1 | |
| | ORIGINAL ID -----> | 039GW009V1 | | 039GW020V1 | | 039GW021V1 | | 039GW09DV1 | | 039GW09IV1 | | 039GW20DV1 | |
| | LAB SAMPLE ID ---> | 37122.08 | | 37122.03 | | 37122.09 | | 37122.06 | | 37122.07 | | 37122.01 | |
| | ID FROM REPORT --> | 039GW009V1 | | 039GW020V1 | | 039GW021V1 | | 039GW09DV1 | | 039GW09IV1 | | 039GW20DV1 | |
| | SAMPLE DATE -----> | 01/18/99 | | 01/15/99 | | 01/18/99 | | 01/18/99 | | 01/18/99 | | 01/15/99 | |
| | DATE ANALYZED ---> | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Water | | Water | |
| | UNITS -----------> | UG/L | | UG/L | | UG/L | | UG/L | | UG/L | | UG/L | |
| CAS # | Parameter | 37122 | VAL | 37122 | VAL | 37122 | VAL | 37122 | VAL | 37122 | VAL | 37122 | VAL |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-01-4 | Vinyl chloride | 8. | | 5. | U | 5. | U | 5. | U | 3. | J | 5. | U |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-64-1 | Acetone | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 1. | J | 5. | U | 5. | U | 5. | U |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 4. | J |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U | 3. | J | 5. | U | 5. | U | 5. | U | 1. | J |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 124-48-1 | Dibromochloromethane | 5. | U | 1. | J | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-43-2 | Benzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-88-3 | Toluene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-42-5 | Styrene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | 32. | | 5. | U | 5. | U | 5. | U | 11. | | 5. | U |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 1634-04-4 | Methyl tert-butyl ether | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW
## AOC 039 VI SAMPLES



| SW-VOA | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-G-W20I-V1 | | 039-G-W21D-V1 | | 039-G-W21I-V1 | | | | |
| | ORIGINAL ID -----> | 039GW20IV1 | | 039GW21DV1 | | 039GW21IV1 | | | | |
| | LAB SAMPLE ID ---> | 37122.02 | | 37122.04 | | 37122.05 | | | | |
| | ID FROM REPORT --> | 039GW20IV1 | | 039GW21DV1 | | 039GW21IV1 | | | | |
| | SAMPLE DATE -----> | 01/15/99 | | 01/15/99 | | 01/16/99 | | | | |
| | DATE ANALYZED ---> | 01/20/99 | | 01/20/99 | | 01/20/99 | | | | |
| | MATRIX ----------> | Water | | Water | | Water | | | | |
| | UNITS -----------> | UG/L | | UG/L | | UG/L | | | | |
| CAS # | Parameter | 37122 | VAL | 37122 | VAL | 37122 | VAL | | | |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 5. | U | | | |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 5. | U | | | |
| 75-01-4 | Vinyl chloride | 5. | U | 5. | U | 5. | U | | | |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 5. | U | | | |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 5. | U | | | |
| 67-64-1 | Acetone | 5. | UR | 5. | UR | 5. | UR | | | |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 5. | U | | | |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 5. | U | | | |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 5. | U | | | |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 5. | U | | | |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 5. | U | | | |
| 78-93-3 | 2-Butanone (MEK) | 5. | UR | 5. | UR | 5. | UR | | | |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 5. | U | | | |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 5. | U | | | |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 5. | U | | | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U | 5. | U | 5. | U | | | |
| 75-27-4 | Bromodichloromethane | 6. | | 8. | | 2. | J | | | |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 5. | U | | | |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | | | |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 5. | U | | | |
| 124-48-1 | Dibromochloromethane | 4. | J | 2. | J | 1. | J | | | |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 5. | U | | | |
| 71-43-2 | Benzene | 5. | U | 5. | U | 5. | U | | | |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | | | |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | UR | 5. | UR | 5. | UR | | | |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 5. | U | | | |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 5. | U | | | |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 5. | U | | | |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 5. | U | | | |
| 108-88-3 | Toluene | 5. | U | 1. | J | 5. | U | | | |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 5. | U | | | |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 5. | U | | | |
| 100-42-5 | Styrene | 5. | U | 5. | U | 5. | U | | | |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | | | |
| 156-59-2 | cis-1,2-Dichloroethene | 1. | J | 5. | U | 5. | U | | | |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 5. | U | | | |
| 1634-04-4 | Methyl tert-butyl ether | 5. | U | 5. | U | 5. | U | | | |

*** Validation Complete ***

# HEARTLAND
ENVIRONMENTAL SERVICES, INC.

## Data Validation Report

| | |
|---|---|
| SDG#: | 37122 |
| Date: | March 9, 1999 |
| Client Name: | Ensafe |
| Project/Site Name: | Charleston Zone A |
| Date Sampled: | January 15, 16, 18, 1999 |
| Number of Samples: | 10 Aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Southwest Laboratory of Oklahoma |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fractions: | Volatiles |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Erica K Ketcham                3/9/99

Paul B. Humburg, President                Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

**SDG# 37122**

## Samples and Fractions Reviewed

Sample Identifications    Analytical Fraction

| ENSAFE ID | MATRIX | VOA | |
|---|---|---|---|
| 039GW009V1 | WATER | X | |
| 039GW020V1 | WATER | X | |
| 039GW021V1 | WATER | X | |
| 039TW021V1 | WATER | X | |
| 039GW09DV1 | WATER | X | |
| 039GW09IV1 | WATER | X | |
| 039GW20DV1 | WATER | X | |
| 039GW20IV1 | WATER | X | |
| 039GW21DV1 | WATER | X | |
| 039GW21IV1 | WATER | X | |
| Total Billable Samples (Water/Soil) | | 10 | 0 |

VOA= Volatiles

# DATA ASSESSMENT AND NARRATIVE

# VOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8260; the National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results.

**SDG # 37122**

A validation was performed on the Volatile Data from SDG 37122. The data was evaluated based on the following parameters.

- * Data Completeness
- * Holding Times
- * GC/MS Tuning
- Calibrations
- * Internal Standard Performance
- * Blanks
- * Surrogate Recoveries
- * Laboratory Control Samples
- * Field Duplicates
- * Compound Identification /Quantitation

* - All criteria were met for this parameter

## DATA ASSESSMENT AND NARRATIVE

## VOLATILE ANALYSIS



### Initial Calibration

The initial calibration, analyzed on 01-18-99, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

| | |
|---|---|
| All samples | acetone (0.021) |

### Continuing Calibration

The continuing calibration, UL7837.D, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

| | |
|---|---|
| All samples | acetone (0.025)<br>2-butanone (0.049)<br>2-chloroethyl vinyl ether (0.031) |

### System Performance and Overall Assessment

The data as presented requires qualifications.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| All samples | acetone | +/- | J/UR |
| All samples | acetone<br>2-butanone<br>2-chloroethyl vinyl ether | +/- | J/UR |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

HEARTLAND ESI VOA 1 HESI94.1

MULTI-MEDIA VOLATILE ORGANIC FRACTION

CASE NUMBER:________ SDG NUMBER: 37122

LABORATORY: SWL-Tulsa

CLIENT: EnSafe PROJECT: Charleston Zone A Rel 99-1

REVIEWER: WM DATE: 3-9-99

QA/QC LEVEL

- ☐ NEESA C
- ☐ NEESA D
- ☒ DQO LEVEL III
- ☐ DQO LEVEL IV
- ☐ ________

Statement Of Work (SOW)

- ☐ CLP 3/90
- ☐ CLP 2/88
- ☐ SW846 8240
- ☐ SW846 8240 Appendix IX
- ☒ 8260

ANALYSIS MODIFICATIONS:________

## VOLATILE HOLDING TIMES

| | |
|---|---|
| CLP/SW846 : | 14 days from date of sampling (If properly preserved) |
| Region I : | 10 days from VTsR |
| Region III : | 14 days from date of sampling (If properly preserved) |
| NYSDEC : | 7 days from date VTSR |

1. Were the holding times met for the all volatile analysis? YES NO

If yes, complete the following form for all samples that exceeded holding times.

| EPA SAMPLE NO. | MATRIX | VTSR OR DATE SAMPLED | DATE OF ANALYSIS | DA | Action |
|---|---|---|---|---|---|
| | | | | | |
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WM 3/9/9

**Action:** DA - The number of days that the holding time was exceeded.

| | |
|---|---|
| DA $\leq$ 5: | Qualify all positive results as estimated (J). |
| DA $>$ 5 $\leq$ 15: | Qualify all positive results as estimated (J) and all non detects estimated (UJ). |
| DA $>$ 15: | Qualify all positive results estimated (J) and reject all non detects. |

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

PROJECT/JOB NO:
COC NO:
PO NO: #4
REL NO: 81
LAB NAME: SWL

CLIENT: NAVBASE CHARLESTON
PROJECT MANAGER: C. Vernoy
LOCATION: ZONE A, SWMU 39
TELE/FAX NO. 843-884-0029
SAMPLERS: (SIGNATURE) TK Kyle

ANALYSIS REQUIRED

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | VOAs | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| Ø39GW2ØDV1 | 1/15/99 | 1155 | H2O | 40ML VIAL | 4°C | HCl | 2 | X | |
| Ø39GW2ØIV1 | | 1340 | | | | | 2 | X | |
| Ø39GWØ2DV1 | | 1440 | | | | | 2 | X | |
| Ø39GW21DV1 | | 1720 | | | | | 2 | X | |
| Ø39GW21IV1 | 1/16/99 | 1140 | | | | | 2 | X | |
| Ø39GWØ9DV1 | 1/18/99 | 1230 | | | | | 2 | X | |
| Ø39GWØ9IV2 | | 1356 | | | | | 2 | X | |
| Ø39GWØØ9V1 | | 1430 | | | | | 2 | X | |
| Ø39GWØ21V1 | | 1520 | | | | | 2 | X | |
| Ø39TWØ21V1 | | 1550 | | | | | 1 | X | |

TK Kyle
1/18/99

| | | | | | |
|---|---|---|---|---|---|
| RELINQUISHER: Todd K Kyle | DATE 1/18/99 | RECEIVER: | DATE | RELINQUISHER: | DATE |
| PRINTED: TK Kyle | TIME 1630 | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | |

RECEIVER: | DATE | PRINTED: | TIME | COMPANY:

METHOD OF SHIPMENT: FedEx
SHIPMENT NO. 808625948344
SEND RESULTS TO:

COMMENTS: 14 day turn around; MNA VOA List

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

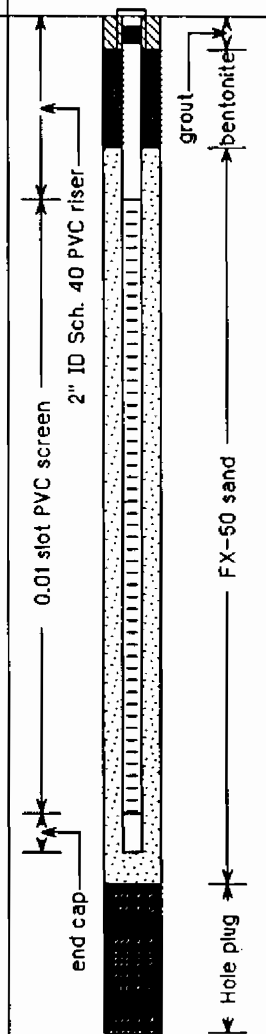
ENSAFE

# Monitoring Well NBCA039016

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315370.73 E, 381079.19 N |
| Location: Charleston, SC | Surface Elevation: 7.9 feet msl |
| Started at 1115 on 9/1/98 | TOC Elevation: 7.71 feet msl |
| Completed at 1200 on 9/1/98 | Depth to Groundwater: 2.70 feet TOC    Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 5.01 feet msl |
| Drilling Company: Alliance Environmental (SC Cert #1437) | Total Depth: 12.7 feet |
| Geologist: T. Kafka | Well Screen: 2.8 to 12.1 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 0–5.5 | | | | | | | | Ground conditions: concrete and asphalt to 0.8 ft. 0-5.5 ft core run blocked off by concrete. | |
| 5.5–15.5 | | | 1 | 0 | 0 | | | Large piece of concrete found in upper 1.5 ft of 2nd run. Logging began beneath concrete as representing top of run. Refer to deep well log NBCA03916D for more accurate depiction of lithology at this well cluster. | 2.4 |
| | | | | | | | SM | Sand: brown to brown-orange; very fine/fine w/ trace med.; silty; saturated. | 2 |
| | | | | | | | SC | Sand: lt. gray w/ orange-brown banding; very fine/fine w/ trace med. in isolated lenses/partings; heavy FeOx stains; clayey (stiff, med. plasticity); moist. | -3.6 |
| | | | | | | | CL SC | Sand: as above w/ increased clay content (firm), moist. | -5.1 |
| 15.5– | | | 2 | 0 | 85 | | | | |

WELL DIAGRAM



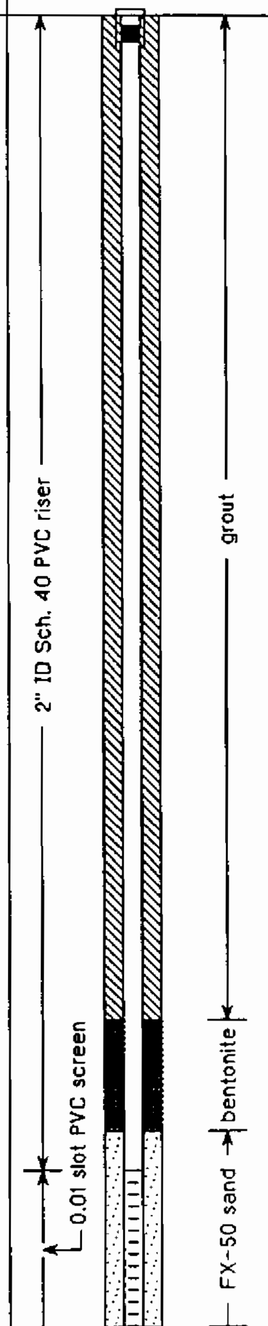
# ENSAFE

# Monitoring Well NBCA03916I

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315369.55 E, 381071.57 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *0755 on 9/1/98* | TOC Elevation: *7.66 feet msl* |
| Completed at *1000 on 9/1/98* | Depth to Groundwater: *4.87 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.79 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *27.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *17.6 to 26.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CONC | Ground conditions: concrete and asphalt to 0.8 ft. | 7 |
| | | | | | | | GP | Gravel: concrete pieces and coarse sand. | 6.5 |
| | | | | | | | SP | Sand: brown; very fine/fine; trace silt; loose; dry to moist. | 5.7 |
| | | | | | | | SC | Sand: orange-brown to orange w/ lt. gray banding increasing w/ depth; very fine/fine w/ trace med.; clayey (med. plasticity); soft to firm; moist. | 3.5 |
| 5 | | | | | | | | | 2.3 |
| | | | 1 | 0 | 64 | | SC | Sand: orange brown w/ lt. gray bands; very fine/med. w/ occ. coarse qtz grains; silty; w/ lt gray, soft to firm, silty, sticky, low plasticity clay; FeOx pits as orange pods; wet. | -.5 |
| | | | | | | | SM | Sand: orange; very fine/fine; silty; some lt. gray clay laminae in last 0.4' ~ 1cm wide; heavy FeOx stains; wet. | -1 |
| 10 | | | | | | | CL/CH, SC | Clay: lt. gray w/ orange-brown pits of FeOx mins; med. plasticity; firm; some silt; w/ fine/med. sand; moist; increased very fine/fine sand content as laminae in last 0.3'. | -1.8, -2.9 |
| | | | | | | | CL/CH | Sand: lt. gray to orange-brown; very fine/fine; heavily oxidized in last 0.3'; clayey; some silt; wet. | -3.6 |
| | | | | | | | SC/SM | Clay: lt. gray w/ orange-brown bands; firm; med. plasticity; some very fine/fine sand; moist. | -5.5 |
| 15 | | | | | | | | Sand: lt. gray w/ orange-brown bands; very fine/fine w/ trace med.; some silt and clay increasing w/ depth; distinct black silty laminae < 1cm wide in last 0.5'; moist. | -7.7 |
| | | | 2 | 0 | 78 | | CH/OH | Clay: lt./med. gray w/ dark green cast; silty; med./high plasticity; firm-stiff; @ 17.5', yellow cracks of few mm size | -11 |
| 20 | | | | | | | SM | Sand: med. brown w/ occ. FeOx pits and small (< 5mm dia.) brown-black patches of silt; very fine/fine; saturated. | |

WELL DIAGRAM



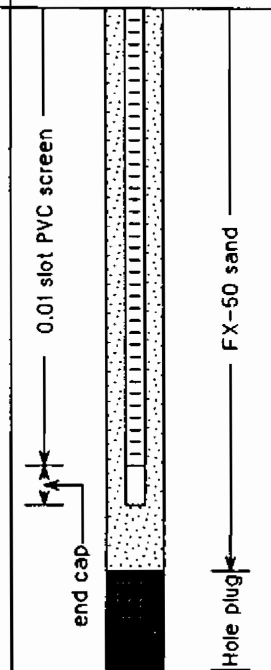
**ENSAFE**

# Monitoring Well NBCA03916I

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315369.55 E, 381071.57 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *0755 on 9/1/98* | TOC Elevation: *7.66 feet msl* |
| Completed at *1000 on 9/1/98* | Depth to Groundwater: *4.87 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.79 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *27.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *17.6 to 26.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM | | -13 |
| | | | | | | | CH | Clay: med. brown-gray w/ occ. orange FeOx bands; silty; med. plasticity; firm-stiff. | -13.4 |
| | | | | | | | SM | Sand: med. brown w/ FeOx banding in last 0.6'; very fine/fine; some silt; saturated. | -14.6 |
| | | | | | | | CL | Clay: lt. gray to orange; silty; med. plasticity; soft to firm; occ. <1 cm wide very fine/fine sand laminae. | -15.1 |
| 25 | | | 3 | 0 | 100 | | SP | Sand: lt. gray to buff white; very fine/fine w/ trace med. but fining w/ depth; @ 23.4-23.7' dark gray clay lense w/ small FeOx band; increased clay content in last 0.2'. | -17.7 |
| | | | | | | | SM | Sand: brown-gray; very fine/fine; some silt; @ 26.7-26.9' dark gray silty clay lens; saturated. | -19.5 |
| 30 | | | 4 | 0 | 100 | | OL CL | Clay: dark gray; silty; occ. very fine/fine lt gray sand in top 1'; soft to firm. | -22.2 |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



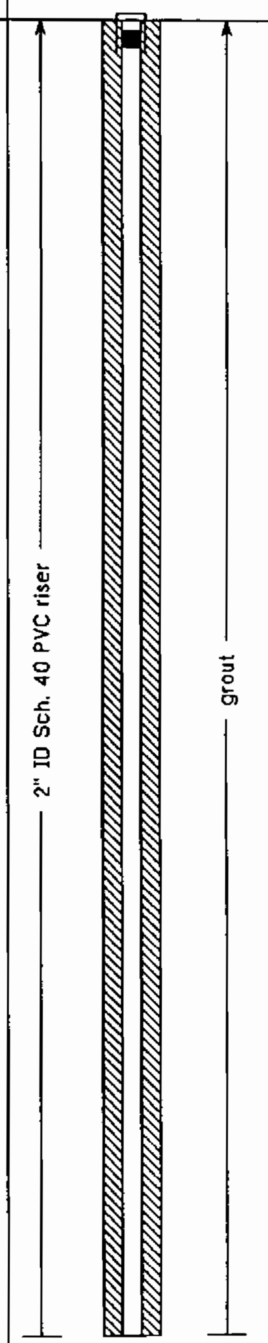
**ENSAFE**

# Monitoring Well NBCA03916D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315368.36 E, 381063.32 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *1320 on 8/31/98* | TOC Elevation: *7.64 feet msl* |
| Completed at *1750 on 8/31/98* | Depth to Groundwater: *4.94 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.70 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *49.0 feet* |
| Geologist: *T. Kafka* | Well Screen: *39.1 to 48.4 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CONC | Ground conditions: concrete and asphalt to 0.8 ft. | 7 |
| | | | | | | | SM | Sand: med. brown; silty; very fine/fine; loose; dry to moist. | 6 |
| | | | | | | | SC | Sand: med. brown to orange-brown w/ some lt. gray bands in last 0.4'; very fine/fine; clayey; trace silt; moist. | 4.7 |
| 5 | | | | | | | | | 2.3 |
| | | | 1 | 0 | 42 | | SM/SC | Sand: med. brown w/ some orange; very fine/fine; silty; clayey in lt. gray bands, low/med. plasticity; wet. | .7 |
| | | | | | | | SC/CL | Sand: med. brown to lt. blue-gray; fine/medium w/ occ. coarse qtz grains; ~10% FeOx pits; clayey; trace-some silt; moist. | -.7 |
| 10 | | | | | | | SM/SP | Sand: brown to orange; very fine/medium grading to very fine/fine at 9.2'; some silt; FeOx stained; wet. | -3.1 |
| | | | | | | | CL/CH | Clay: med. gray to blue-gray w/ heavy FeOx staining in top 0.7'; silty; med. plasticity; firm; moist. | -4.1 |
| | | | | | | | CL | Clay: med. gray w/ orange-brown pits/bands; low/med. plasticity; soft to firm; w/ very fine/fine sand and silt; 3-5" sand pods at 12.2', 13.8', and 14.3'. | -7.2 |
| 15 | | | 2 | 0 | 100 | | CH | Clay: dark gray to blue-gray w/ brown FeOx pits; silty; high plasticity; firm-stiff; moist. | |
| | | | | | | | CH | Clay: green-gray; silty; high plasticity; stiff; moist; grades to med. gray in last 0.6' w/ FeOx pits. | -10.5 |
| 20 | | | | | | | SP | Sand: lt. tan to brown w/ yellow, brown, orange mottling/pits; very fine/fine; unusual dk brown to black stains @ 19.7-20.6'; heavily oxidized in last 0.4'; saturated. | |

WELL DIAGRAM



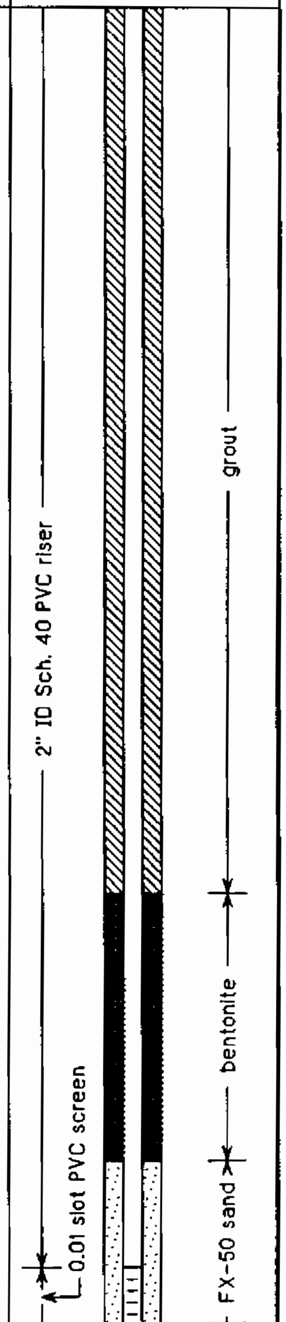
ENSAFE

# Monitoring Well NBCA03916D

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315368.36 E, 381063.32 N |
| Location: Charleston, SC | Surface Elevation: 7.8 feet msl |
| Started at 1320 on 8/31/98 | TOC Elevation: 7.64 feet msl |
| Completed at 1750 on 8/31/98 | Depth to Groundwater: 4.94 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.70 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 49.0 feet |
| Geologist: T. Kafka | Well Screen: 39.1 to 48.4 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | @ 20.6', lense of med. orange-brown, silty, stiff, medium plasticity clay. @ 22.2', lt. gray clay laminae @ 22.6', 0.3' lens of very fine/med. sand (SW) | -15.1 |
| | | | | | | | SM/SC | Sand: bright orange to red; very fine/fine; w/ 0.5 cm thick clay laminae. | -15.8 |
| | | | | | | | CH | Clay: dark gray; silty; firm to stiff; moist. | -16.1 |
| 25 | | | | | | | SP | Sand: brown to buff white; very fine/fine; clean; saturated; 0.2' of dark gray, silty clay @ 25.1'. | -17.5 |
| | | | 3 | 0 | 98 | | SP | | -17.7 |
| | | | | | | | SP/CL | Sand: brown to med. gray; very fine/fine; trace silt and black grains | -18.3 |
| | | | | | | | | Sand: med. gray; very fine/fine; w/ occ. dark gray clay interbedded; wet. | -19.4 |
| 30 | | | | | | | CH/OH | Clay: dark green-gray; silty; med./hi plasticity; stiff; some interbedded very fine/fine sand in last 0.5'. | -23.4 |
| | | | | | | | SW | Sand: green-gray to gray; very fine/fine w/ extensive coarse shell hash @ 31.2–31.7'; trace-some silt; shell hash frags up to 2 cm dia.; wet. | -24.7 |
| 35 | | | | | | | | | -27.7 |
| | | | 4 | 0 | 70 | | SP | Sand: lt. green to green-white; very fine/fine w/ trace med. @ 38.4– 40.5'; high conc. of black grains throughout; saturated. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



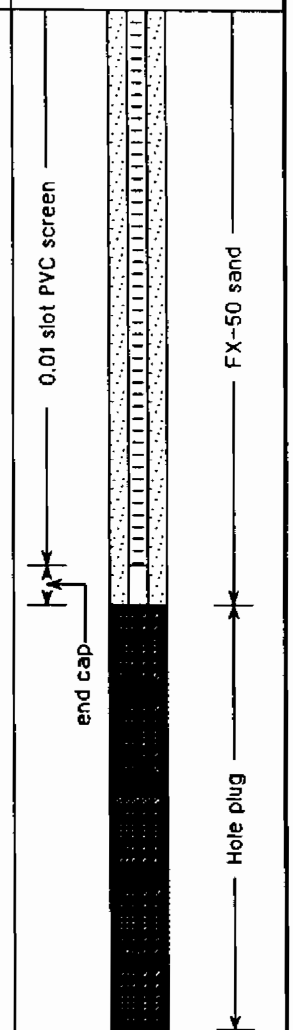
ENSAFE

# Monitoring Well NBCA03916D

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315368.36 E, 381063.32 N |
| Location: Charleston, SC | Surface Elevation: 7.8 feet msl |
| Started at 1320 on 8/31/98 | TOC Elevation: 7.64 feet msl |
| Completed at 1750 on 8/31/98 | Depth to Groundwater: 4.94 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.70 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 49.0 feet |
| Geologist: T. Kafka | Well Screen: 39.1 to 48.4 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | | -34.1 |
| | | | | | | | CH / OH | Clay: dark gray; silty; very fine/fine sand present as partings; firm to stiff; med./high plasticity; moist. | -36.1 |
| 45 | | | | | | | SW | Sand & shell hash: med. gray; very fine/crs. sand and qtz w/ very fine/very coarse shell hash; silty; occ. dark gray clay pods; wet. | -37.2 |
| | | | 5 | 0 | 95 | | | | -37.7 |
| | | | | | | | SW | Sand/Shell hash/Gravel: Lag bed of very fine/coarse sand increasing in size to granules and pebbles; whole oyster & clam shells; very fine to very coarse shell hash; $PO_4$ nodules up to 3" dia., rounded to angular. | -41.4 |
| 50 | | | | | | | ML / CL | Silt: olive-green to olive-brown; clayey; some very fine/fine sand decreasing w/ depth; firm to stiff; moist. | |
| 55 | | | 6 | 0 | 100 | | | | -47.7 |
| 60 | | | | | | | | | |

WELL DIAGRAM



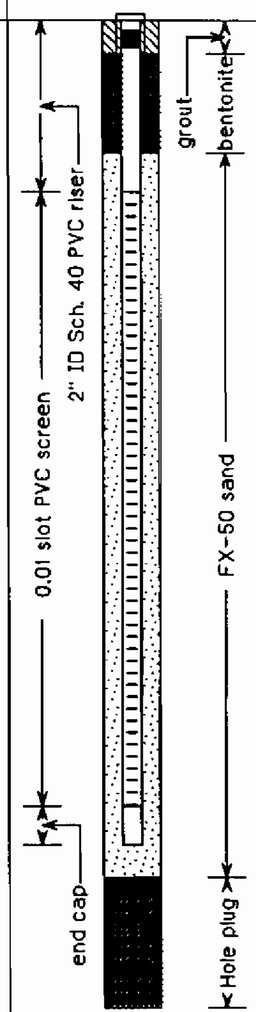
# ENSAFE

## Monitoring Well NBCA039017

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315589.94 E, 381082.59 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.8 feet msl* |
| Started at *1650 on 8/28/98* | TOC Elevation: *8.64 feet msl* |
| Completed at *1735 on 8/28/98* | Depth to Groundwater: *5.88 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.76 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *12.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *2.6 to 11.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CONC | Ground conditions: concrete and asphalt to 0.8 ft. | 8 |
| | | | | | | | SC / CL | Sand: olive-brown to yellow-green; very fine/fine; silty; clayey; firm in last 0.3'; moist. | 6.7 |
| | | | | | | | SM / SC | Sand: dark brown-black; very fine/fine; silty; organic-rich w/ roots; loose; dry; @ 2.5' grades to lt. gray clayey sand w/ green-blue, med. plasticity clay pods and 1-2 cm wide laminae throughout. | 5 |
| 5 | | | 1 | 0 | 60 | | | | 3.8 |
| | | | | | | | SM | Sand: olive-brown to brown w/ lt. gray-blue lenses; very fine/fine; silty; moist. | 2.9 |
| | | | | | | | ML | Silt: olive-brown, marl fill, debris included. | 2.6 |
| | | | | | | | SM / ML | Sand: brown to olive-brown; very fine/fine; silty; saturated to flowing. | 1.1 |
| 10 | | | | | | | SC / CL | Sand: blue-green w/ orange-red to red-brown lenses/pits; heavy FeOx stains; very fine/medium; silty; clayey (soft to firm); stiff; moist. | 5.5 |
| 15 | | | 2 | 0 | 100 | | SM / SP | Sand: orange-brown to tan; very fine/medium; heavy FeOx stains in top 0.3'; silty; loose; moist; last 0.2' is clean beach sand. | 6.2 |
| 20 | | | | | | | | | |

WELL DIAGRAM



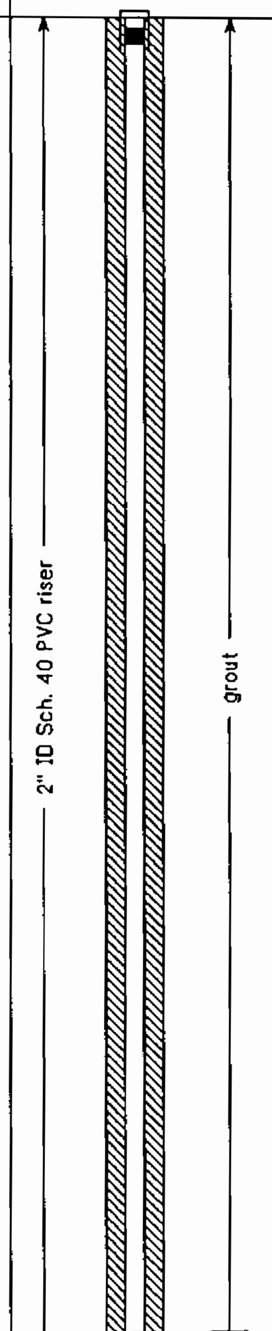
# ENSAFE

## Monitoring Well NBCA03917I

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315595.44 E, 381083.52 N |
| Location: Charleston, SC | Surface Elevation: 8.8 feet msl |
| Started at 1415 on 8/28/98 | TOC Elevation: 8.52 feet msl |
| Completed at 1605 on 8/28/98 | Depth to Groundwater: 4.87 feet TOC  Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 3.65 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 33.8 feet |
| Geologist: T. Kafka | Well Screen: 23.9 to 33.2 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CONC | Ground conditions: concrete and asphalt to 0.8 ft. | 8 |
| | | | | | | | SM SC | Sand: med. brown and orange; very fine/fine; silty; clayey; moist. | 7 |
| | | | | | | | CL CH | Clay: med. brown w/ orange & gray mottling; silty; trace-some very fine/fine sand; high plasticity; stiff. | 6.7 |
| | | | | | | | SP | Sand: lt. tan to buff white; very fine/fine; trace-some silt; loose; dry. | 5.8 |
| | | | | | | | CL | Clay: olive-brown w/ orange & gray mottling; some very fine/fine sand; silty; stiff; moist. | 5.3 |
| | | | | | | | SM | Sand: olive-brown to black; interbedded w/ bands of silt; trace-some clay; loose; moist. | 4.8 |
| 5 | | | 1 | 0 | 58 | | SM | Sand: brown; very fine/fine; silty; soft; wet. | 3.3 |
| 10 | | | | | | | SC CL | Sand: blue-green w/ orange FeOx bands; very fine/fine; w/ soft clay; in last 2', clay becomes firm and grain size inc. to med.; moist. | .5 |
| 15 | | | 2 | 0 | 100 | | SW SM | Sand: orange w/ red-brown and gray mottling; very fine/medium; silty; occ. FeOx concretions in red pits; moist. | -6 |
| 20 | | | | | | | SP | Sand: lt. tan to lt. orange-tan to tan-white; very fine/fine; trace silt; loose; black grain laminae of 1-2 cm wide, irregularly spaced in last 5.5'; moist. | -6.7 |

WELL DIAGRAM



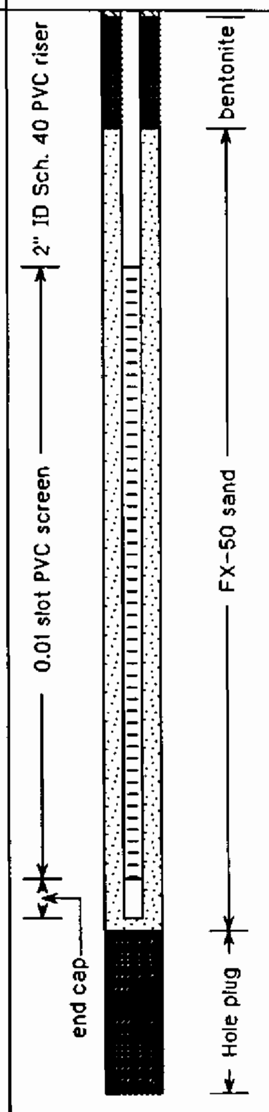
# ENSAFE

## Monitoring Well NBCA03917I

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315595.44 E, 381083.52 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.8 feet msl* |
| Started at *1415 on 8/28/98* | TOC Elevation: *8.52 feet msl* |
| Completed at *1605 on 8/28/98* | Depth to Groundwater: *4.87 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *3.65 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *33.8 feet* |
| Geologist: *T. Kafka* | Well Screen: *23.9 to 33.2 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | | |
| | | | | | | | | | 15.7 |
| 25 | | | | | | | | | |
| | | | 3 | 0 | 90 | | | | 16.7 |
| | | | | | | | SP | Sand: lt. tan to buff white; very fine/fine; clean; occ. black grain laminae <1-2 cm thick; loose; wet. | |
| 30 | | | | | | | | | |
| | | | | | | | | | 25.2 |
| 35 | | | | | | | | | |
| | | | 4 | 0 | 85 | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



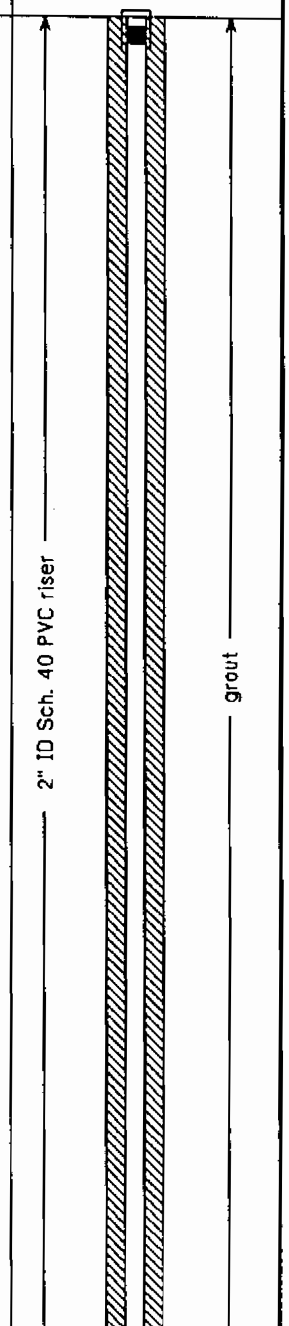
ENSAFE

# Monitoring Well NBCA03917D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315601.57 E, 381084.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.8 feet msl* |
| Started at *0850 on 8/28/98* | TOC Elevation: *8.59 feet msl* |
| Completed at *1300 on 8/28/98* | Depth to Groundwater: *5.84 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.75 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *52.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *42.6 to 51.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CONC | Ground conditions: concrete and asphalt to 0.8 ft. | 8 |
| | | | | | | CL | Clay: orange-brown; silty; w/ very fine/fine sand; soft; moist. | 7.2 |
| | | | | | | SC | Sand: lt. gray to white; very fine/fine; trace silt; clayey; occ. lenses of firm, silty, med plasticity clay. | 5.7 |
| | | | | | | CL | Clay: orange-brown w/ FeOx mottling; silty; w/ very fine/fine sand; soft; low plasticity. | 5.5 |
| | | | | | | SC | | 5.3 |
| 5 | | | 1 | 0 | 49 | SP | Sand: med. gray; very fine/fine; lt. brown/black silty laminae; loose; moist. | 3.3 |
| | | | | | | SM | Sand: brown to gray-brown; silty; very fine/fine; wet. | 2.8 |
| 10 | | | | | | SC | Sand: lt. blue-gray to green-gray w/ olive-brown banding; very fine/ fine w/ occ. very fine/med. 1-2 cm lenses of silt; clayey; moist. | 3.4 |
| | | | | | | SC / CL | Sand: as above w/ increased orange banding ~1.5 cm wide; increased clay content, firm to stiff; increased sand content in last 0.5'. | 5.4 |
| 15 | | | | | | SM | Sand: orange to rust-brown; fine/medium w/ trace-some silt; moist. | 5.9 |
| | | | 2 | 0 | 100 | SP / SM | Sand: med. orange to orange-brown; very fine/fine; trace silt; occ. FeOx concretions ~ 3cm dia.; moist. | 6.7 |
| 20 | | | | | | SP | Sand: lt. brown to lt. gray; very fine/fine; ~15% black grains; loose; moist. | |

WELL DIAGRAM



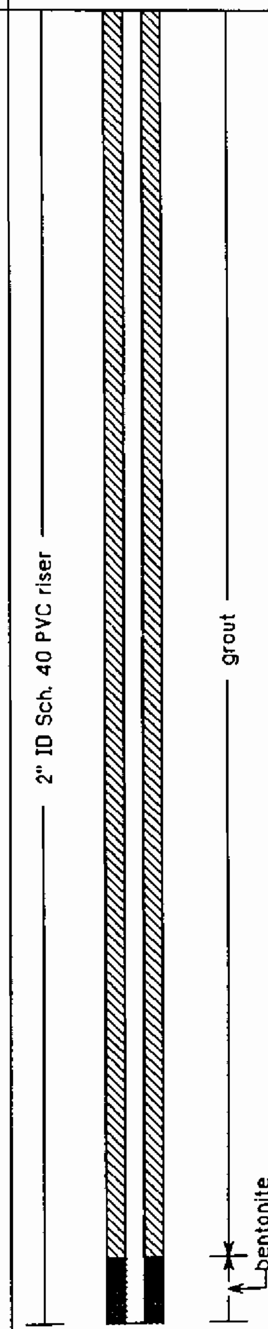
# ENSAFE

## Monitoring Well NBCA03917D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315601.57 E, 381084.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.8 feet msl* |
| Started at *0850 on 8/28/98* | TOC Elevation: *8.59 feet msl* |
| Completed at *1300 on 8/28/98* | Depth to Groundwater: *5.84 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.75 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *52.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *42.6 to 51.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | @ 20', grading to lt. gray to buff white; black grains layered in 1 cm lenses; loose; wet. | |
| 25 | | | | | | | | | -16.2 |
| | | | 3 | 0 | 95 | | SP | Sand: lt./med. gray w/ buff white; very fine/fine; loose; 10-20% black grains; wet. | -16.7 |
| 30 | | | | | | | | | |
| | | | | | | | | at 34', color change to lt./med. tan. | |
| 35 | | | | | | | | | -26.2 |
| | | | 4 | 0 | 95 | | SP | Sand: lt./med. tan w/ some gray; very fine/fine; trace silt; loose; ~10-15% black grains; wet. | -26.7 |
| | | | | | | | | @ 39.5', color change to orange-tan w/ dec. in black grains to < 5%; occ. pits of black grains in bottom 1.5'. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



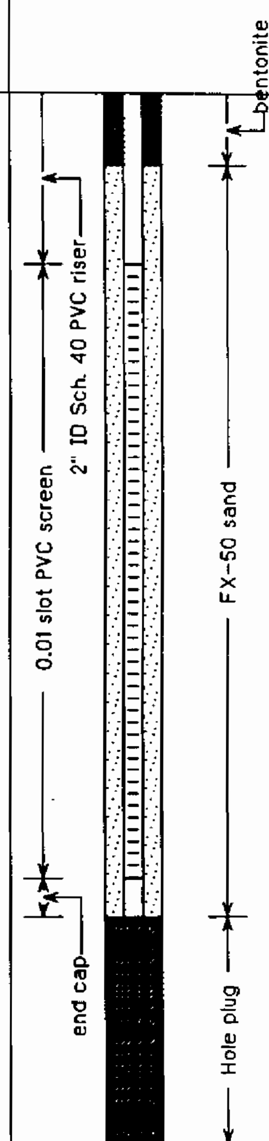
ENSAFE

# Monitoring Well NBCA03917D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315601.57 E, 381084.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.8 feet msl* |
| Started at *0850 on 8/28/98* | TOC Elevation: *8.59 feet msl* |
| Completed at *1300 on 8/28/98* | Depth to Groundwater: *5.84 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.75 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *52.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *42.6 to 51.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | @ 41.5', ~0.5" thick silty, clay laminae, soft, sticky, low plasticity | -35.7 |
| 45 | | | 5 | 0 | 90 | | | | -36.7 |
| | | | | | | | SP / SM | Sand: med. to lt. tan w/ some orange bands; very fine/fine; trace to some silt; wet. | -38.2 |
| 50 | | | | | | | SM / SW | Sand: brown to orange-brown; fine/med.; moderately sorted; <5% very fine/fine shell hash; black grains intermixed; @ 50', increase in shell content to 10-15% w/ pieces as large as 0.6"; occ. qtz pebbles and possible $PO_4$ nodules. | -42.2 |
| | | | | | | | SW | Sand: tan to orange-brown; crs qtz granules;$PO_4$ nodules <2cm dia. occ. clasts of buff white silt intermixed. | -43 |
| | | | | | | | ML / SM | | -43.4 |
| | | | | | | | ML / CL | Silt: brown to lt. gray-brown; some very fine/fine sand and clay; mottled texture; low plasticity; soft; sticky. | |
| 55 | | | 6 | 0 | 100 | | | Silt: olive-green; trace very fine/fine sand dec. in content w/ depth; some low plasticity, firm-stiff, clay; dry-moist. | -46.7 |
| 60 | | | | | | | | | |

WELL DIAGRAM



**ENSAFE**

# Monitoring Well NBCA039018

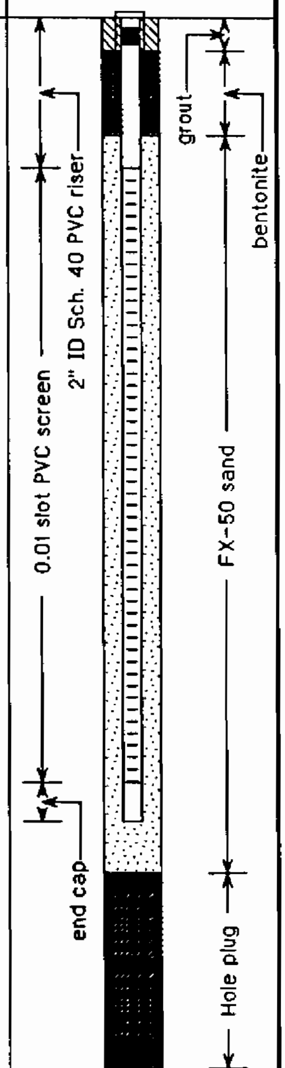
| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315717.92 E, 381350.24 N |
| Location: Charleston, SC | Surface Elevation: 8.8 feet msl |
| Started at 1025 on 9/2/98 | TOC Elevation: 8.54 feet msl |
| Completed at 1145 on 9/2/98 | Depth to Groundwater: 5.53 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 3.01 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 12.2 feet |
| Geologist: T. Kafka | Well Screen: 2.3 to 11.6 feet |

| SAMPLE NO. | OVA (ppm) | % RECOVERY |
|---|---|---|
| 1 | 0 | 88 |
| 2 | 0 | 85 |

| SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|
| | Ground conditions: asphalt | 8.1 |
| WOOD | Wood: creosote timber w/ sandy gravel; heavy chem. odor. | |
| SM SC | Sand: tan grading to gray; very fine/fine; silty; w/ lt. gray to red silty, firm clay lens @ 1.6-1.9'; wood frags and roots; fill sand. | 5.7 |
| CL SC | Clay: red to orange-red w/ lt. gray mottling; firm-stiff; silty; w/ very fine/fine sand; rubber strands at 3.5-3.5'; moist. | 4.6 |
| SC | Sand: lt. gray w/ black silty laminae in top 0.3'; very fine/fine; clayey; silty; wet. | 3.9 |
| | | 3.3 |
| SM SW | Sand: olive-green to gray w/ dark black banding; very fine/fine w/ trace med.; fine/med. w/ trace crs @ 7-7.3'; silty; clayey; wet. | 1.3 |
| SM SC | Sand: orange w/ dark brown banding; fine/med. w/ trace crs; silty; occ. qtz granules; wet. | .7 |
| SC CL | Sand: lt. orange to gray; very fine/fine; silty; clayey; FeOx pits in top 0.2'. | -1.2 |
| SM | Sand: orange; very fine/fine; silty; saturated. | -1.8 |
| CL | Clay: lt. gray w/ orange-brown FeOx pits/bands; silty; low plasticity; soft-firm; w/ very fine/fine sand; wet. | -2.2 |
| SM | Sand: orange; very fine/fine; silty; occ. 5mm wide lt. gray clay partings; 10% brown pits of heavy mins in last 1'; saturated. | -5.2 |

DEPTH IN FEET: 5, 10, 15, 20

## WELL DIAGRAM



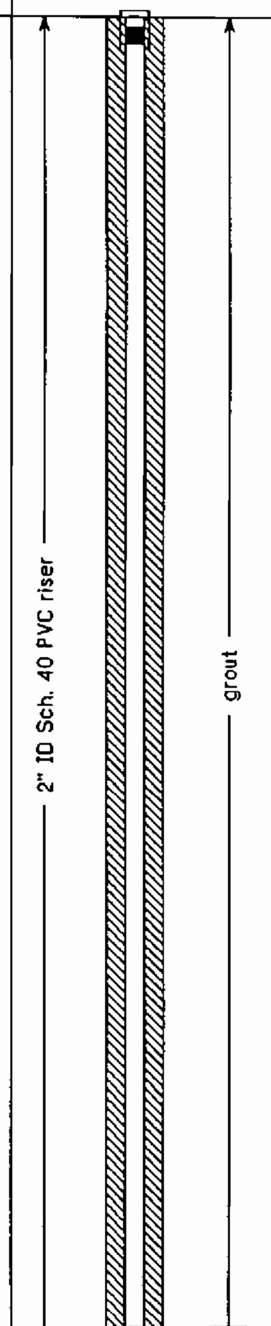
**ENSAFE**

# Monitoring Well NBCA03918I

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315724.52 E, 381351.22 N |
| Location: Charleston, SC | Surface Elevation: 8.7 feet msl |
| Started at 0800 on 9/2/98 | TOC Elevation: 8.38 feet msl |
| Completed at 0955 on 9/2/98 | Depth to Groundwater: 5.91 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.47 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 34.9 feet |
| Geologist: T. Kafka | Well Screen: 25.0 to 34.3 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Ground conditions: asphalt | |
| | | | | | | | SM | Sand: black to med. gray; very fine/fine w/ trace med.; silty; loose; occ. roots; dry. | 7.7 |
| | | | | | | | CL / CH | Clay: red to orange w/ lt. gray banding; silty; firm-stiff; some very fine/fine sand; moist; small pieces of rubber debris at 4'. | 6.2 |
| 5 | | | | | | | | | 4.2 |
| | | | 1 | 2 | 78 | | SM / SC | Sand: orange; very fine/fine w/ trace med. in top 1'; some white to lt. gray silty clay lenses irregularly spaced, 1-2 cm size; wet. | 3.2 |
| 10 | | | | | | | SM | Sand: orange to brown-orange; very fine/fine; silty; wet. | 2 |
| 15 | | | | | | | | | -2.6 |
| | | | 2 | 0 | 58 | | SM | Sand: orange; very fine/fine; silty; grades to olive-brown w/ trace med. grains as indistinct patches at 16.3'; micaceous; saturated. | -6.8 |
| 20 | | | | | | | SM / SC | Sand: orange to olive-brown; very fine/fine; silty; micaceous; distinct lenses of lt. gray-green, silty clay w/ FeOx staining @ 18.5-18.7', 18.9-19', 19.2-19.9', and 21-21.3'; lenses are 0.5-1 cm wide. | -9.8 |

WELL DIAGRAM



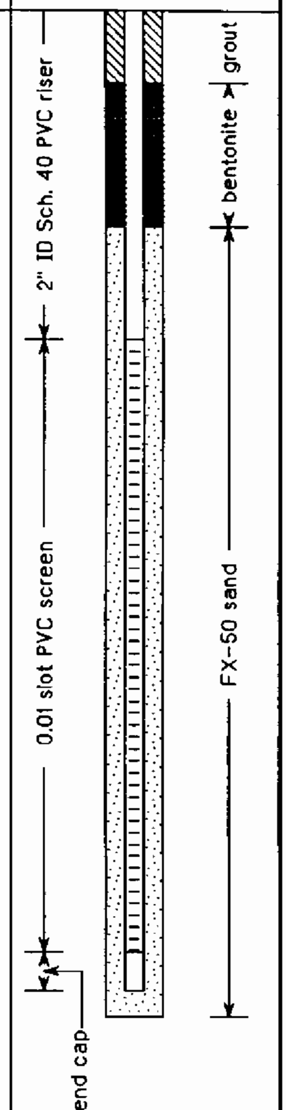
ENSAFE

# Monitoring Well NBCA03918I

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315724.52 E, 381351.22 N |
| Location: Charleston, SC | Surface Elevation: 8.7 feet msl |
| Started at 0800 on 9/2/98 | TOC Elevation: 8.38 feet msl |
| Completed at 0955 on 9/2/98 | Depth to Groundwater: 5.91 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.47 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 34.9 feet |
| Geologist: T. Kafka | Well Screen: 25.0 to 34.3 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM/SC | | -12.6 |
| | | | | | | | SM | Sand: olive-green; very fine/fine; silty; distinct black laminae ~0.5 cm wide, irregularly spaced; micaceous; wet. | |
| | | | | | | | | Sand: olive-green w/ orange FeOx banding; very fine/fine; < 0.5 cm wide olive-green, silty, soft clay laminae @ 22.9-23.4'. | -14.9 |
| | | | | | | | SM/SC | | -15.4 |
| 25 | | | | | | | | | |
| | | | 3 | 0 | 86 | | | | -16.8 |
| | | | | | | | SM | Sand: olive-green; very fine/fine; 10-15% mica content; some silt. | -17.5 |
| | | | | | | | SP | Sand: olive-green; very fine/fine; trace silt; micaceous; 5-10% black grains; @ 28.4', grades to orange brown w/ brown-black silty pods. | |
| 30 | | | | | | | | @ 30.2', changes to med. tan w/ orange FeOx zones; 5% brown silty pods | |
| | | | | | | | | @ 31.4, changes to tan w/ distinct 5 mm wide laminae of black grains irregularly spaced in bottom 1'; ~10% rusty brown silty pits in top 0.3' & last 0.5'. | -24.8 |
| 35 | | | | | | | | | |
| | | | 4 | 0 | 80 | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



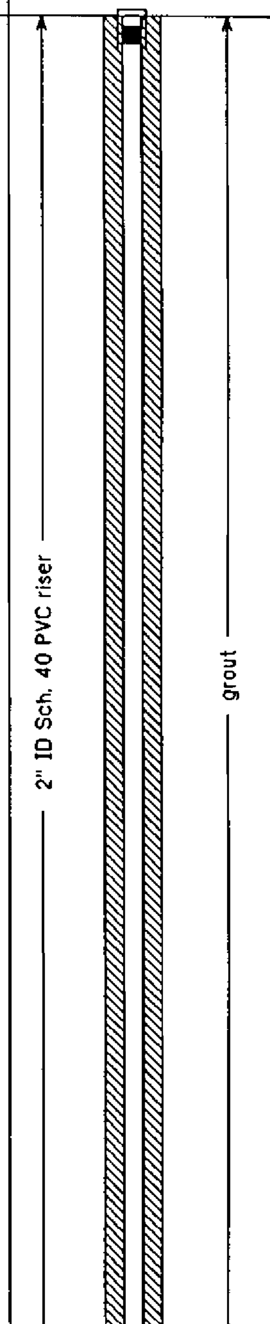
**ENSAFE**

# Monitoring Well NBCA03918D

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315730.48 E, 381352.25 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.7 feet msl* |
| Started at *1440 on 9/1/98* | TOC Elevation: *8.37 feet msl* |
| Completed at *1710 on 9/1/98* | Depth to Groundwater: *5.87 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.50 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *53.3 feet* |
| Geologist: *T. Kafka* | Well Screen: *43.4 to 52.7 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Ground conditions: asphalt | |
| | | | | | | | SM | Sand: tan to brown; very fine/med.; silty; loose; dry; fill sand. | 6.8 |
| | | | | | | | SC | Sand: med. brown to gray-brown; very fine/fine; silty; clayey (soft to firm & low plasticity); moist. | 6.1 |
| | | | | | | | CH<br>CL | Clay: gray w/ orange FeOx banding; silty; <15% very fine/fine sand; stiff; dry to moist. | 5.2 |
| 5 | | | 1 | 0 | 64 | | | | 3.2 |
| | | | | | | | CH<br>CL | Clay: as above w/ heavy FeOx staining as red bands and mottling; moist; gradational contact below. | 1.6 |
| | | | | | | | SP | Sand: orange-brown to med. tan; fine/med.; clean; wet. | .5 |
| 10 | | | | | | | SM | Sand: lt. gray to tan-orange w/ occ. red FeOx banding; very/med. grading to very fine/fine @11.2'; silty; trace clay; wet. | -5.5 |
| 15 | | | 2 | 0 | 100 | | | | -6.8 |
| | | | | | | | SM | Sand: orange-brown grading to olive-green; very fine/fine; silty; lt. gray, soft, silty clay lenses at 16' and 18.7-18.9'; wet. | |
| 20 | | | | | | | | | |

WELL DIAGRAM



ENSAFE

# Monitoring Well NBCA03918D

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315730.48 E, 381352.25 N |
| Location: Charleston, SC | Surface Elevation: 8.7 feet msl |
| Started at 1440 on 9/1/98 | TOC Elevation: 8.37 feet msl |
| Completed at 1710 on 9/1/98 | Depth to Groundwater: 5.87 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.50 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 53.3 feet |
| Geologist: T. Kafka | Well Screen: 43.4 to 52.7 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM | @ 20', grading to olive-green w/ freq. micaceous laminae and pods; some soft, silty olive-green clay laminae in last 1.5'. | -14.8 |
| 25 | | | | | | | | | -16.8 |
| | | | 3 | 0 | 80 | | SP | Sand: tan to lt. olive-brown; very fine/fine; trace silt; wet. @ 27.3-27.8', color change to bright orange (FeOx); grades into lt. tan to olive-gray w/ occ. FeOx nodules and orange-brown pits; high conc. of micaceous mins. assoc. w/ small silty clay pods. | -23.8 |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | -26.8 |
| | | | 4 | 0 | 70 | | SP | Sand: buff white grading to orange-tan and olive-brown at 38.5'; very fine/fine; 20% micaceous mins.; wet. | |
| 40 | | | | | | | | | |

WELL DIAGRAM

2" ID Sch. 40 PVC riser

grout

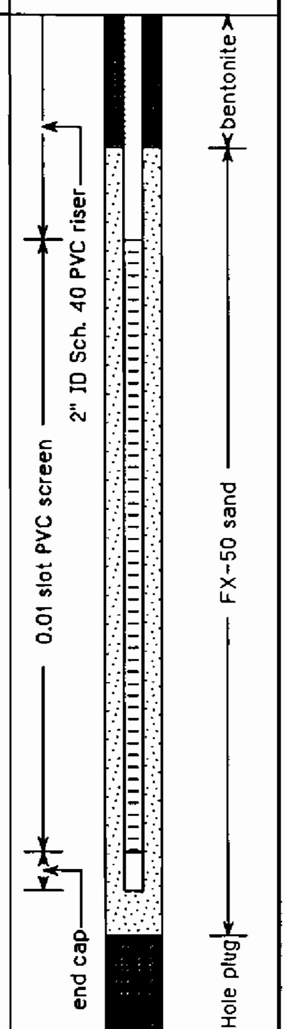
**ENSAFE**

# Monitoring Well NBCA03918D

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315730.48 E, 381352.25 N* |
| Location: *Charleston, SC* | Surface Elevation: *8.7 feet msl* |
| Started at *1440 on 9/1/98* | TOC Elevation: *8.37 feet msl* |
| Completed at *1710 on 9/1/98* | Depth to Groundwater: *5.87 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.50 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *53.3 feet* |
| Geologist: *T. Kafka* | Well Screen: *43.4 to 52.7 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | | -35.3 |
| 45 | | | 5 | 0 | 85 | | | | -36.8 |
| | | | | | | | SP | Sand: dark gray; very fine/fine; 20% micaceous mins.; saturated; 0.1' silty clay lens @ 48.8'; 0.2' fine/coarse shell hash lens @ 48.9'; interbedded sand & clay laminae 49.3-49.5'. | -40.8 |
| 50 | | | | | | | SW | Shell hash/coquina: olive-brown to tan-white; fine/med. w/ occ. very fine/very coarse sizes; 2-3" dia. clam shells; w/ very fine/coarse subrounded-subhedral qtz sand; occ. olive-green silt pods intermixed; $PO_4$ pebble lag in last 0.1'. | -44.3 |
| 55 | | | 6 | 0 | 100 | | ML CL | Silt: olive-green; clayey; w/ very fine/fine sand in top 1.5'; firm; moist. | -46.8 |
| 60 | | | | | | | | | |

WELL DIAGRAM



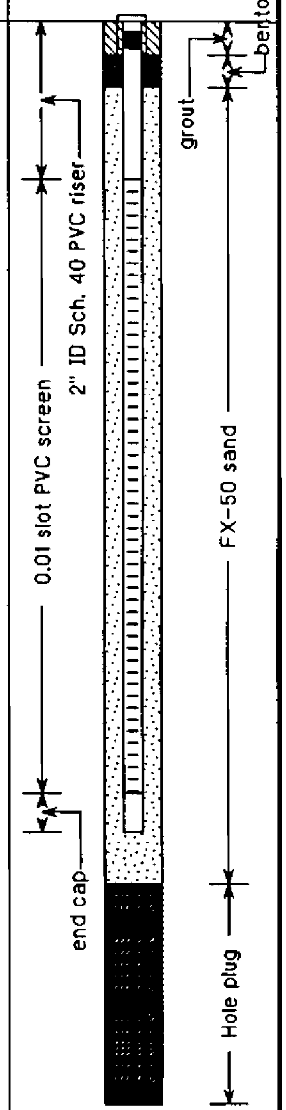
**ENSAFE**

# Monitoring Well NBCA039019

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315299.98 E, 381376.49 N |
| Location: Charleston, SC | Surface Elevation: 9.3 feet msl |
| Started at 1030 on 9/3/98 | TOC Elevation: 9.08 feet msl |
| Completed at 1210 on 9/3/98 | Depth to Groundwater: 2.64 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 6.44 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 12.3 feet |
| Geologist: T. Kafka | Well Screen: 2.4 to 11.7 feet |

| DEPTH IN FEET | SAMPLE NO. | OVA (ppm) | % RECOVERY | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|
| | | | | SM/GM | Ground conditions: grass on shoulder of Ave. "B". | 8.3 |
| | | | | SM/SC | Sand/gravel: dark brown; fine/crs w/ pebbles up to 2" dia.; roots; silty. | 7.6 |
| | | | | SC | Sand: brown to orange w/ black silt pods; very fine/fine; w/ some clay; loose. | |
| | | | | | Sand: yellow-brown grading to olive-green at 3'; very fine/fine; silty; clayey; w/ small distinct lenses of blue-gray, silty, soft clay at 2.5-3.2'. | 5.3 |
| 5 | 1 | 0 | 88 | | | 4.3 |
| | | | | GM | Sand: black; some gravel; med./crs; organic-rich. | 3.6 |
| | | | | SC | Sand: olive-yellow; clayey; silty; moist. | 2.9 |
| | | | | PT/ML | Peat: dark brown; silty; w/ very fine/fine sand; roots and wood frags throughout; moist. | 1.4 |
| | | | | SM | Sand: dark gray; silty; gradational upper contact. | .8 |
| 10 | | | | SC/CL | Sand: lt. gray to blue-gray; very fine/fine; silty; w/ soft-firm clay, decreasing in content w/ depth. | -2.2 |
| | | | | SM/SP | Sand: orange to olive; med. w/ trace crs; blue-green silty clay in upper 0.8'. | -5.4 |
| 15 | | | | | | |
| | 2 | 0 | 100 | | | |
| 20 | | | | | | |

WELL DIAGRAM



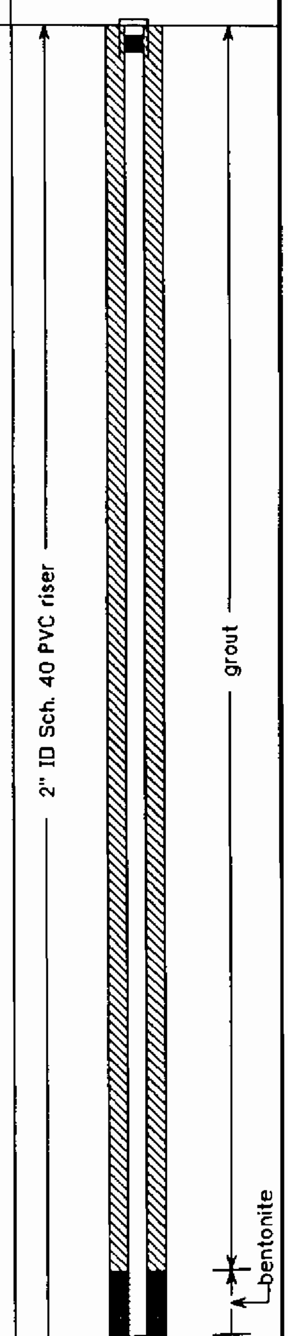
**ENSAFE**

# Monitoring Well NBCA03919I

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315303.55 E, 381370.21 N* |
| Location: *Charleston, SC* | Surface Elevation: *9.3 feet msl* |
| Started at *0745 on 9/3/98* | TOC Elevation: *9.03 feet msl* |
| Completed at *0930 on 9/3/98* | Depth to Groundwater: *2.63 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *6.40 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *31.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *21.6 to 30.9 feet* |

| DEPTH IN FEET | SAMPLE NO. | OVA (ppm) | % RECOVERY | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|
| | | | | ML | Ground conditions: grass on shoulder of Ave. "B". | 7.9 |
| | | | | SC/SM | Sand: brown; very fine/fine; silty; roots; loose; gravelly. | 7.5 |
| | | | | SC | Sand: olive-green; very fine/fine; silty; clayey; firm; moist. | 6.3 |
| | | | | | Sand: olive-green to yellow-green; very fine/fine; clayey w/ occ. distinct laminae/lenses (soft, low plasticity). | |
| 5 | 1 | 0 | 55 | | | 3.8 |
| | | | | SM/SC | Sand: lt. gray to blue-gray; very fine/fine; silty; clayey; wet. | 2 |
| | | | | PT/ML | Peat: brown; silty; soft; pieces of wood in top 0.3'; grass fibers; wet. | .8 |
| | | | | SM/SC | Sand: gray; very fine/fine; silty; clayey in last 0.5'; orange-brown laminae of clay. | -.3 |
| 10 | | | | SM | Sand: orange; med. w/ trace crs; FeOx stained. | -1.5 |
| 15 | 2 | 0 | 55 | | | -6.2 |
| | | | | SM/SC | Sand: orange-brown grading to tan; med./crs fining to fine/med. In last 2.5'; silty; some 1 cm wide lenses of brown, silty, clay in last 2'. | |
| 20 | | | | | | |

WELL DIAGRAM



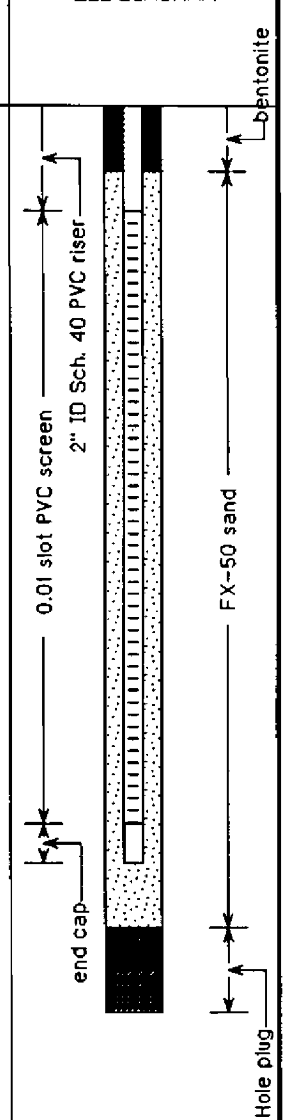
**ENSAFE**

# Monitoring Well NBCA03919I

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315303.55 E, 381370.21 N* |
| Location: *Charleston, SC* | Surface Elevation: *9.3 feet msl* |
| Started at *0745* on *9/3/98* | TOC Elevation: *9.03 feet msl* |
| Completed at *0930* on *9/3/98* | Depth to Groundwater: *2.63 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *6.40 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *31.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *21.6 to 30.9 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM/SC | | -11.7 |
| 25 | | | 3 | 0 | 55 | | SM | Sand: med. gray; fine/med.; occ. shell hash, very fine/med.; silty. | -16.2 |
| | | | | | | | SM/SC | Sand: med. gray to brown; very fine/fine; silty; w/ dark gray clay stringers/lenses @ 26.9-27', 27.5', and 28.5'; heavy FeOx staining at basal contact. | -17.4 |
| 30 | | | | | | | SM | Sand: lt. tan to brown; fine/med.; trace-some silt; occ. clay lens in last 1', soft, brown. | -19.8 |
| | | | | | | | | | -22.2 |
| | | | 4 | | 92 | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



ENSAFE

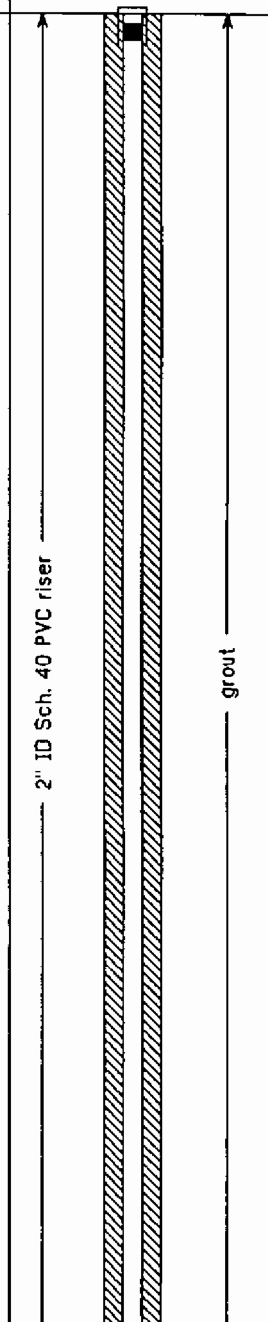
# Monitoring Well NBCA03919D

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315308.21 E, 381363.12 N |
| Location: Charleston, SC | Surface Elevation: 9.2 feet msl |
| Started at 1410 on 9/2/98 | TOC Elevation: 8.96 feet msl |
| Completed at 1730 on 9/2/98 | Depth to Groundwater: 6.16 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.80 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 54.8 feet |
| Geologist: T. Kafka | Well Screen: 44.9 to 54.2 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY |
|---|---|---|---|---|---|
| 5–10 | X | | 1 | 0 | 100 |
| 15–20 | X | | 2 | 0 | 100 |

| SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|
| ML | Ground conditions: grass on shoulder of Ave. "B". | 7.9 |
| SM/SC | Silt: dark black; organic-rich topsoil; w/ very fine/fine sand; dry. | 6.7 |
| SM | Sand: olive-green w/ orange-brown lenses; very fine/fine; silty; clayey w/ occ. gray clay pods; dry. | |
| SC | Sand: olive-green to tan; very fine/fine w/ trace med.; silty in lt. brown-black irreg. spaced stringers/pods; occ. lt. gray clay pods; loose; moist. | 4.6 |
| SM/SP | Sand: lt. gray to blue-gray w/ green cast; very fine/fine; silty; clay in 1cm blue-gray stringers and 1 cm dia. pods; 10% heavy mins; wet. | 3.4 |
| SC | Sand: med. gray to black; very fine/fine; silty; organic-rich; wet. | 2.6 |
| PT/ML | Sand: med. gray w/ yellow laminae; very fine/fine; silty; clayey; wet | 2.2 |
| SM/SP | Peat: dark brown; grass & woody frags; silty; w/ very fine/fine sand. | .4 |
| SC | Sand: lt. gray w/ brown; very fine/fine w/ trace med.; silty; wet; gradational contact w/ above. | .7 |
| SP/SW | Sand: lt. green-blue grading to orange-green in last 0.3'; fine/med. grading to med. @ 11-11.5'; 1 cm wide orange FeOx bands @10.7-11.9'; w/ firm, silty gray clay. | 2.7 |
| | Sand: orange to red-orange; med. w/ trace crs @ 12.9-14.5'; silty; lt. brown, silty, soft, low plasticity clay laminae in last 0.6'. | 5.8 |
| | | 6.3 |
| SM/SW | Sand: orange to orange-brown; fine/med. w/ some crs; silty; occ. silty clay lenses @ 18.1', 18.3', 19.2-19.7'; clay is low plasticity & soft. | |

WELL DIAGRAM



**ENSAFE**

# Monitoring Well NBCA03919D

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315308.21 E, 381363.12 N* |
| Location: *Charleston, SC* | Surface Elevation: *9.2 feet msl* |
| Started at *1410 on 9/2/98* | TOC Elevation: *8.96 feet msl* |
| Completed at *1730 on 9/2/98* | Depth to Groundwater: *6.16 feet TOC* Measured: *9/24/98* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.80 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1437)* | Total Depth: *54.8 feet* |
| Geologist: *T. Kafka* | Well Screen: *44.9 to 54.2 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM/SW | | -11 |
| 25 | | | 3 | 0 | 47 | | | Shelby Tube 25.5-28': Sand: brown-gray, very fine/fine, silty, w/ gray silty clay bands. | |
| | | | 4 | | 100 | | SP/SM | Sand: tan grading to med. gray; very fine/fine; some silt; saturated. | -18.9 |
| 30 | | | | | | | OL | Clay: dark gray; silty; soft-firm; med. plasticity; w/ very fine/fine sand interbedded as stringers/partings < 1cm wide @ 30.9', 32.6', 33'. | -21.6 |
| 35 | | | | | | | | | -25.4 |
| | | | 5 | 0 | 94 | | OH | Clay: dark gray; silty; firm; high plasticity; occ. $CaCO_3$ fossil concretions and occ. sand partings in top 8'; freq. dark gray very fine/fine sand laminae between 0.5-2 cm size in last 1.5'; 10% very fine/fine shell hash intermixed. | -26.3 |
| 40 | | | | | | | | | |

WELL DIAGRAM

2" ID Sch. 40 PVC riser

grout

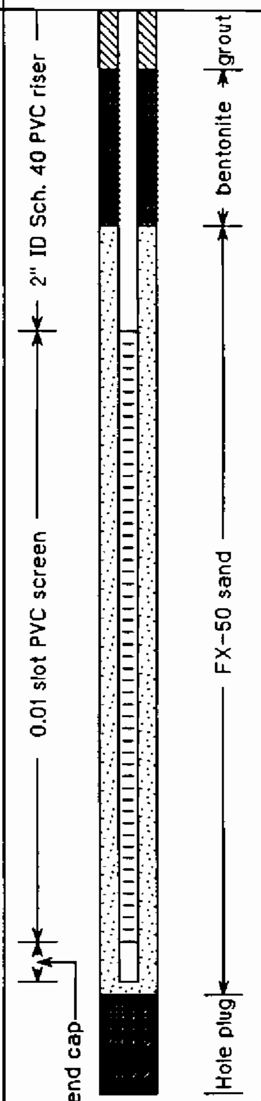
ENSAFE

# Monitoring Well NBCA03919D

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315308.21 E, 381363.12 N |
| Location: Charleston, SC | Surface Elevation: 9.2 feet msl |
| Started at 1410 on 9/2/98 | TOC Elevation: 8.96 feet msl |
| Completed at 1730 on 9/2/98 | Depth to Groundwater: 6.16 feet TOC Measured: 9/24/98 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.80 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1437) | Total Depth: 54.8 feet |
| Geologist: T. Kafka | Well Screen: 44.9 to 54.2 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | OH | | |
| 45 | | | 5 | 0 | 100 | | SP | Sand: lt./med. gray; very fine/fine w/ some $PO_4$ grains throughout; @ 48.1-49.4', irreg. spaced gray, silty laminae ~0.5-2 cm thick of firm, med. plasticity clay. | -36.3 |
| 50 | | | 6 | 0 | 100 | | | | |
| | | | | | | | SW / GW | Shell hash: med. gray; very fine/crs w/ very coarse shell hash; whole bivalve shells up to 4" size; 3" dia. subrounded $PO_4$ nodules. | -42.5 |
| 55 | | | 7 | 0 | 94 | | ML / CL | Silt: olive-brown; clayey; w/ very fine $PO_4$ sand; firm-stiff; dry; occ. $CaCO_3$ fossils/concretions. | -45.5 |
| | | | | | | | | | -47.2 |
| 60 | | | | | | | | | |

WELL DIAGRAM



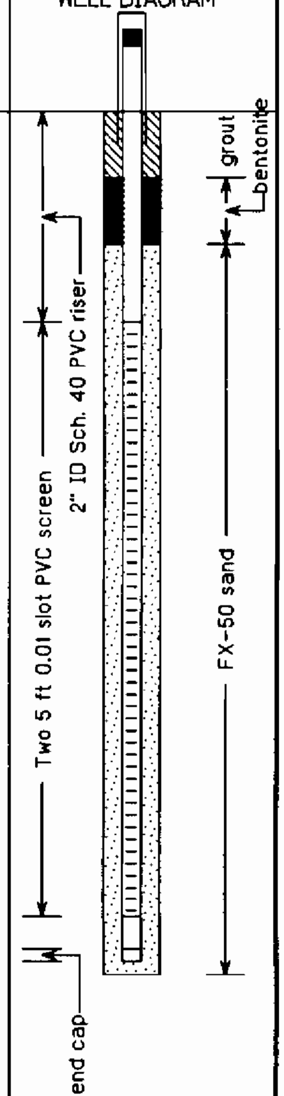
ENSAFE

# Monitoring Well NBCA039020

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315106.34 E, 380989.20 N |
| Location: Charleston, SC | Surface Elevation: 6.5 feet msl |
| Started at 0830 on 1/13/99 | TOC Elevation: 9.00 feet msl |
| Completed at 0950 on 1/13/99 | Depth to Groundwater: 4.41 feet TOC  Measured: 1/29/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 4.59 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1435) | Total Depth: 12.9 feet |
| Geologist: T. Kafka | Well Screen: 3.2 to 12.2 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ML | Ground conditions: grass | |
| | | | | | | | SM | Silt: dk. brown to black; some vf/f sand; occ. gravel; little soft clay; moist. | 5.5 |
| | | | | | | | FILL | Fill: asphalt pieces | 5 |
| | | | | | | | SM | Sand: lt. brown/tan w/ orange patches; vf/f; silty; loose; moist. | 4 |
| | | | | | | | SC CL | Sand: lt. brown grading to blue-gray w/ FeOx stains; vf/f; clayey- soft-med., low plasticity; little silt; moist. | 2.5 |
| 5 | | | | | | | | | |
| | | | 1 | 0 | 57 | | | | .5 |
| | | | | | | | SC | Sand: lt. gray w/ orange-brown band; med. w/ trace crs; well-sorted; clayey; little silt; cohesive. | -1.6 |
| 10 | | | | | | | SM | Sand: orange; med. grading to vf/f @ 8.3'; silty; some laminae of silty clay @ 9.8-10.2'; saturated. | |
| | | | | | | | | | -4.5 |
| | | | 2 | 0 | 67 | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |

WELL DIAGRAM



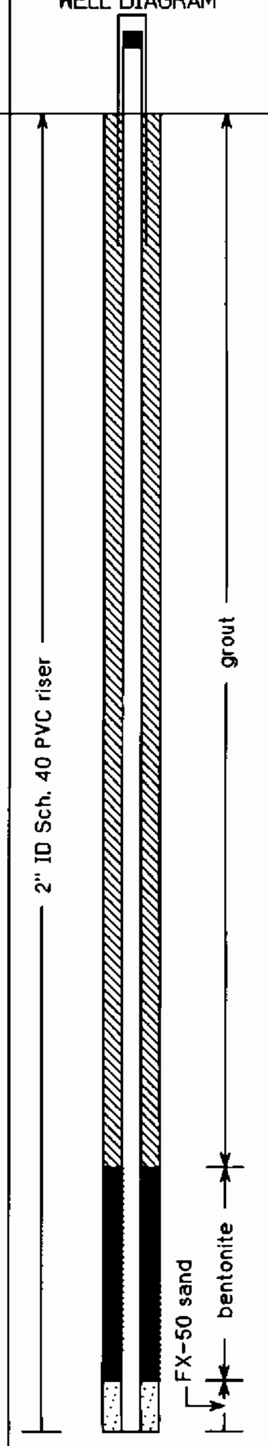
ENSAFE

# Monitoring Well NBCA03920I

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315104.86 E, 380982.74 N |
| Location: Charleston, SC | Surface Elevation: 6.5 feet msl |
| Started at 1555 on 1/12/99 | TOC Elevation: 8.87 feet msl |
| Completed at 1700 on 1/12/99 | Depth to Groundwater: 4.30 feet TOC Measured: 1/29/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 4.57 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1435) | Total Depth: 30.1 feet |
| Geologist: T. Kafka | Well Screen: 20.4 to 29.4 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM/ML | Ground conditions: grass<br>Sand: dk. brown; silty; vf/f; few gravel pcs; trace clay; loose; moist. | 5.3 |
| | | | | | | | SM | Sand: dk-med. brown; silty matrix & as black laminae; trace gravel & pebbles; loose. | 3.5 |
| | | | | | | | CL | Clay: orange-brown grading to blue-gray in last 1'; silty; little vf/f sand increasing to SC in last 0.2'; med-firm; low plasticity. | 2.3 |
| 5 | | | | | | | | | .5 |
| | | | 1 | | 70 | | SC | Sand: blue-gray; f/m w/ trace coarse; poorly sorted; little silt; w/ soft clay; moist. | -.1 |
| | | | | | | | CL | Clay: blue-gray w/ orange FeOx patches @ 6.8-6.9'; silty; little f/m sand in matrix; soft; low plasticity/lean. | -.5 |
| 10 | | | | | | | SM | Sand: orange; vf/f w/ trace med.; silty; loose; moist to wet. | |
| 15 | | | | | | | | | -8.5 |
| | | | 2 | | 70 | | | | |
| 20 | | | | | | | SP | | -13.5 |

WELL DIAGRAM



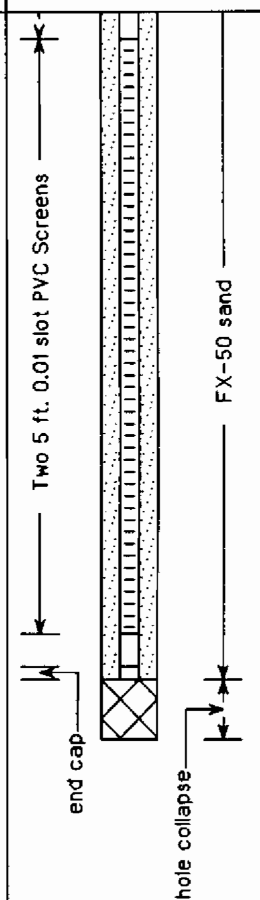
**ENSAFE**

# Monitoring Well NBCA03920I

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315104.86 E, 380982.74 N* |
| Location: *Charleston, SC* | Surface Elevation: *6.5 feet msl* |
| Started at *1555 on 1/12/99* | TOC Elevation: *8.87 feet msl* |
| Completed at *1700 on 1/12/99* | Depth to Groundwater: *4.30 feet TOC* Measured: *1/29/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *4.57 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *30.1 feet* |
| Geologist: *T. Kafka* | Well Screen: *20.4 to 29.4 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | Sand: lt. tan to orange @ 26'; vf/f; trace silt; well-sorted; wet. | -13.5 |
| 25 | | | | | | | | | |
| | | | | | | | SW / SM | Sand: orange-brown to red-brown; lense of vf/f to f/m w/ trace crs throughout section; occ. qtz granules; clay laminae in last 0.4'; sharp contact w/ below. | -21 |
| 30 | | | | | | | | | |
| | | | 3 | | 73 | | OH | Clay: dk. gray; silty; firm; high plasticity; fat. | -24 |
| | | | | | | | | | -24.5 |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



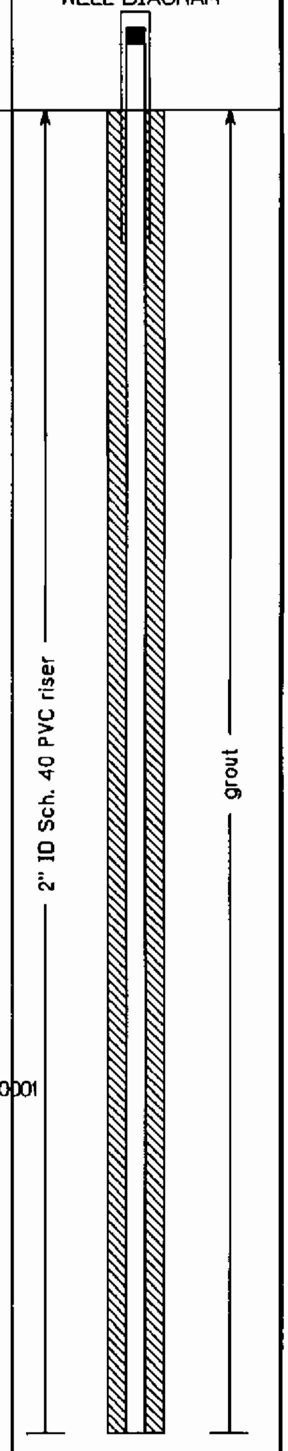
ENSAFE

# Monitoring Well NBCA03920D

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2315103.22 E, 380974.80 N |
| Location: Charleston, SC | Surface Elevation: 6.4 feet msl |
| Started at 1050 on 1/12/99 | TOC Elevation: 8.86 feet msl |
| Completed at 1540 on 1/12/99 | Depth to Groundwater: 6.65 feet TOC Measured: 1/15/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 2.21 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1435) | Total Depth: 47.5 feet |
| Geologist: T. Kafka | Well Screen: 37.8 to 46.8 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM | Ground conditions: grassy field<br>Sand: brown w/ orange mottling; very fine/fine; some silt; trace clay; organic matter throughout (sticks, grass); occ. gravel; moist. | 4.4 |
| | | | | | | | CL | Clay: orange to orange-brown; w/ some very fine sand; firm-stiff; low plasticity. | 3.9 |
| | | | | | | | SM | Sand: brown to gray-brown; very fine/fine; some silt; moist. | 3.2 |
| | | | | | | | CL | Clay: orange-brown grading to green-blue w/ orange mottling; trace to little very fine/fine sand; soft becoming med. at 4'; med. plasticity; w/ some silt; moist. | 2.1 |
| 5 | | | | | | | SP | Sand: gray; fine/med.; trace silt; mod.-well sorted. | 1.6 |
| | | | 1 | 0 | 80 | | SP | Sand: orange; very fine/fine; trace silt; saturated. | .4 |
| | | | | | | | SC | Sand: orange w/ lt. gray mottling; very fine/fine; trace silt; few to some soft, lt. gray clay of med. plasticity. Changes to buff white and lt. tan, very fine/fine sand at 11.2'. | .2 |
| | | | | | | | CL | | .8 |
| 10 | | | | | | | SP | | |
| 15 | | | | | | | SW | Sand: buff white to lt. tan w/ orange-brown lenses; very fine/med. w/ trace crs.; occ. mica. | 8.400001 |
| | | | 2 | 0 | 100 | | SP | Sand: lt. orange; very fine/fine; clean. | 9.6 |
| | | | | | | | SW | Sand: lt. orange; fine/med. grading to crs; poorly sorted; clean; grades to very fine/fine at 21'. | 10.6 |
| 20 | | | | | | | | | |

WELL DIAGRAM



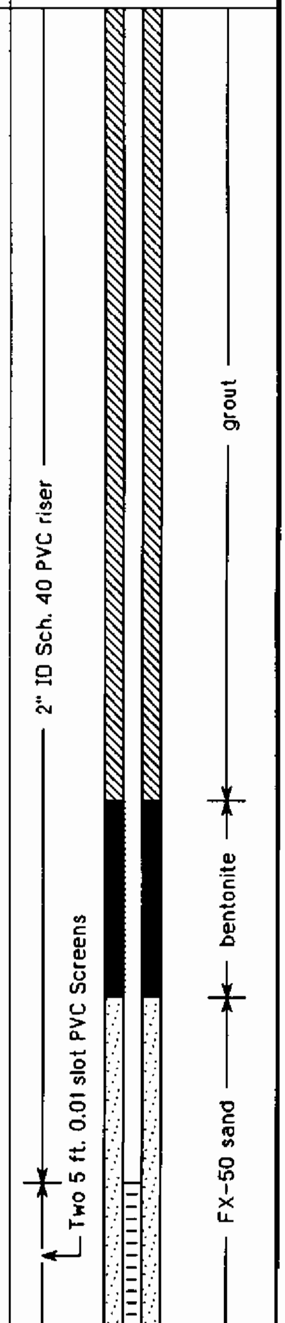
**ENSAFE**

# Monitoring Well NBCA03920D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315103.22 E, 380974.80 N* |
| Location: *Charleston, SC* | Surface Elevation: *6.4 feet msl* |
| Started at *1050 on 1/12/99* | TOC Elevation: *8.86 feet msl* |
| Completed at *1540 on 1/12/99* | Depth to Groundwater: *6.65 feet TOC* Measured: *1/15/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.21 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *47.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *37.8 to 46.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SW | | -15.1 |
| | | | | | | | SM / CL | Clay/Sand mix: lt. brown to gy. clay; soft; lean; low plasticity; interbedded w/ very fine/fine sand lenses/pods throughout; few-some silt. | -16.9 |
| | | | | | | | SP | Sand: lt. green-gray; very fine/fine; clean; wet. | -17.1 |
| 25 | | | 3 | 0 | 75 | | | | |
| | | | | | | | SM / SC | Sand: dk. gray; very fine/fine w/ few-some silt; ~5% phosphate grain content; interbedded w/ gray, firm-stiff, fat, silty clay as irreg. spaced lenses between 1-4" thick; occ. shell frags in sand. | -19.6 / -22.6 |
| 30 | | | | | | | OH / SP | Clay: dk. gray; silty; firm-stiff; fat; high plasticity; sticky; occ. irreg. spaced very fine/fine sand lenses/partings ~1/2" thick that thicken w/ depth: 1-2" lenses at 36.2'& 36.5'. | |
| 35 | | | 4 | | 100 | | | | -30.1 |
| 40 | | | | | | | OH | Clay: as above, but clean w/ no sand lenses. | |

WELL DIAGRAM



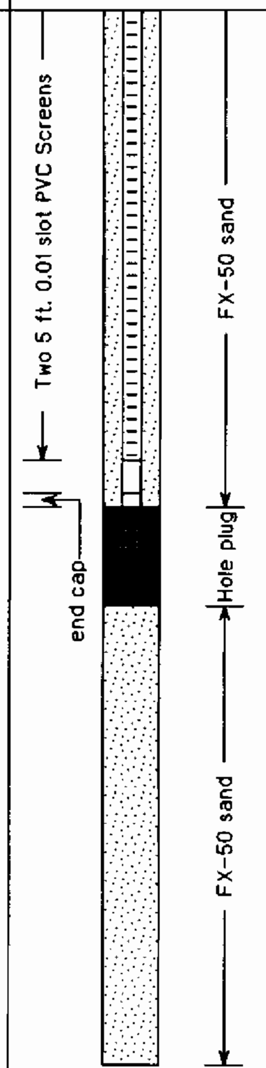
ENSAFE

# Monitoring Well NBCA03920D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315103.22 E, 380974.80 N* |
| Location: *Charleston, SC* | Surface Elevation: *6.4 feet msl* |
| Started at *1050 on 1/12/99* | TOC Elevation: *8.86 feet msl* |
| Completed at *1540 on 1/12/99* | Depth to Groundwater: *6.65 feet TOC* Measured: *1/15/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.21 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *47.5 feet* |
| Geologist: *T. Kafka* | Well Screen: *37.8 to 46.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | OH | | -34.1 |
| | | | | | | | OH / SW | Clay: as above w/ very fine/fine silty gray sand lens from 40.5-41'; at 41.7', sand lenses become very fine/crs. w/ fine/med. shell hash. | -35.6 |
| 45 | | | | | | | | Remainder of core was not rec'vd. Too loose to be retained in core barrel once unit below was contacted. | -39.6 |
| | | | 5 | 0 | 60 | | | | |
| 50 | | | | | | | ML / CL | Silt: olive-brown; trace to little very fine/fine sand; firm to stiff; dry; Ashley Fm. | |
| 55 | | | 6 | 0 | 100 | | | | -49.6 |
| 60 | | | | | | | | | |

WELL DIAGRAM



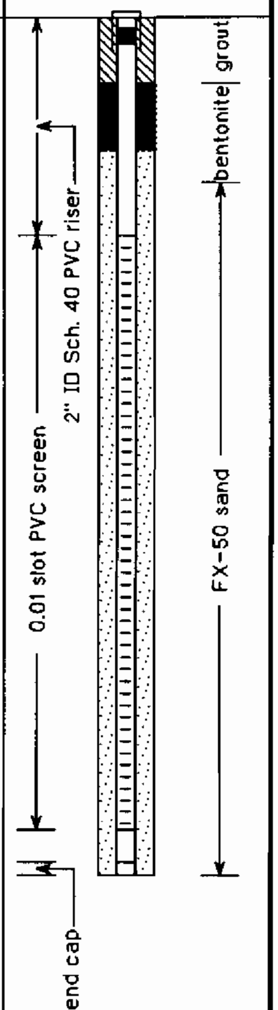
ENSAFE

# Monitoring Well NBCA039021

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2316016.76 E, 381155.71 N* |
| Location: *Charleston, SC* | Surface Elevation: *6.8 feet msl* |
| Started at *0945 on 1/14/99* | TOC Elevation: *6.62 feet msl* |
| Completed at *1115 on 1/14/99* | Depth to Groundwater: *4.57 feet TOC* Measured: *1/29/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *2.05 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *13.0 feet* |
| Geologist: *T. Kafka* | Well Screen: *3.3 to 12.3 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FILL | Ground conditions: gravel/ROC | 6.1 |
| | | | | | | | ML / CL | Silt/Clay mix: olive-brown to olive-green w/ orange marbling; mix of inorganic clay and Ashley Fm; all Fill materials. | 3 |
| | | | | | | | OL / WD | Clay: dk. black; silty; soft, sticky marsh clay; w/ grass/wood pieces throughout; bottom 0.4' all pulverized wood. | 2.3 |
| 5 | | | | | | | | | |
| 10 | | | | | | | | Due to poor core recovery at this location, refer to paired deep well boring log at NBCA039210 for lithologic details. | |
| | | | 1 | | 38 | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |

WELL DIAGRAM



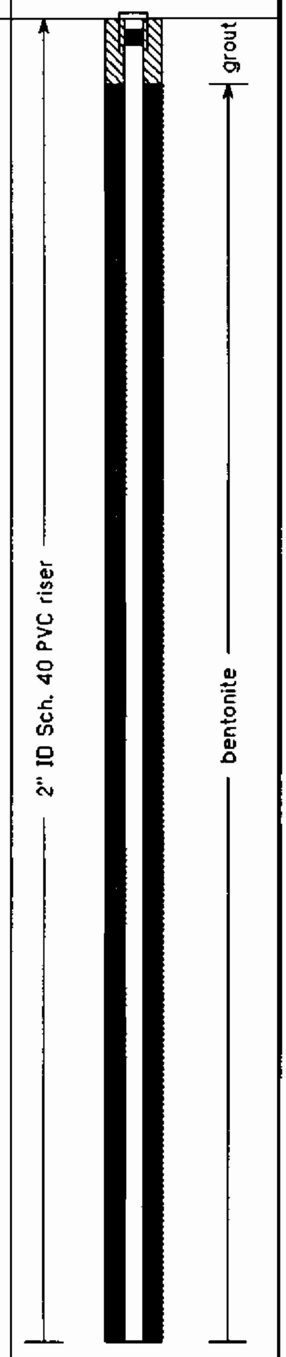
**ENSAFE**

# Monitoring Well NBCA03921I

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2316020.20 E, 381147.78 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.0 feet msl* |
| Started at *1600 on 1/13/99* | TOC Elevation: *6.87 feet msl* |
| Completed at *0930 on 1/14/99* | Depth to Groundwater: *5.02 feet TOC* Measured: *1/29/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.85 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *34.9 feet* |
| Geologist: *T. Kafka* | Well Screen: *25.2 to 34.2 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FILL | Ground conditions: gravel/ROC | 6.2 |
| | | | | | | | CH | Clay: marbled orange, gray, red; stiff; little vf/f sand; silty; dry to moist; high plasticity. | 4.9 |
| | | | | | | | ML/CL | Silt: olive-brown; trace-little vf/f sand; clayey-soft to med.; Ashley Fm. fill. | 3.2 |
| 5 | | | | | | | OL/PT | Clay: dk. gray; silty; soft, stick marsh clay; lenses of wood/peat; last 0.4' all pulverized wood; $H_2S$ odor. | 2 |
| | | | 1 | | 71 | | | | 0 |
| | | | | | | | WOOD | Wood: pulverized wood. | 1.5 |
| 10 | | | | | | | OL/PT | Peat: dk. brown; silty; soft; moist; grasses throughout; $H_2S$ odor | 4 |
| | | | | | | | SM | Sand: dk. brown grading to med. brown-gray; vf/f; silty; organic rich; trace clay; cohesive; wet. | 5.2 |
| 15 | | | | | | | CL/CH | Clay: blue-gray to green-blue; firm; w/ some vf/f sand in matrix and pods throughout; silty; med. plasticity; occ. grasses. | 8.2 |
| | | | 2 | | 82 | | | | 10 |
| 20 | | | | | | | SC | Sand: blue-green; f/m; clayey; trace-little silt; moist; @ 20.3-22.2' dec. grain size to vf/f, color change to orange-brown, and inc. silt content. | |

WELL DIAGRAM



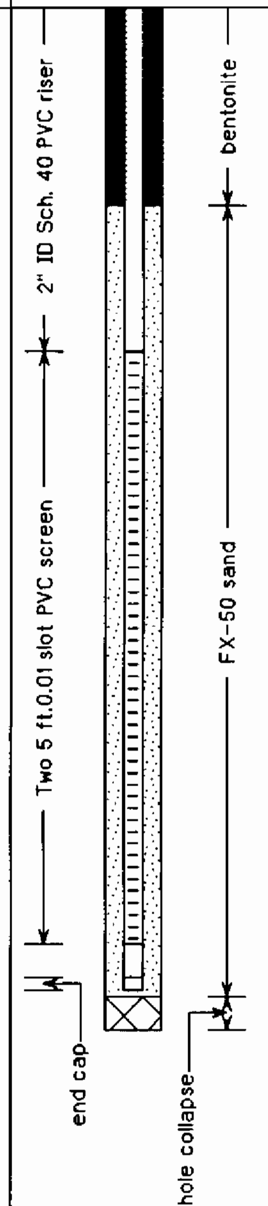
**ENSAFE**

# Monitoring Well NBCA03921I

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2316020.20 E, 381147.78 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.0 feet msl* |
| Started at *1600 on 1/13/99* | TOC Elevation: *6.87 feet msl* |
| Completed at *0930 on 1/14/99* | Depth to Groundwater: *5.02 feet TOC* Measured: *1/29/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.85 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *34.9 feet* |
| Geologist: *T. Kafka* | Well Screen: *25.2 to 34.2 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SC | | -15.2 |
| 25 | | | | | | | SP | Sand: orange to tan w/ FeOx zones; vf/f w/ black phosphate grains throughout; occ. brown silty clay pods in bottom 1'; wet. | -18 |
| | | | | | | | | | -20 |
| 30 | | | 3 | | 80 | | SP | Sand: tan grading to gray @ 31.5'; f/m w/ trace crs @ 30.5-32'; dec. to vf/f @ 32-35.5'. | |
| 35 | | | | | | | | | -28.5 |
| 40 | | | 4 | | 94 | | | | |

WELL DIAGRAM



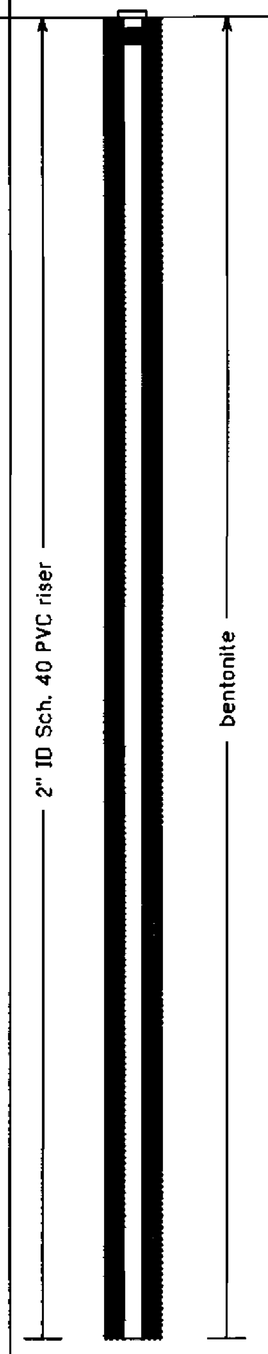
ENSAFE

# Monitoring Well NBCA03921D

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2316024.08 E, 381139.28 N |
| Location: Charleston, SC | Surface Elevation: 7.0 feet msl |
| Started at 1325 on 1/13/99 | TOC Elevation: 6.71 feet msl |
| Completed at 1540 on 1/13/99 | Depth to Groundwater: 5.21 feet TOC Measured: 1/15/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 1.50 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1435) | Total Depth: 51.0 feet |
| Geologist: T. Kafka | Well Screen: 41.3 to 50.3 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FILL | Ground conditions: gravel/ROC lot<br>Fill: ROC | 5.5 |
| | | | | | | | CH | Clay: marbled orange, gray, brown; trace very fine/fine sand; stiff; high plasticity. | 4.4 |
| 5 | | | | | | | ML<br>CL | Silt: olive-green; trace very fine/fine sand; soft-med.; low plast.; moist. | 1.3 |
| | | | | | | | WOOD | Wood: lt. tan pulverized wood | .7 |
| | | | 1 | 0 | 100 | | OL | Clay/Peat mix: gray to brown; silty; w/ orange-brown wood fibers; wood in last 0.3'; moist. | 0 |
| 10 | | | | | | | | Soft peat material pushed out of way during 2nd core run. Logged from bottom in field. | 5 |
| | | | | | | | WOOD | Wood: lt. tan, pulverized; $H_2S$ odor. | 6.5 |
| | | | | | | | SM<br>SC | Sand: brown to gray-brown; very fine/fine; silty; w/ occ. wood pcs & grass; wet. | 7.2 |
| 15 | | | 2 | 0 | 50 | | CL<br>SC | Clay: green-brown; med.-firm; silty; little fine/med. sand; med. plasticity; some woody frags w/ wood layer @16.5'; $H_2S$ odor. | 10 |
| 20 | | | | | | | SC | Sand: blue-green; fine/med. w/ trace crs.; clayey; firm-med.; trace to little silt; grain size changes to very fine/med. sand @20' and @20.8-21'; interbedded seq. of clay & sand from 21-21.2'. | |

WELL DIAGRAM



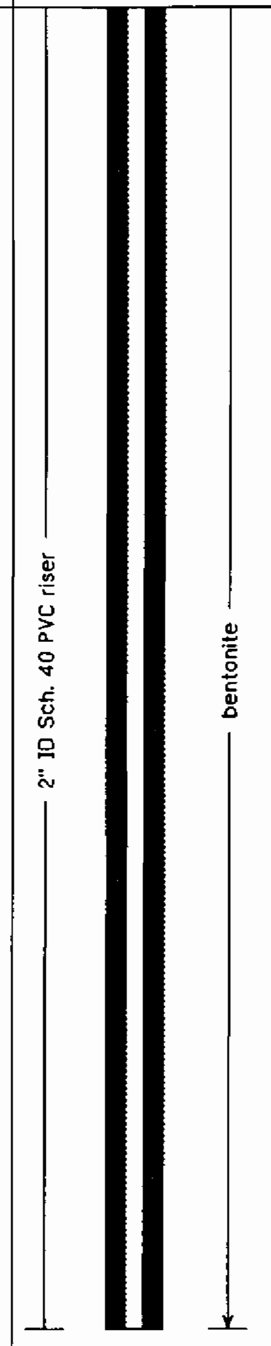
# ENSAFE

# Monitoring Well NBCA03921D

| | |
|---|---|
| Project: ZONE A - Naval Base Charleston | Coordinates: 2316024.08 E, 381139.28 N |
| Location: Charleston, SC | Surface Elevation: 7.0 feet msl |
| Started at 1325 on 1/13/99 | TOC Elevation: 6.71 feet msl |
| Completed at 1540 on 1/13/99 | Depth to Groundwater: 5.21 feet TOC Measured: 1/15/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 1.50 feet msl |
| Drilling Company: Alliance Environmental (SC Cert # 1435) | Total Depth: 51.0 feet |
| Geologist: T. Kafka | Well Screen: 41.3 to 50.3 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SC | | -14.2 |
| 25 | | | | | | | SP<br>SM | Sand: lt. gray grading to: lt. olive brown @21.9', tan @23.2', bright orange/rust @23.8', and lt. tan @25.2'; predom. grain size is very fine/fine w/ fine/med. lenses at 23.2-23.7' & 24.2-25'; mod. well sorted; trace to little silt throughout. | -19.6 |
| 30 | | | 3 | 0 | 96 | | SP | Sand: lt. tan to olive-gray grading to lt. gray at 31.8'; fine/med. w/ trace crs; clean; changes to very fine/fine w/ trace med. at 31.8'; black $PO_4$ grains from 31.8-36.2'. | -20 |
| 35 | | | | | | | | | -29.2 |
| 40 | | | 4 | 0 | 92 | | SP | Sand: lt. gray to green-gray; very fine/fine w/ black $PO_4$ grains; slight orange cast in last 1'. | -30 |

WELL DIAGRAM



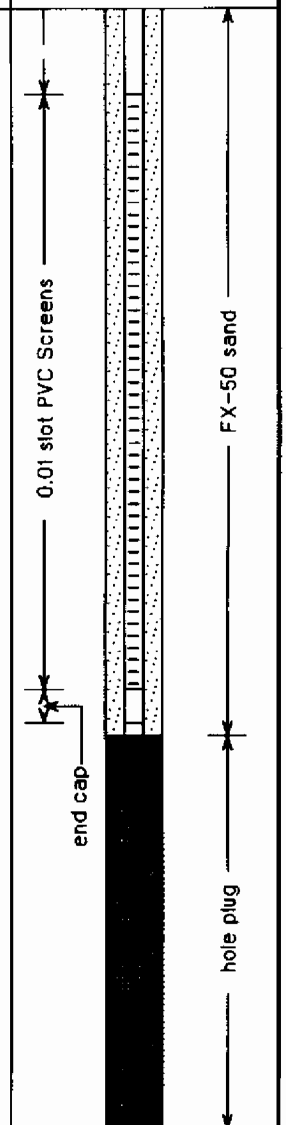
**ENSAFE**

# Monitoring Well NBCA03921D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2316024.08 E, 381139.28 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.0 feet msl* |
| Started at *1325 on 1/13/99* | TOC Elevation: *6.71 feet msl* |
| Completed at *1540 on 1/13/99* | Depth to Groundwater: *5.21 feet TOC* Measured: *1/15/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.50 feet msl* |
| Drilling Company: *Alliance Environmental (SC Cert # 1435)* | Total Depth: *51.0 feet* |
| Geologist: *T. Kafka* | Well Screen: *41.3 to 50.3 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP | | |
| | | | | | | | SW | Sand: tan; fine/med. w/ little crs and very fine; little–some black $PO_4$ grains throughout; clean; inc. to med./crs. in last 0.4'; occ. $PO_4$ nodules throughout. | -36 |
| 45 | | | | | | | SW/SM | Sand: olive-brown; fine/crs. w/ shell hash fragments (< 5mm dia.) & brown $PO_4$ pellets (<1 cm dia.); occ. shell pcs. > 1 cm long; silty; some Qtz pebbles; lag bed. | -38.6 / -39.2 |
| | | | 5 | 0 | 92 | | GM/SW | Gravel lag: lt. tan to buff white (chalky app.); very fine/crs. sand some silt; some fine to very crs. shell hash up to 5 cm size (clam molds); some $PO_4$ nodules between 1.5–4 cm size; color changes to brown-olive in last 0.8' w/ very crs. shell hash and large shell pcs.; small lens of black silty clay on top of underlying silt. | -40 |
| 50 | | | | | | | ML/CL | Silt: olive-brown; firm-med.; low plasticity; trace very fine/fine sand in top 2–3'; dry; Ashley Fm. | -42.8 |
| 55 | | | 6 | 0 | 100 | | | | -50 |
| 60 | | | | | | | | | |

WELL DIAGRAM



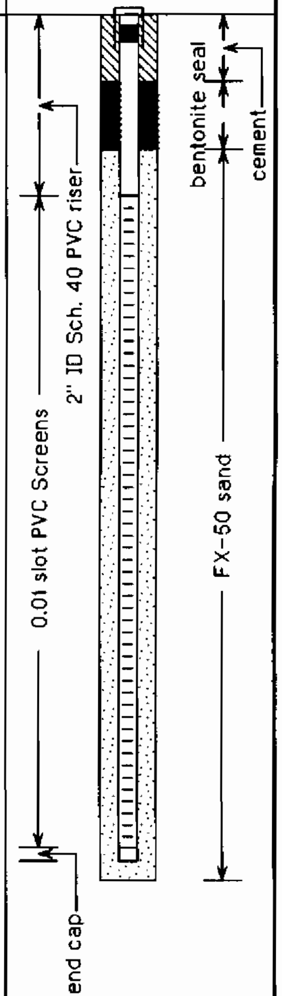
ENSAFE

# Monitoring Well NBCA039022

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315068.14 E, 381366.36 N* |
| Location: *Charleston, SC* | Surface Elevation: *9.3 feet msl* |
| Started at *1510 on 7/22/99* | TOC Elevation: *9.10 feet msl* |
| Completed at *1540 on 7/22/99* | Depth to Groundwater: *4.45 feet TOC* Measured: *7/27/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *4.65 feet msl* |
| Drilling Company: *AEI (SC Cert # 1435)* | Total Depth: *12.7 feet* |
| Geologist: *T. Kafka* | Well Screen: *2.7 to 12.5 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SM/GM | Surface conditions: sand & silt next to RR bed. Sand: orange w/ black gravel intermixed; vf/f; silty; loose. | 8.3 |
| | | | | | | | SM | Sand: dk brown to black; vf/f; silty; strong PETRO odor in black lenses in last 0.2'; trace-some clay; wet. | 7.1 |
| 5 | | | | | | | SC/CL | Sand: lt green-gray to gray-green w/ orange-brown stringers (FeOx); vf/f; clayey; trace-some silt; firm; cohesive; PETRO odor @ 4.5'. | 4.7 |
| | | | 1 | 0 | 61 | | | | 1.8 |
| | | | | | | | SC | Sand: lt gray to orange; vf/f; clayey; trace-some silt; wet. | .9 |
| 10 | | | | | | | SM/SP | Sand: lt tan, orange to green-brown; vf/f grading to f/m w/ trace crs @8.8' grading to vf/f @11' and then grading to f/m w/ some crs @11.5'; blue-green, soft, sticky clay @11.9-12.2'; @12-13.5' become med olive sand; trace-some silt throughout depth. | |
| | | | 2 | 0 | 100 | | | | -4.2 |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |

WELL DIAGRAM



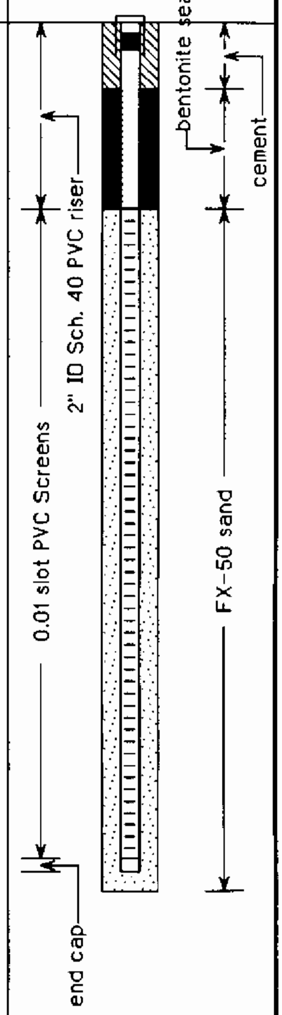
ENSAFE

# Monitoring Well NBCA039023

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315049.30 E, 381191.31 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.3 feet msl* |
| Started at *1020 on 7/22/99* | TOC Elevation: *7.18 feet msl* |
| Completed at *1100 on 7/22/99* | Depth to Groundwater: *3.64 feet TOC* Measured: *7/27/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *3.54 feet msl* |
| Drilling Company: *AEI (SC Cert # 1435)* | Total Depth: *12.7 feet* |
| Geologist: *T. Kafka* | Well Screen: *2.8 to 12.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | GW | Surface conditions: sand & silt next to RR bed. Gravel: black w/ pebbles, m/crs sand, some silt. | 6 |
| 5 | | | | | | | SM | Sand: lt tan to brown and gray brown; vf/f; silty; cohesive; moist. | 1 |
| | | | 1 | 0 | 100 | | SM/SC | Sand: olive-brown to brown gray; vf/f w/ FeOx clay band @ 6.2-6.6'; silt throughout. | -2 |
| 10 | | | | | | | | Core barrel dropped during casing advancement for second interval-- soft sediments from 7.5-13 ft not obtainable; refer to log of 03923D. | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |

WELL DIAGRAM



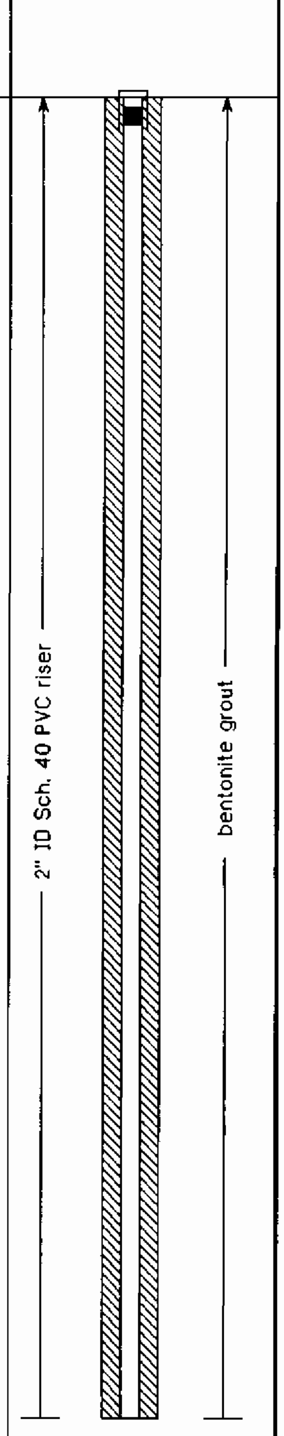
**ENSAFE**

# Monitoring Well NBCA03922D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315067.61 E, 381361.39 N* |
| Location: *Charleston, SC* | Surface Elevation: *9.4 feet msl* |
| Started at *1315 on 7/22/99* | TOC Elevation: *9.14 feet msl* |
| Completed at *1430 on 7/22/99* | Depth to Groundwater: *4.48 feet TOC* Measured: *7/27/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *4.66 feet msl* |
| Drilling Company: *AEI (SC Cert # 1435)* | Total Depth: *32.0 feet* |
| Geologist: *T. Kafka* | Well Screen: *32.2 to 42.0 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | GW | Surface conditions: sand & silt next to RR bed. | |
| | | | | | | | SM | Gravel: black w/ pebbles & med/crs sand. | |
| | | | | | | | | Sand: orange to orange-brown; vf/f; some black silt; loose; moist. | 7.7 |
| | | | | | | | SM SC | Sand: lt tan to olive-gray; vf/f; silty; clayey; moist. | 5.9 |
| 5 | | | | | | | CL | Clay: orange-brown w/ FeOx pits grading to blue-green; w/ vf/f sand (~25%) inc w/ depth to SC; silty; firm; moist; PETRO odor @5.5'. | 2.6 |
| | | | 1 | 0 | 91 | | | | 1.9 |
| | | | | | | | SC | Sand: lt gray to olive-gray; f/m; silty; clayey; firm; wet. | 1.4 |
| 10 | | | | | | | SW | Sand: olive-brown to tan w/ occ. lenses of buff to gray; f/m w/ trace crs; FeOx deposits @ 9.8' assoc. w/ inc grain size to m/crs; @ 11.3- 11.9' dec to f/vf then inc to f/m w/ tr crs w/ trace silty clay laminae @ 12-12.2'. | |
| 15 | | | | | | | | | |
| | | | 2 | 0 | 58 | | | | -8.1 |
| | | | | | | | OH | Clay: dk gray to gray-green; silty; w/ trace vf/f sand in <1" laminae throughout; sticky; soft inc to stiff w/ depth; med/hi plasticity; @ 32-33' inc frequency of 0.5" sand lenses. | |
| 20 | | | | | | | | | |

WELL DIAGRAM



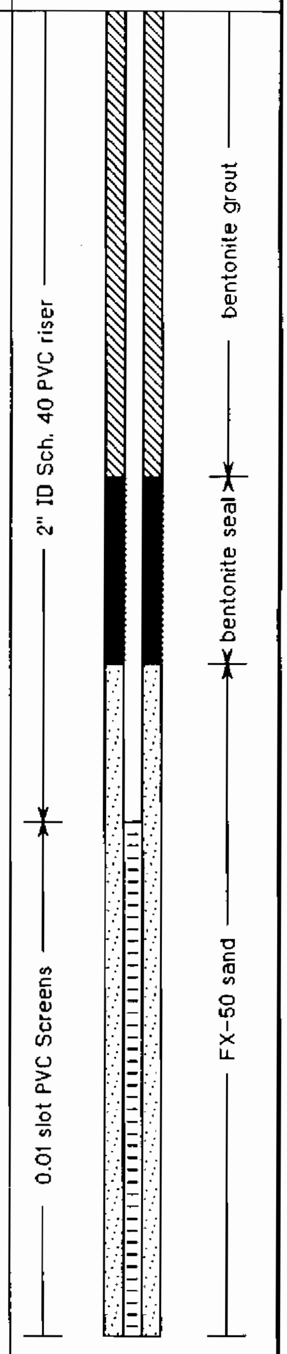
ENSAFE

# Monitoring Well NBCA03922D

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315067.61 E, 381361.39 N |
| Location: Charleston, SC | Surface Elevation: 9.4 feet msl |
| Started at 1315 on 7/22/99 | TOC Elevation: 9.14 feet msl |
| Completed at 1430 on 7/22/99 | Depth to Groundwater: 4.48 feet TOC Measured: 7/27/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 4.66 feet msl |
| Drilling Company: AEI (SC Cert # 1435) | Total Depth: 32.0 feet |
| Geologist: T. Kafka | Well Screen: 32.2 to 42.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | | | | OH | | |
| | | | 3 | 0 | 100 | | | | |
| 30 | | | | | | | | | |
| | | | | | | | SP / OH | Sand: gray to med gray; vf/f w/ trace vf shell hash; interbedded w/ soft to firm, gray silty clay in irreg. spaced lenses inc in freq w/ depth. | -23.6 |
| 35 | | | | | | | | | |
| | | | | | | | SW / GW | Sand: gray; vf/m w/ vf/crs shell hash/frags & pebble to gravel sized $PO_4$ nodules; lag bed. | -27.3 |
| | | | 4 | 0 | 100 | | SP | Sand: med gray; vf/f; clayey; loose. | -28.1 |
| 40 | | | | | | | SW / GW | Sand/gravel: crs sand w/ pebble-gravel size $PO_4$ nodules, round to subrounded; occ shell hash/frags in top 0.3'; sharp basal contact. | -29.8 |

WELL DIAGRAM

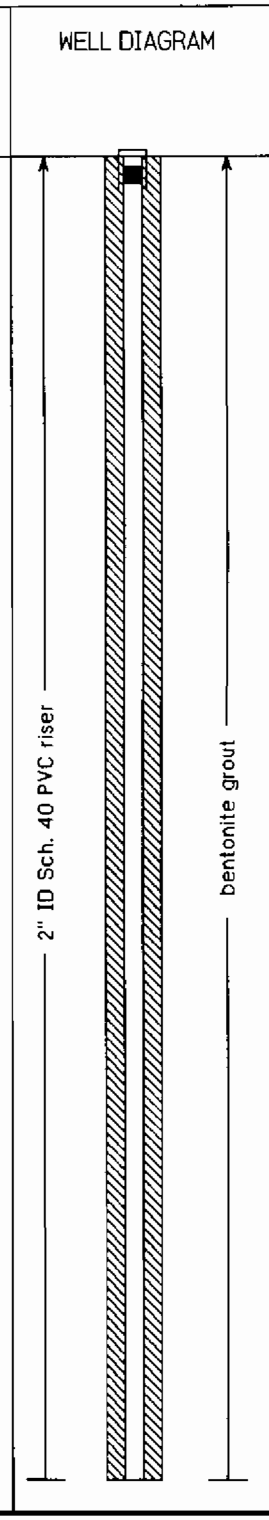


ENSAFE

# Monitoring Well NBCA03923D

| | |
|---|---|
| Project: ZONE A – Naval Base Charleston | Coordinates: 2315048.39 E, 381183.52 N |
| Location: Charleston, SC | Surface Elevation: 7.3 feet msl |
| Started at 0815 on 7/22/99 | TOC Elevation: 7.14 feet msl |
| Completed at 1055 on 7/22/99 | Depth to Groundwater: 3.11 feet TOC Measured: 7/27/99 |
| Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit) | Groundwater Elevation: 4.03 feet msl |
| Drilling Company: AEI (SC Cert # 1435) | Total Depth: 37.0 feet |
| Geologist: T. Kafka | Well Screen: 27.0 to 36.8 feet |

| DEPTH IN FEET | SAMPLE NO. | OVA (ppm) | % RECOVERY | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|
| | | | | GW | Surface conditions: sand & silt next to RR bed. Gravel: dk gray w/ crs to vy crs sand and pebbles. | 6.1 |
| 5 | | | | SM | Sand: med brown-gray grading to orange @ 2.7-4.2'& back to brown- gray; vf/f; some st in black pods/matrix; lt. gray, soft, sticky clay balls in last 0.3'; wet. | 1.4 |
| | | | | SM/SC | Sand: mottled olive-gray to tan; vf/f w/ some st; orange-tan to blue- green clay as lenses; occ. wood frags @ 7.2'; wet. | -.5 |
| 10 | | | | | | -2.7 |
| | | | | SM/SP | Sand: gray turning brown @ 11.5'; vf/f; sty; wet. | -4.7 |
| | 1 | 0 | 62 | SM/PT | Sand: brown; silty; peaty; intermixed due to core loss. | -6.2 |
| | | | | OL/PT | Silt: brown; peat w/ orange organic material; some vf/f sand in last 0.3'. | -6.9 |
| 15 | | | | SP | Sand: lt gray; vf/f; trace brown st in pods in top 0.8'. | -10.2 |
| 20 | 2 | 0 | 75 | SP/SC | Sand: lt gray to olive-tan; vf/f w/ some f/m @ 18.8-19.1'; trace silt; trace clay @ 19.2-20'. | |



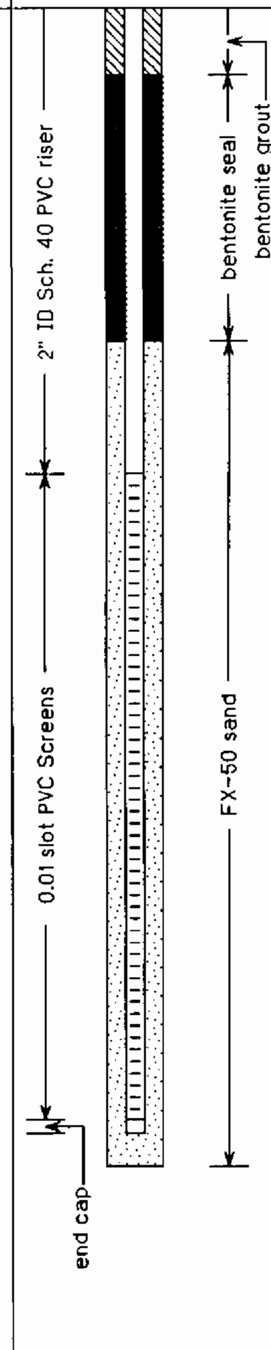
ENSAFE

# Monitoring Well NBCA03923D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315048.39 E, 381183.52 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.3 feet msl* |
| Started at *0815 on 7/22/99* | TOC Elevation: *7.14 feet msl* |
| Completed at *1055 on 7/22/99* | Depth to Groundwater: *3.11 feet TOC* Measured: *7/27/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *4.03 feet msl* |
| Drilling Company: *AEI (SC Cert # 1435)* | Total Depth: *37.0 feet* |
| Geologist: *T. Kafka* | Well Screen: *27.0 to 36.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SP/SC | | -13.6 |
| | | | | | | | SP | Sand: orange to buff; m/crs becoming vf/f @ 21.3'; clean. | -14.7 |
| 25 | | | | | | | | | -20.2 |
| | | | 3 | 0 | 45 | | SM/SW | Sand: lt gray to buff; vf/m; some st; trace clay in top 0.3'; wet. | -21.6 |
| 30 | | | | | | | OL | Clay: gray; sticky; soft; low plasticity; trace vf/f sd as lenses & pods. | -24.4 |
| | | | | | | | SM/OL | Sand: med gray; vf/f; silty; intermixed w/ soft, gray, sticky, silty, clay in 0.2-0.4' wide lenses. | -27.2 |
| 35 | | | | | | | GM/GW | Gravel lag: gray-black; vf/crs sand w/ $PO^4$ nodules up to 2" dia.; vy crs shell frags and hash; silty matrix. | -28.9 |
| | | | | | | | ML/CL | Silt: olive-green to olive-brown; trace vf/f sand & trace clay; firm; dry; sharp overlying contact. | -30.2 |
| | | | 4 | 0 | 100 | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



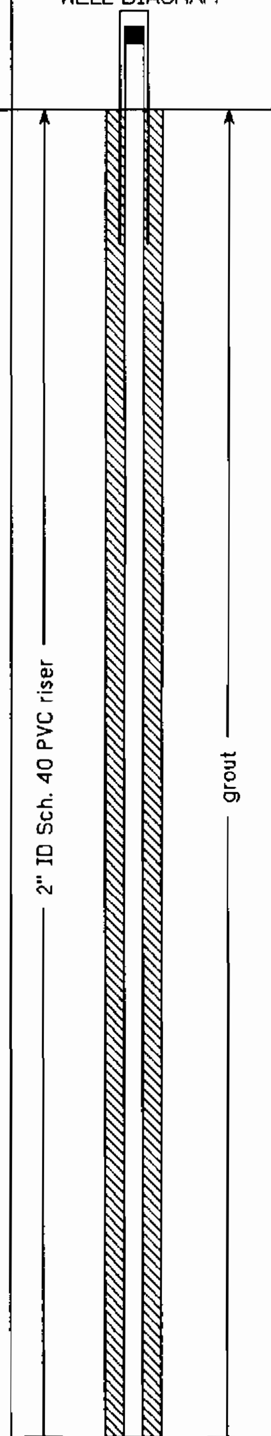
ENSAFE

# Monitoring Well NBCA04202D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315050.76 E, 380576.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *1645 on 7-20-99* | TOC Elevation: *10.43 feet msl* |
| Completed at *1800 on 7-20-99* | Depth to Groundwater: *8.71 feet TOC* Measured: *8/2/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.72 feet msl* |
| Drilling Company: *AEI (SC Cert # 889)* | Total Depth: *46.0 feet* |
| Geologist: *P. Bayley* | Well Screen: *36.0 to 45.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Ground conditions: Gravel/thin Asphalt | 7.2 |
| | | | | | | | SP SM | Sand: dark grey-brown; very fine, some silt to silty, occasional pebble; soft. | 6.7 |
| | | | | | | | SP | Sand: brown; very fine to fine, trace silt, trace clay; soft. @1.5 to 1. ft.: clayey, silty. | 5.8 |
| | | | | | | | CL | Clay: red-orange w/orange-brown and some black; some silt to silty, some sand-very fine; moist, soft, plastic. @2.9 to 3.2 ft.: sandy. @3.7 to 4.5 ft.: change in color to orange brown and grey-green. | 3.3 |
| 5 | | | | | | | SP | Sand: orange w/trace grey; very fine to fine, trace to some silt. | 2.3 |
| | | | 1 | | 73 | | SP | Sand: lt grey and orange brown; very fine to fine, trace to some silt. | .3 |
| | | | | | | | CL | Clay: lt grey w/some orange; sandy-very fine to fine, silty; gradational basal contact. | 0 |
| | | | | | | | SP | Sand: lt grey-brown w/some orange; very fine to fine, trace to some silt; wet, soft-loose, trace plasticity. | -.6 |
| 10 | | | | | | | SP SW | @10.3 to 13.3 ft.: slight increase in grainsize (very fine to medium, trace coarse; no silt). | -2.5 |
| | | | | | | | SP | Sand: red-orange; very fine to fine, trace silt; wet, loose. | -5.5 |
| 15 | | | | | | | OL CL | Clay: orange and lt grey; wet, soft, plastic; w/occasional sandy laminae and pods. @15.8 to 16.4 ft.: Sand: orange; very fine to fine, trace silt; wet, loose; w/very thin clay partings in basal 0.4 ft. @16.4 to 17.5 ft.: clay grades to firm. | -6.6 |
| | | | | | | | SP | | -8 |
| | | | 2 | | 100 | | OL CL | Clay: grey; wet, soft, plastic; w/occasional lt grey sandy pits. @18.8 to 19.0 ft.: Sand: lt grey; very fine, trace mica. | -8.6 |
| 20 | | | | | | | | | |

WELL DIAGRAM



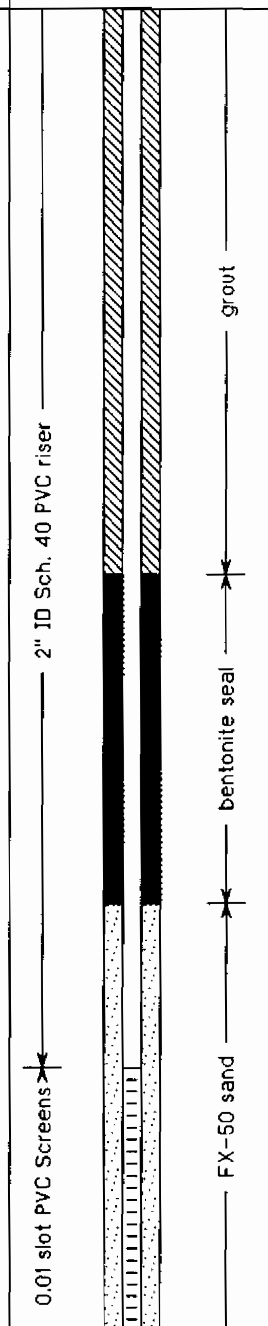
**ENSAFE**

# Monitoring Well NBCA04202D

| | |
|---|---|
| Project: *ZONE A – Naval Base Charleston* | Coordinates: *2315050.76 E, 380576.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *1645 on 7-20-99* | TOC Elevation: *10.43 feet msl* |
| Completed at *1800 on 7-20-99* | Depth to Groundwater: *8.71 feet TOC* Measured: *8/2/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.72 feet msl* |
| Drilling Company: *AEI (SC Cert # 889)* | Total Depth: *46.0 feet* |
| Geologist: *P. Bayley* | Well Screen: *36.0 to 45.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | OL<br>CL | @20.6 to 21.9 ft.: occasional sand laminae; very fine, trace mica. | |
| | | | | | | | | @23.0 to 25.0 ft.: stiff; w/ olove green spots. | -15.2 |
| 25 | | | | | | | | @25.0 to 27.5 ft.:color change to dark grey brown; stiff, w/occasional very thin lt grey sandy partings every 0.1 ft - decreasing in frequency w/depth. | |
| | | | 3 | | 100 | | | Clay: dark olive-grey; moist, stiff, plastic. | |
| | | | | | | | | @28.1 to 28.3, 30.2 to 30.3, and 31.0 to 31.1 ft.: very thin lt grey sand partings. | |
| 30 | | | | | | | OL<br>OH | | |
| 35 | | | | | | | | @35.1 to 37.0 ft.: thin lt grey sand partings and occasional laminae every 0.1 to 0.3 ft. | |
| | | | 4 | | 100 | | | @38.3, 39.4 and 40.0 ft.: very thin lt grey sand partings. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



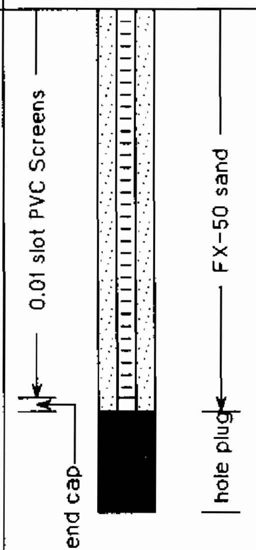
**ENSAFE**

# Monitoring Well NBCA04202D

| | |
|---|---|
| Project: *ZONE A - Naval Base Charleston* | Coordinates: *2315050.76 E, 380576.54 N* |
| Location: *Charleston, SC* | Surface Elevation: *7.8 feet msl* |
| Started at *1645 on 7-20-99* | TOC Elevation: *10.43 feet msl* |
| Completed at *1800 on 7-20-99* | Depth to Groundwater: *8.71 feet TOC* Measured: *8/2/99* |
| Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)* | Groundwater Elevation: *1.72 feet msl* |
| Drilling Company: *AEI (SC Cert # 889)* | Total Depth: *46.0 feet* |
| Geologist: *P. Bayley* | Well Screen: *36.0 to 45.8 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | OVA (ppm) | % RECOVERY | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | OL/OH | | -32.5 |
| | | | | | | | SP/SW, SW | Sand: dark grey to black; very fine to coarse, w/fine to coarse shell fragments (white and phosphatic); wet, loose; some small bivalves and a small whelk shell. @ 41.1 to 45.0 ft.: Shells and fine to coarse grey sand. . | -33.3 |
| 45 | | | | | | | ML/CL | Silt: yellow olive-brown; clayey; moist, stiff, plastic. (Ashley Fm) @45.0 to 45.3 ft.: dark grey sandy pods: burrow infills. | -37.2 |
| | | | 5 | | 100 | | | | -39.7 |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |

WELL DIAGRAM



# ATTACHMENT C

## SOIL GAS DATA RESULTS

COLUMBIA ENVIRONMENTAL TECHNOLOGIES

ANALYTICAL LABORATORY DATA

FAX COVER SHEET

DATE: 5/17-5/19

TO: Charlie Vernoy
COMPANY: Ensafe
FAX PHONE: 843-856-0107

FROM: Eric Magdar

JOB INFO:

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvc |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 0.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

| | | | |
|---|---|---|---|
| Samples Collected: 5/17-5/19 | Collected by: Randy Brand | Client: | Ensafe |
| Samples Received: 5/17-5/19 | Received by: Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: 5/17-5/19 | Analyzed by: Eric Magdar | | Suite 113 |
| Samples Reported: 5/17-5/19 | Reported by: Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: Charleston, SC | Report Revision: 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: ENM05079 | Method Deviations: none | Client Phone: | 843-884-0029 |
| Purchase Order: N/A | Sampling Method: unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | BLANK 001 (ug/L) | N250 W650 (ug/L) | N250 W600 (ug/L) | N200 W600 (ug/L) | N150 W600 (ug/L) | N150 W550 (ug/L) | N150 W500 (ug/L) | N200 W550 (ug/L) | N100 W450 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.21 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 1.75 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.168 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.215 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory
U: see sample narrative
Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve
ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

| | | | | | | |
|---|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 6/20/98-6/23/98 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N100 W500 (ug/L) | N100 W550 (ug/L) | N100 W600 (ug/L) | N100 W650 (ug/L) | N50 W650 (ug/L) | N50 W600 (ug/L) | N50 W550 (ug/L) | N50 W500 (ug/L) | N50 W450 (ug/L) | N 0 W450 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.21 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 1.75 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.168 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.215 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory
U: see sample narrative
Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve
ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

*Phone: (301)362-8520* *PO. Box 6239 Columbia, MD 21045-6239* *Fax: (301)362-8524*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N 0 W500 (ug/L) | BLANK 002 (ug/L) | N100 W200 (ug/L) | N100 W250 (ug/L) | N100 W300 (ug/L) | N200 W650 (ug/L) | BLANK 003 (ug/L) | N 0 W400 (ug/L) | N50 W400 (ug/L) | N100 W400 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | 5.15 | ND | ND | 1.07 | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | ND | ND | 2.21 | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N100 W450 (ug/L) | N150 W450 (ug/L) | N200 W200 (ug/L) | N250 W450 (ug/L) | N250 W500 (ug/L) | N250 W550 (ug/L) | N200 W500 (ug/L) | N200 W450 (ug/L) | N200 W150 (ug/L) | N200 W100 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory
U: see sample narrative
Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve
ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

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| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| | | N250 | N250 | N250 | N150 | N100 | N100 | BLANK | N100 | N150 | N150 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | PQL[2] | W100 | W50 | W 0 | W100 | W100 | W50 | 004 | W 0 | W 0 | W50 |
| | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) |
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | 12.2 | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N100 W150 (ug/L) | N100 W350 (ug/L) | BLANK 005 (ug/L) | BLANK 006 (ug/L) | N 0 W 0 (ug/L) | N50 W 0 (ug/L) | N50 W50 (ug/L) | N 0 W50 (ug/L) | N 0 W100 (ug/L) | N50 W100 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | 2.9 | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

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*Phone: (301)362-8520* *PO. Box 6239 Columbia, MD 21045-6239* *Fax: (301)362-8524*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N 0 W600 (ug/L) | N 0 W200 (ug/L) | N 0 W250 (ug/L) | N50 W250 (ug/L) | N50 W300 (ug/L) | N 0 W300 (ug/L) | N 0 W150 (ug/L) | N50 W350 (ug/L) | N50 W150 (ug/L) | N 0 W650 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND | 3.45 | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | 1.55 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

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*Phone: (301)362-8520* *PO. Box 6239 Columbia, MD 21045-6239* *Fax: (301)362-8524*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
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| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N 0 W350 (ug/L) | N50 W200 (ug/L) | BLANK 007 (ug/L) | N150 W350 (ug/L) | N200 W250 (ug/L) | N250 W250 (ug/L) | N200 W300 (ug/L) | BLANK 007 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | 3.56 | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory
U: see sample narrative
Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve
ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

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|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | BLANK 009 (ug/L) | N150 W400 (ug/L) | N200 W400 (ug/L) | N200 W350 (ug/L) | N200 W50 (ug/L) | N200 W 0 (ug/L) | N 0 W550 (ug/L) | N300 W 0 (ug/L) | N200 E100 (ug/L) | N300 E100 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | 2.99 | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | 0.460 | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | ND | 1.33 | ND | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

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| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | N250 E100 (ug/L) | N300 E50 (ug/L) | N250 E50 (ug/L) | N200 E50 (ug/L) | N150 E50 (ug/L) | N150 E100 (ug/L) | BLANK 011 (ug/L) |
|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | 0.374 | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

| | | | | | |
|---|---|---|---|---|---|
| Samples Collected: | 5/17-5/19 | Collected by: | Randy Brand | Client: | Ensafe |
| Samples Received: | 5/17-5/19 | Received by: | Eric Magdar | Client Address: | 935 Houston Northcutt Blvd. |
| Samples Analyzed: | 5/17-5/19 | Analyzed by: | Eric Magdar | | Suite 113 |
| Samples Reported: | 5/17-5/19 | Reported by: | Eric Magdar | | Mt. Pleasant, SC. 29464 |
| Project Identification: | Charleston, SC | Report Revision: | 1.0 | Client Contact: | Charlie Vernoy |
| Columbia Job Code: | ENM05079 | Method Deviations: | none | Client Phone: | 843-884-0029 |
| Purchase Order: | N/A | Sampling Method: | unknown | Client Fax: | 843-856-0107 |

**USEPA Method 8010M Soil Vapor Sample Analysis Results in ug/L**

| Compound | PQL[2] (ug/L) | BLANK 012 (ug/L) | N175 W625 (ug/L) | N200 W625 (ug/L) | N225 W625 (ug/L) | N225 W650 (ug/L) | S50 W600 (ug/L) | S50 W650 (ug/L) | S50 W500 (ug/L) | S50 W550 (ug/L) | S50 W670 (ug/L) | S100 W600 (ug/L) | S100 W650 (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| trans-1,2-dichloroethene | 2.76 | ND | ND | ND | ND | 2.76 | ND | 3.01 | ND | ND | ND | ND | ND |
| cis-1,2-dichloroethene | 3.54 | ND | ND | ND | ND | ND | ND | 15.5 | ND | ND | ND | ND | ND |
| trichloroethene | 0.268 | ND | ND | ND | ND | 1.28 | ND | 0.406 | ND | ND | ND | ND | ND |
| tetrachloroethene | 0.344 | ND | ND | 0.347 | 0.751 | 1.09 | ND | 0.732 | ND | ND | ND | ND | ND |
| Sample Condition (S,U)/Dilution (PQL) | 1 | S | S | S | S | S | S | S | S | S | S | S | S |

S: Satisfactory, U: Unsatisfactory

U: see sample narrative

Dilution: numerical dilution factor used to quantitate analyte concentrations within the range of the initial calibration curve

ND: Not Detected at or above the PQL.

[2] PQL: Practical quantitation limit using the initial calibration curve low point and dilution factors where applicable

SAMPLE NARRATIVE:

Quality Control Review:

*This report will not be reproduced without the permission of the client*

*Phone: (301)362-8520* *PO. Box 6239 Columbia, MD 21045-6239* *Fax: (301)362-8524*

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846-VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-PG16-01 | | 039-S-PG16-02 | | 039-S-PG17-01 | | 039-S-PG17-02 | | 039-S-PG18-01 | | 039-S-PG18-02 | |
| | ORIGINAL ID -----> | 039SPG1601 | | 039SPG1602 | | 039SPG1701 | | 039SPG1702 | | 039SPG1801 | | 039SPG1802 | |
| | LAB SAMPLE ID ---> | 38687.01 | | 38687.02 | | 38687.03 | | 38687.04 | | 38687.05 | | 38687.06 | |
| | ID FROM REPORT --> | 039SPG1601 | | 039SPG1602 | | 039SPG1701 | | 039SPG1702 | | 039SPG1801 | | 039SPG1802 | |
| | SAMPLE DATE -----> | 05/21/99 | | 05/21/99 | | 05/21/99 | | 05/21/99 | | 05/21/99 | | 05/21/99 | |
| | DATE ANALYZED ---> | 05/28/99 | | 05/28/99 | | 05/28/99 | | 05/28/99 | | 05/28/99 | | 05/28/99 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | 38687 | | 38687 | | 38687 | | 38687 | | 38687 | | 38687 | |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-01-4 | Vinyl chloride | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-69-4 | Trichlorofluoromethane | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 67-64-1 | Acetone | 5. | U | 22. | | 10. | | 6. | U | 5. | U | 22. | |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 71-43-2 | Benzene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 108-88-3 | Toluene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 124-48-1 | Dibromochloromethane | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 95-47-6 | o-Xylene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | | ?????????? | |
| 100-42-5 | Styrene | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 4. | U | 6. | U | 5. | U | 5. | U |

# CHARLESTON - ZONE A
## NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846-VOA | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-PG16-01 | 039-S-PG16-02 | 039-S-PG17-01 | 039-S-PG17-02 | 039-S-PG18-01 | 039-S-PG18-02 |
| | ORIGINAL ID -----> | 039SPG1601 | 039SPG1602 | 039SPG1701 | 039SPG1702 | 039SPG1801 | 039SPG1802 |
| | LAB SAMPLE ID ---> | 38687.01 | 38687.02 | 38687.03 | 38687.04 | 38687.05 | 38687.06 |
| | ID FROM REPORT --> | 039SPG1601 | 039SPG1602 | 039SPG1701 | 039SPG1702 | 039SPG1801 | 039SPG1802 |
| | SAMPLE DATE -----> | 05/21/99 | 05/21/99 | 05/21/99 | 05/21/99 | 05/21/99 | 05/21/99 |
| | DATE ANALYZED ---> | 05/28/99 | 05/28/99 | 05/28/99 | 05/28/99 | 05/28/99 | 05/28/99 |
| | MATRIX ----------> | Soil | Soil | Soil | Soil | Soil | Soil |
| | UNITS -----------> | UG/KG A | UG/KG A | UG/KG A | UG/KG A | UG/KG A | UG/KG A |
| CAS # | Parameter | 38687 | 38687 | 38687 | 38687 | 38687 | 38687 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. U | 5. U | 4. U | 6. U | 5. U | 5. U |
| 541-73-1 | 1,3-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? |
| 106-46-7 | 1,4-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? |
| 95-50-1 | 1,2-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? |
| 9999900-05-0 | m+p Xylene | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? |
| 540-59-0 | 1,2-Dichloroethene (total) | 5. U | 5. U | 4. U | 2. J | 5. U | 5. U |
| 1634-04-4 | Methyl tert-butyl ether | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? | ?????????? |

| SW846-VOA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-PG19-01 | | 039-S-PG19-02 | | 039-S-PG20-01 | | 039-S-PG20-02 | | | |
| | ORIGINAL ID -----> | 039SPG1901 | | 039SPG1902 | | 039SPG2001 | | 039SPG2002 | | | |
| | LAB SAMPLE ID ---> | 38687.07 | | 38687.08 | | 38687.09 | | 38687.10 | | | |
| | ID FROM REPORT --> | 039SPG1901 | | 039SPG1902 | | 039SPG2001 | | 039SPG2002 | | | |
| | SAMPLE DATE -----> | 05/21/99 | | 05/21/99 | | 05/21/99 | | 05/21/99 | | | |
| | DATE ANALYZED ---> | 05/28/99 | | 05/28/99 | | 05/28/99 | | 05/28/99 | | | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | | |
| | UNITS -----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | | |
| CAS # | Parameter | 38687 | | 38687 | | 38687 | | 38687 | | | |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-01-4 | Vinyl chloride | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-69-4 | Trichlorofluoromethane | ?????????? | | ?????????? | | ?????????? | | ?????????? | | | |
| 67-64-1 | Acetone | 5. | U | 19. | | 6. | U | 70. | | | |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 156-60-5 | trans-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | | |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 78-93-3 | 2-Butanone (MEK) | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 156-59-2 | cis-1,2-Dichloroethene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | | |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 71-43-2 | Benzene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-27-4 | Bromodichloromethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 108-88-3 | Toluene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 124-48-1 | Dibromochloromethane | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 95-47-6 | o-Xylene | ?????????? | | ?????????? | | ?????????? | | ?????????? | | | |
| 100-42-5 | Styrene | 5. | U | 5. | U | 6. | U | 5. | U | | |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 6. | U | 5. | U | | |

CHARLESTON - ZONE A
NAVAL BASE CHARLESTON ZONE A (NBCH)



| SW846-VOA | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-S-PG19-01 | 039-S-PG19-02 | 039-S-PG20-01 | 039-S-PG20-02 | | |
| | ORIGINAL ID -----> | 039SPG1901 | 039SPG1902 | 039SPG2001 | 039SPG2002 | | |
| | LAB SAMPLE ID ---> | 38687.07 | 38687.08 | 38687.09 | 38687.10 | | |
| | ID FROM REPORT --> | 039SPG1901 | 039SPG1902 | 039SPG2001 | 039SPG2002 | | |
| | SAMPLE DATE -----> | 05/21/99 | 05/21/99 | 05/21/99 | 05/21/99 | | |
| | DATE ANALYZED ---> | 05/28/99 | 05/28/99 | 05/28/99 | 05/28/99 | | |
| | MATRIX ----------> | Soil | Soil | Soil | Soil | | |
| | UNITS -----------> | UG/KG A | UG/KG A | UG/KG A | UG/KG A | | |
| CAS # | Parameter | 38687 | 38687 | 38687 | 38687 | | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. U | 5. U | 6. U | 5. U | | |
| 541-73-1 | 1,3-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | | |
| 106-46-7 | 1,4-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | | |
| 95-50-1 | 1,2-Dichlorobenzene | ?????????? | ?????????? | ?????????? | ?????????? | | |
| 9999900-05-0 | m+p Xylene | ?????????? | ?????????? | ?????????? | ?????????? | | |
| 540-59-0 | 1,2-Dichloroethene (total) | 5. U | 5. U | 6. U | 5. U | | |
| 1634-04-4 | Methyl tert-butyl ether | ?????????? | ?????????? | ?????????? | ?????????? | | |

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN;
LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL;
RALEIGH,NC; COLOGNE, GERMANY

# CHAIN OF CUSTODY RECORD

COC NO:
PO NO: 4
REL NO: 97
LAB NAME: Southwest

CLIENT: Naval Base Charleston
LOCATION: Zone A
SAMPLERS: (SIGNATURE)
PROJECT MANAGER: Charlie Vernoy
TELE/FAX NO.: (843)884-0029/856-0107

ANALYSIS REQUIRED

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | VOAs | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| NBCA\039SP01601 | 5/21/99 | 1020 | Soil | Encore, 2oz Jar | 4° | — | 4 | X | |
| NBCA\039SP01602 | 5/21/99 | 1025 | Soil | Encore, 2oz Jar | 4° | — | 4 | X | |
| NBCA\039SP01701 | 5/21/99 | 1055 | Soil | Encore, 2oz Jar | 4° | — | 4 | X | |
| NBCA\039SP01702 | 5/21/99 | 1100 | Soil | | 4° | — | 4 | X | |
| NBCA\039SP01801 | 5/21/99 | 1155 | Soil | | | — | 4 | X | Diesel Odor |
| NBCA\039SP01802 | 5/21/99 | 1200 | Soil | | | — | 4 | X | Diesel Odor |
| NBCA\039SP01901 | 5/21/99 | 1215 | Soil | | | — | 4 | X | Diesel/odor |
| NBCA\039SP01902 | 5/21/99 | 1220 | Soil | | | — | 4 | X | Diesel odor |
| NBCA\039SP02001 | 5/21/99 | 1305 | Soil | | | — | 4 | X | |
| NBCA\039SP02002 | 5/21/99 | 1310 | Soil | | | — | 4 | X | |
| RB ~~FT~~ NBCA\039TP02002 | 5/21/99 | — | Water | 40mL | 4° | — | 2 | X | |

| RELINQUISHER: | DATE 5/24/99 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
|---|---|---|---|---|---|---|---|
| PRINTED: Robert Botts | TIME 1500 | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: FedEx
SHIPMENT NO. 808625948973
SEND RESULTS TO:

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

# ATTACHMENT D

# STORM SEWER INVERT SKETCHES

# AND SURFACE WATER SAMPLING DATA

BPA 1498 Service Order # DT 1107 Storm Sewer Locations
Data file 11548-dt1107.csv

| GisID | Northing | Easting | RimEL | MapID | Surv | Date | Shot |
|---|---|---|---|---|---|---|---|
| DIA-001 | 381526.97 | 2316404.72 | 8.05 | DIA-001 | TH | 1298 | 4585 |
| DIA-002 | 381511.06 | 2316298.03 | 8.29 | DIA-002 | TH | 1298 | 4584 |
| DIA-003 | 381495.39 | 2316188.64 | 7.77 | DIA-003 | TH | 1298 | 4583 |
| DIA-004 | 381440.08 | 2316113.12 | 7.83 | DIA-004 | TH | 1298 | 4582 |
| DIA-005 | 381395.8 | 2315930.08 | 7.29 | DIA-005 | TH | 1298 | 4574 |
| DIA-006 | 381355.02 | 2315645 | 8.11 | DIA-006 | TH | 1298 | 4581 |
| DIA-007 | 381324.73 | 2315402.07 | 7.47 | DIA-007 | TH | 1298 | 4570 |
| DIA-008 | 381381.02 | 2315358.64 | 7.87 | DIA-008 | TH | 1298 | 4571 |
| DIA-009 | 381347.33 | 2315318.37 | 8.65 | DIA-009 | TH | 1298 | 4572 |
| DIA-010 | 381194.43 | 2315522.2 | 7.39 | DIA-010 | TH | 1298 | 4573 |
| DIA-011 | 381128.33 | 2315632.01 | 8.16 | DIA-011 | TH | 1298 | 4569 |
| DIA-012 | 381155.78 | 2315813.65 | 8.21 | DIA-012 | TH | 1298 | 4568 |
| DIA-013 | 381166.4 | 2315888.53 | 7.92 | DIA-013 | TH | 1298 | 4567 |
| DIA-014 | 381251.05 | 2315916.65 | 6.80 | DIA-014 | TH | 1298 | 4575 |
| DIA-015 | 381631.35 | 2316558.99 | 8.07 | DIA-015 | TH | 1298 | 4587 |
| DIA-016 | 381657.6 | 2315957.98 | 6.98 | DIA-016 | TH | 1298 | 4577 |
| DIA-017 | 381620.45 | 2315658.09 | 7.95 | DIA-017 | TH | 1298 | 4579 |
| DIA-018 | 381624.21 | 2315551.25 | 7.67 | DIA-018 | TH | 1298 | 4580 |
| DIA-019 | 381509.98 | 2315337.08 | 7.61 | DIA-019 | TH | 1298 | 4588 |
| DIA-020 | 381740.17 | 2315679.62 | 6.36 | DIA-020 | TH | 1298 | 4578 |
| DIA-022 | 380986.14 | 2315641.33 | 7.16 | DIA-022 | TH | 1298 | 4566 |

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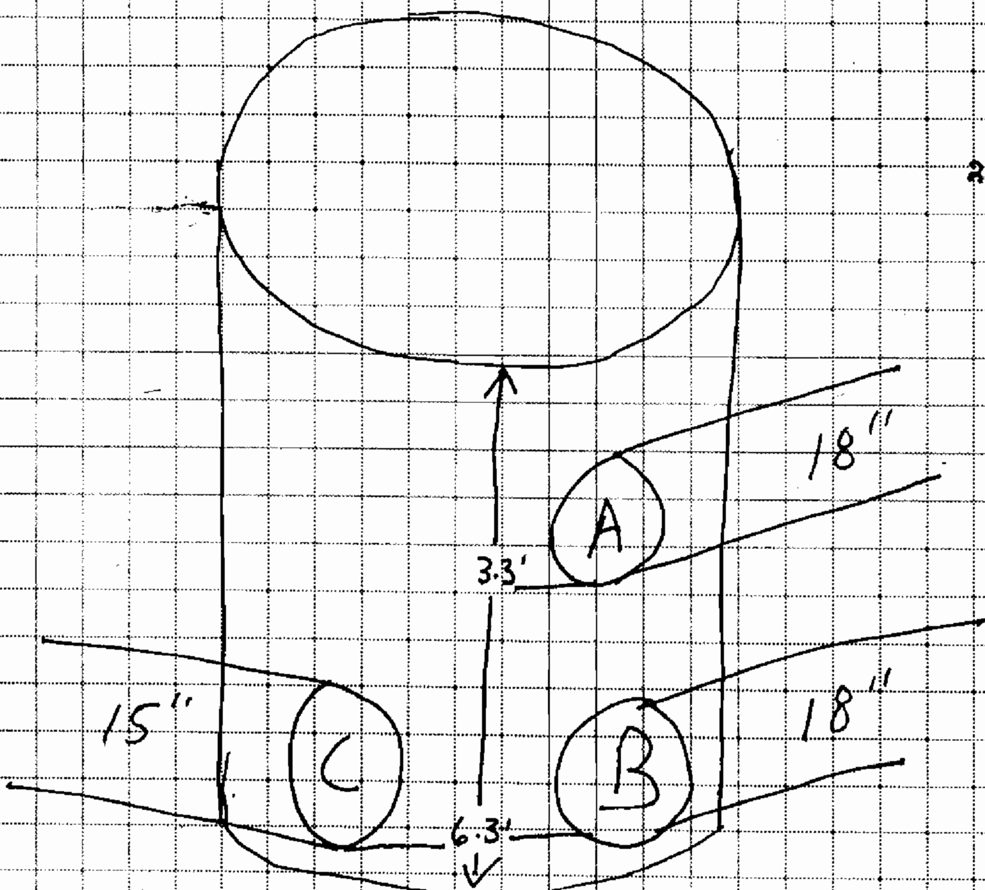
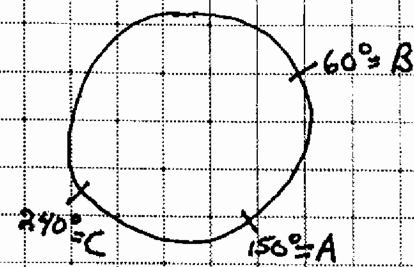
SCALE

Location#- DIA-001
Rim Elevation (ft msl)
8.05

Metal Grate
Standing Water



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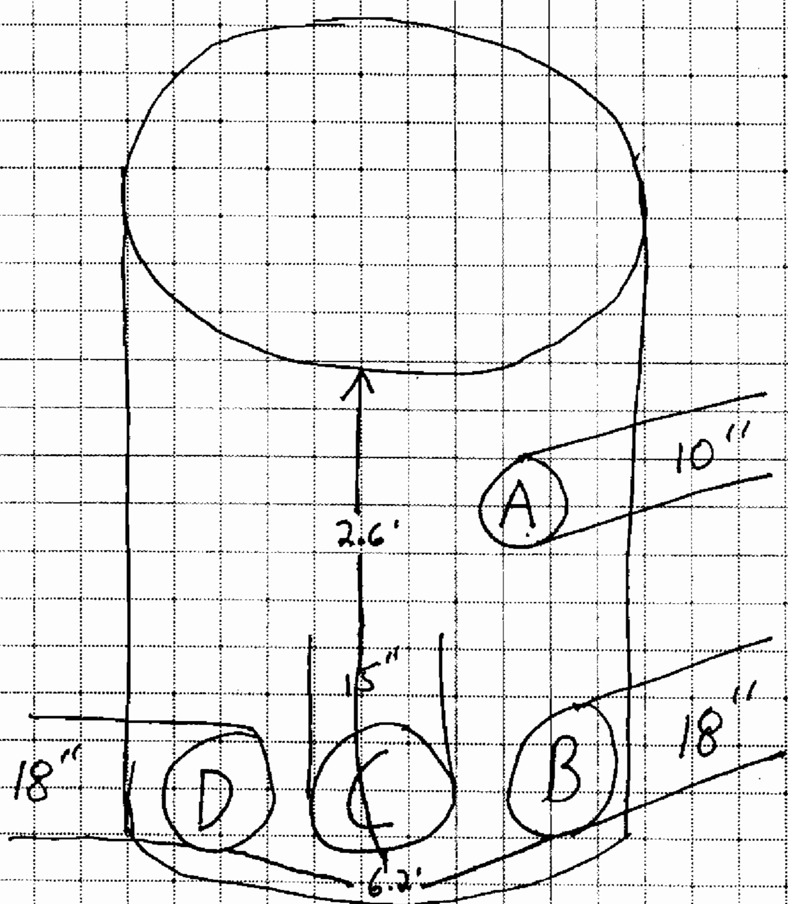
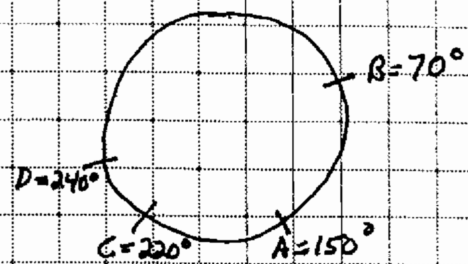
Location #- DIA-002
Rim Elevation (ft msl)
8.29

Metal Grate
Standing Water



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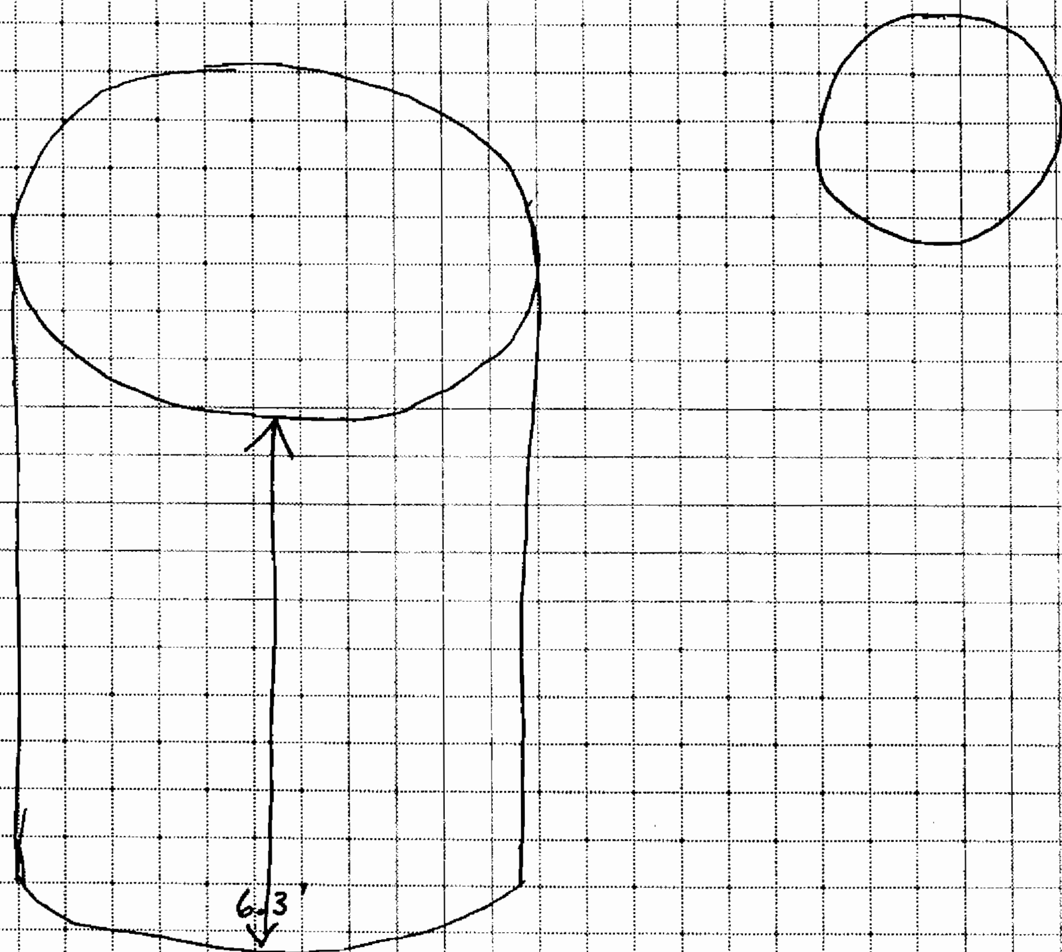
CHECKED BY ______ DATE ______
SCALE ______

Location#- DIA-003
Rim Elevation (ft msl)
7.77

Metal Grate
No inverts
No water



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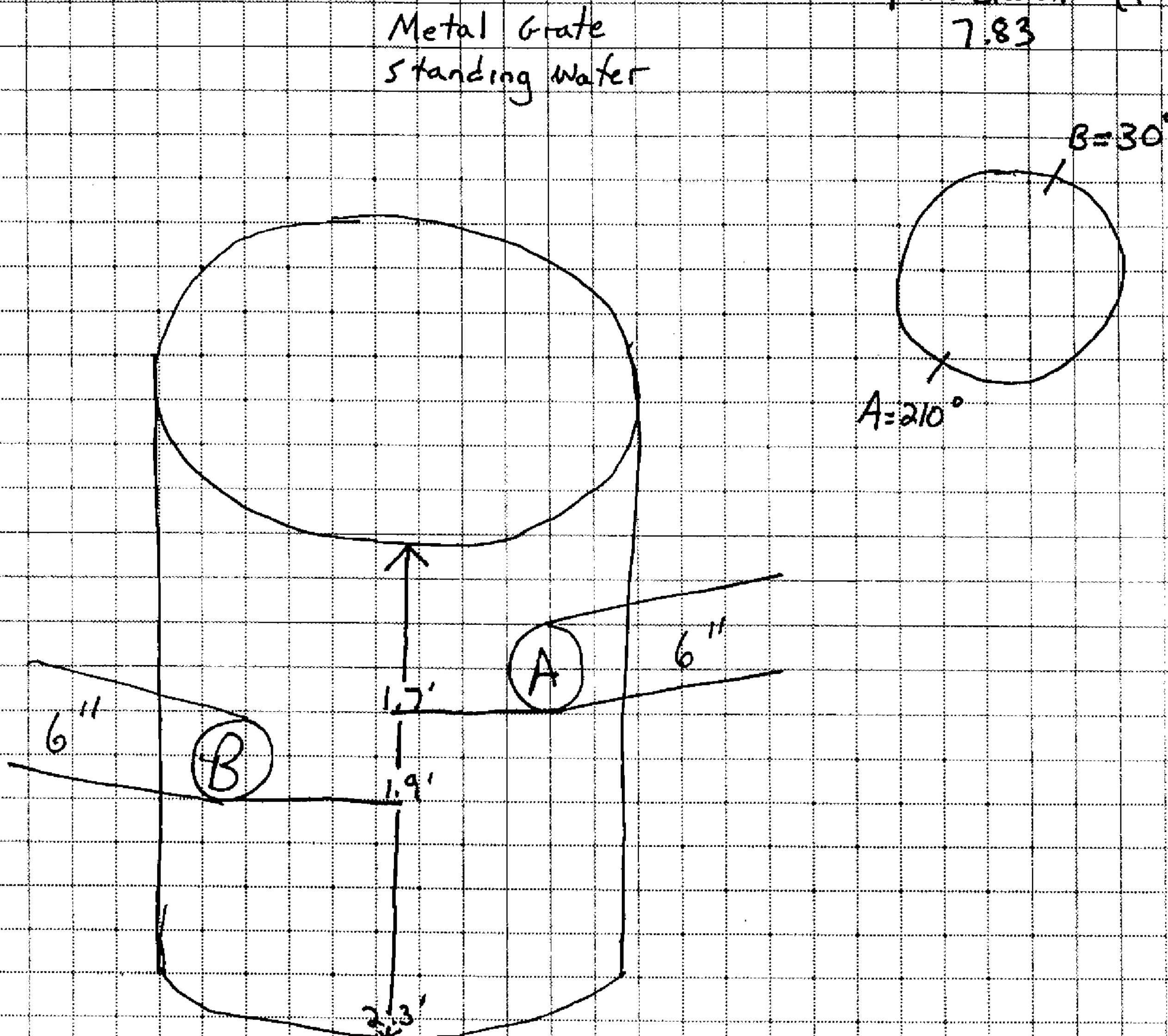
SCALE ____

Location# DJA-004
Rim Elevation (ft msl)
7.83



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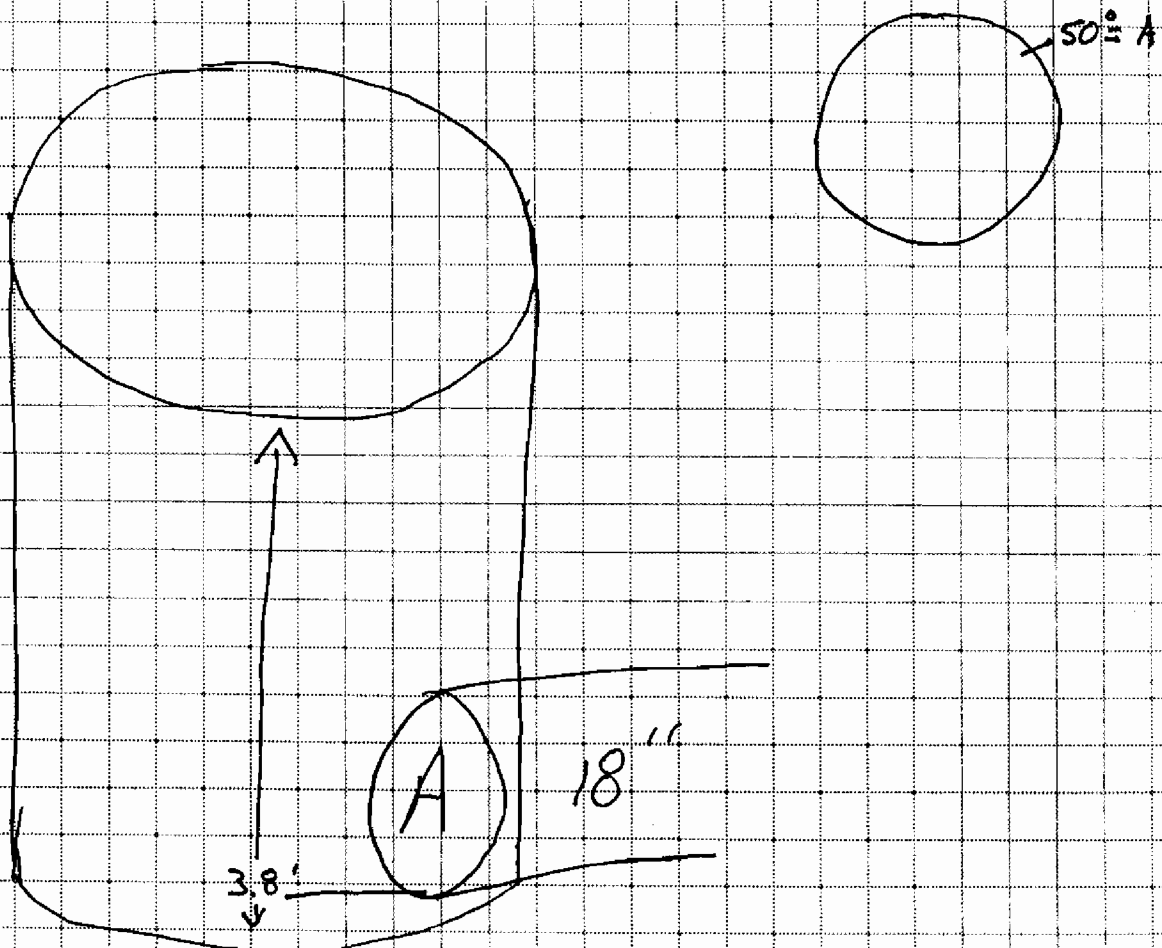
Location#- DIA-005

Rim Elevation (ft msl)

7.29

Metal Grate

Standing Water



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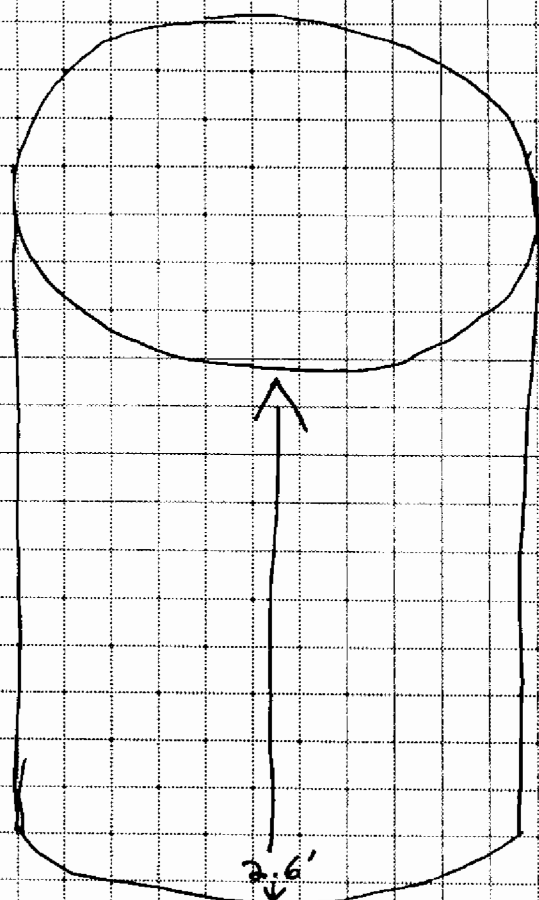
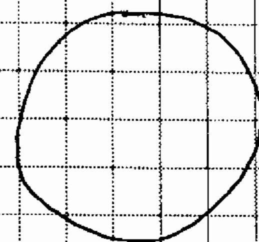
SCALE ______

Location #- DIA-006
Rim Elevation (ft msl)
8.11

Metal Grate
Standing water
No inverts



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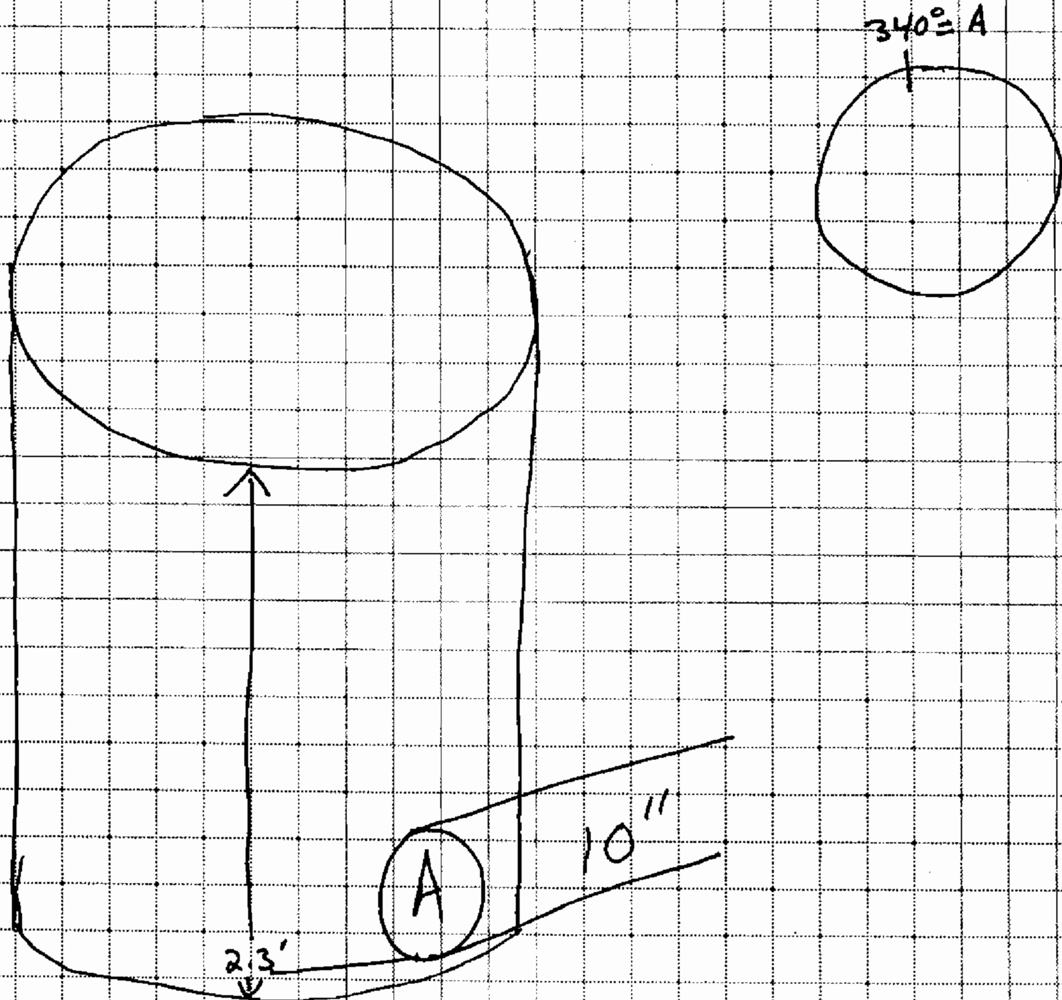
SCALE ____________

Location# - DIA-007
Rim Elevation ft msl
7.47

Metal Grate
Standing water



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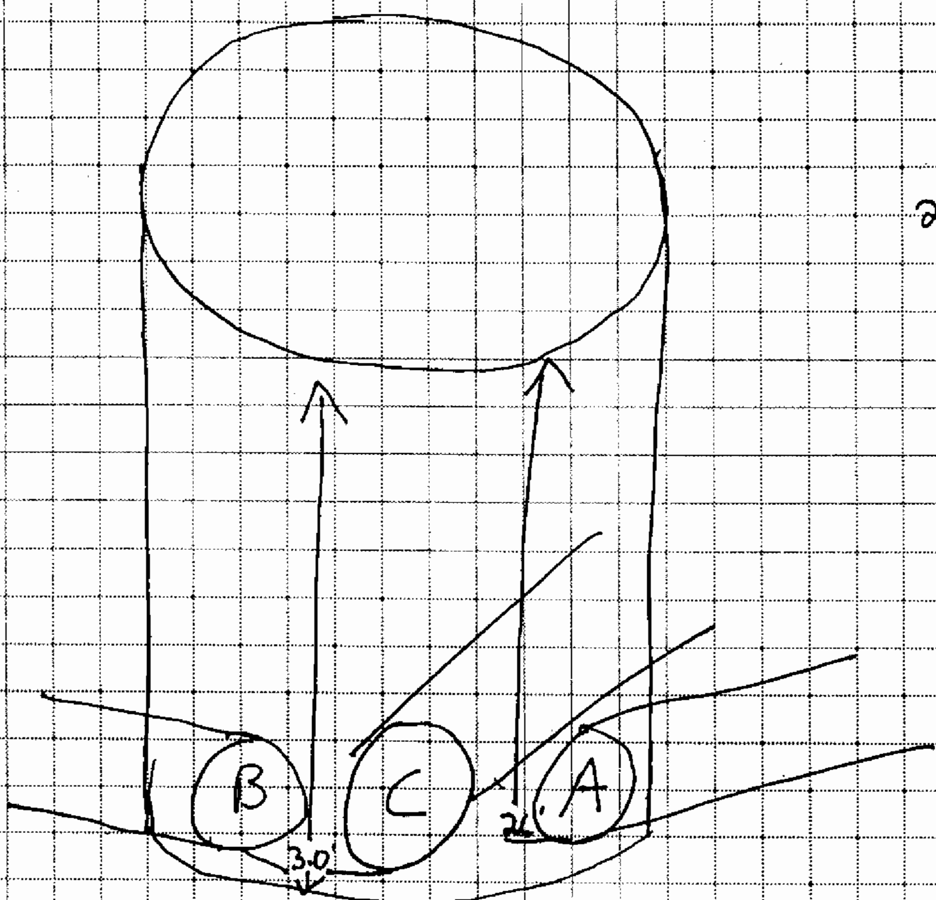
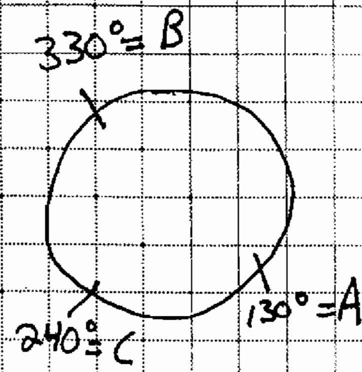
Location #- DIA-008

Rim Elevation (ft msl)

7.87

Metal Grate



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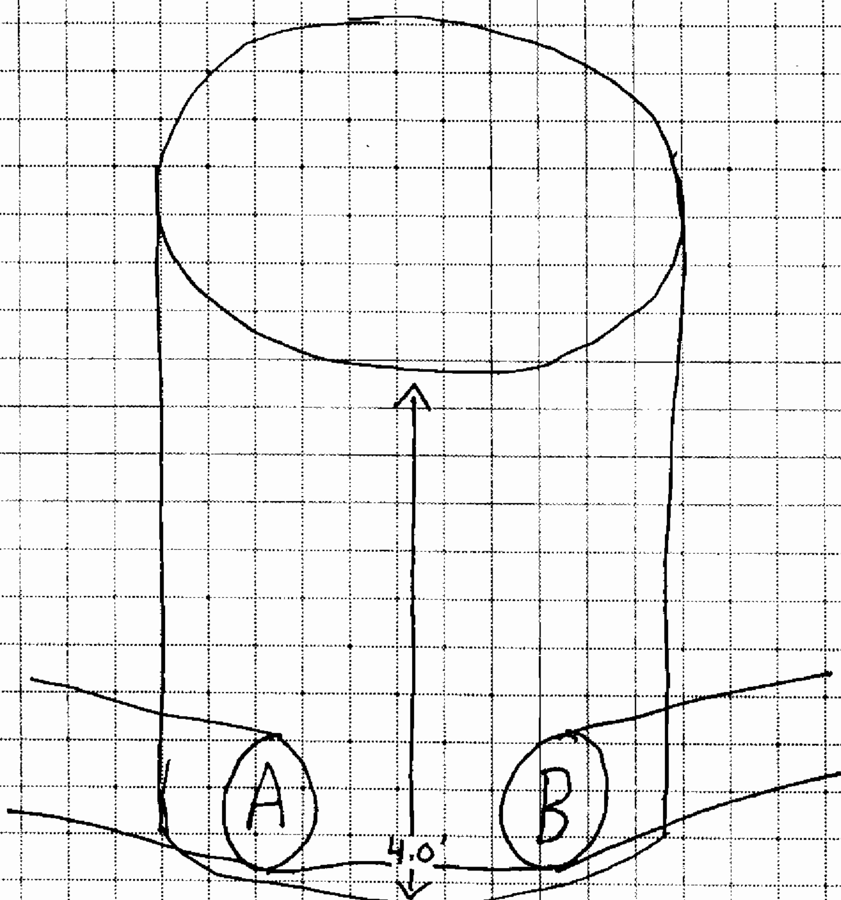
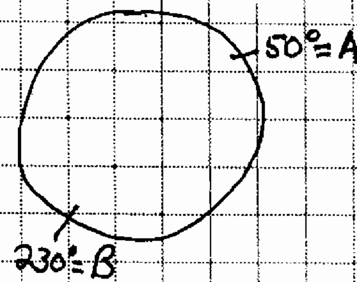
SCALE ______

Location# - DIA-009
Rim Elevation (ft msl)
8.65

Metal Grate
Standing Water



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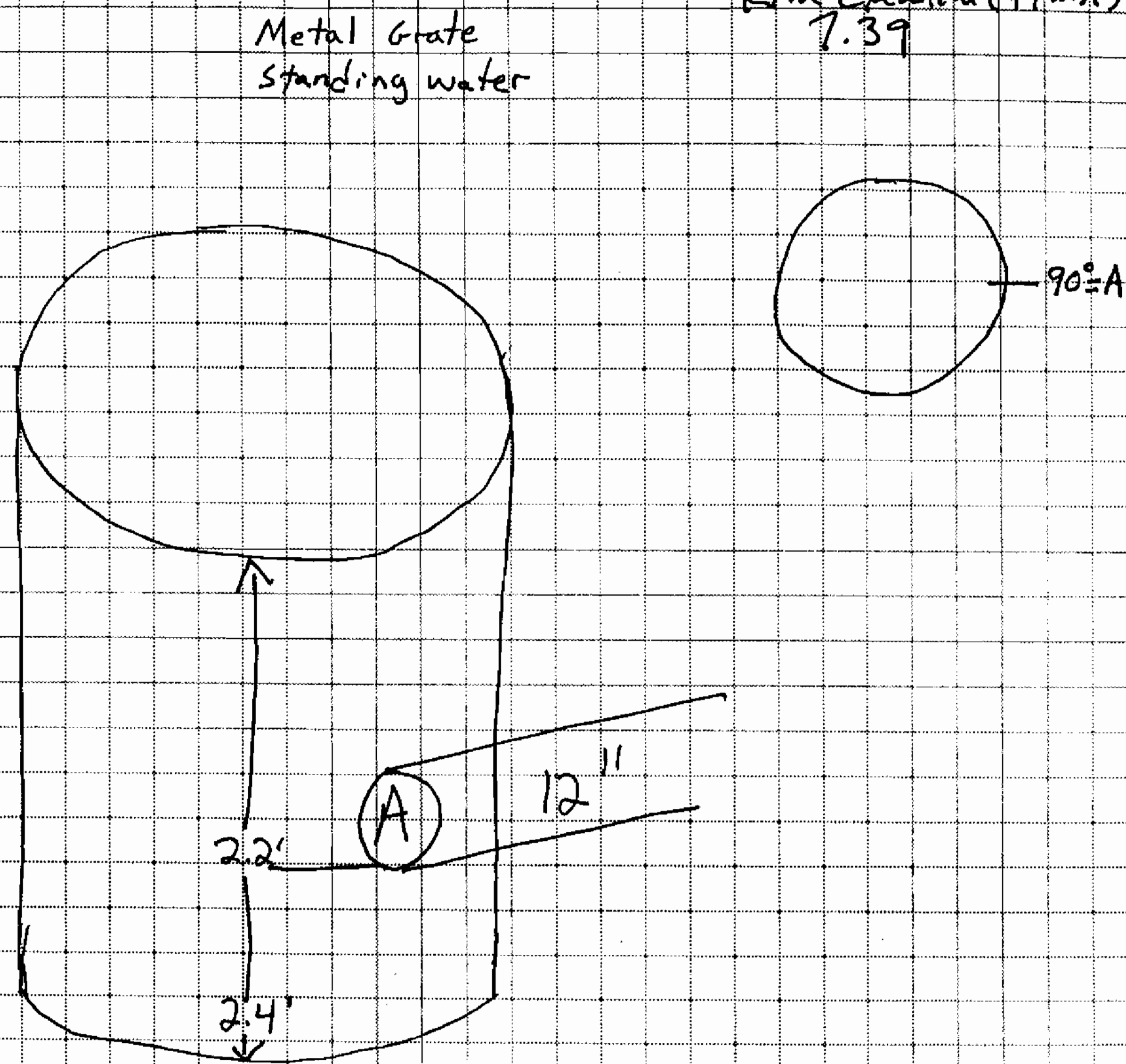
SCALE

Location# - DIA-010
Rim Elevation (ft msl)
7.39



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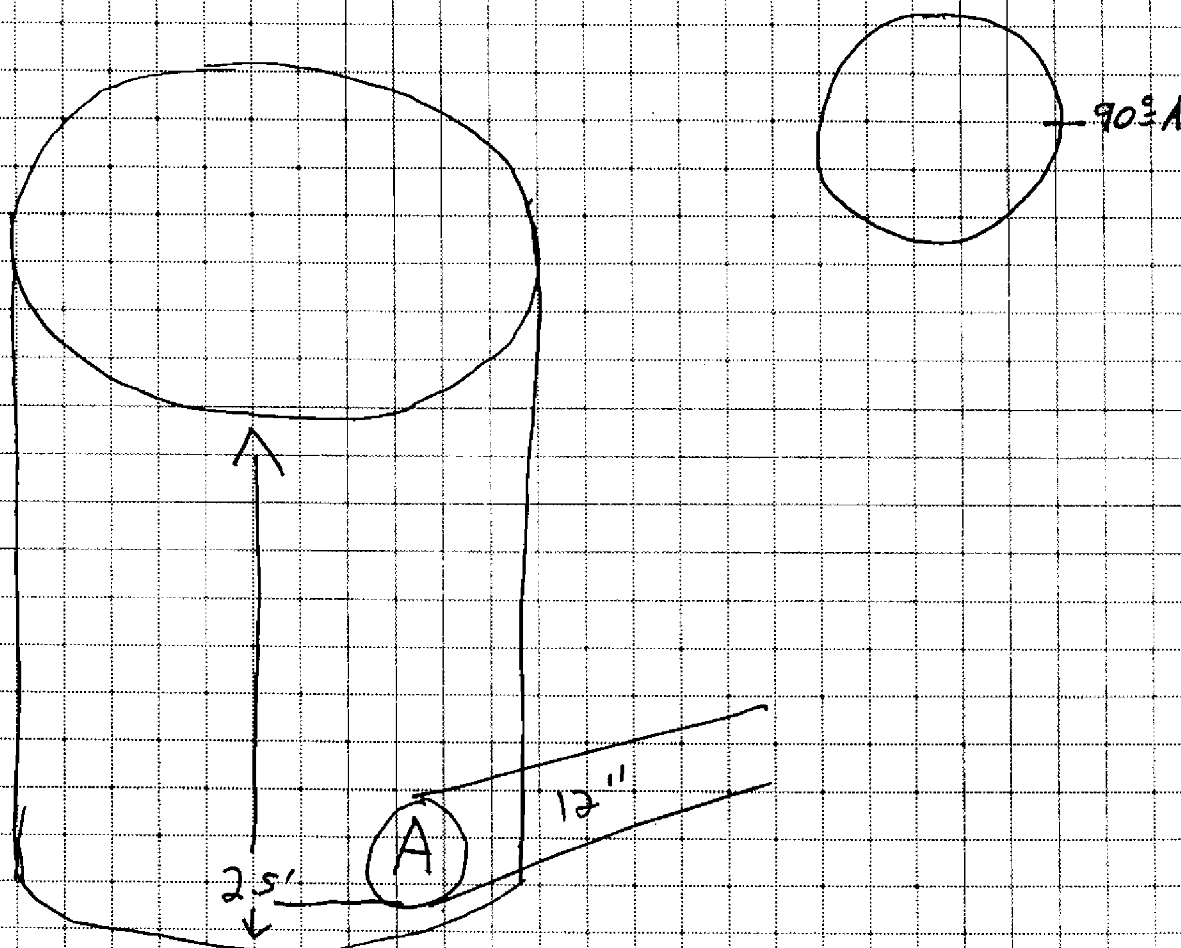
Location#- DIA-011
Rim Elevation (ft msl)
8.16

Metal Grate
Standing water



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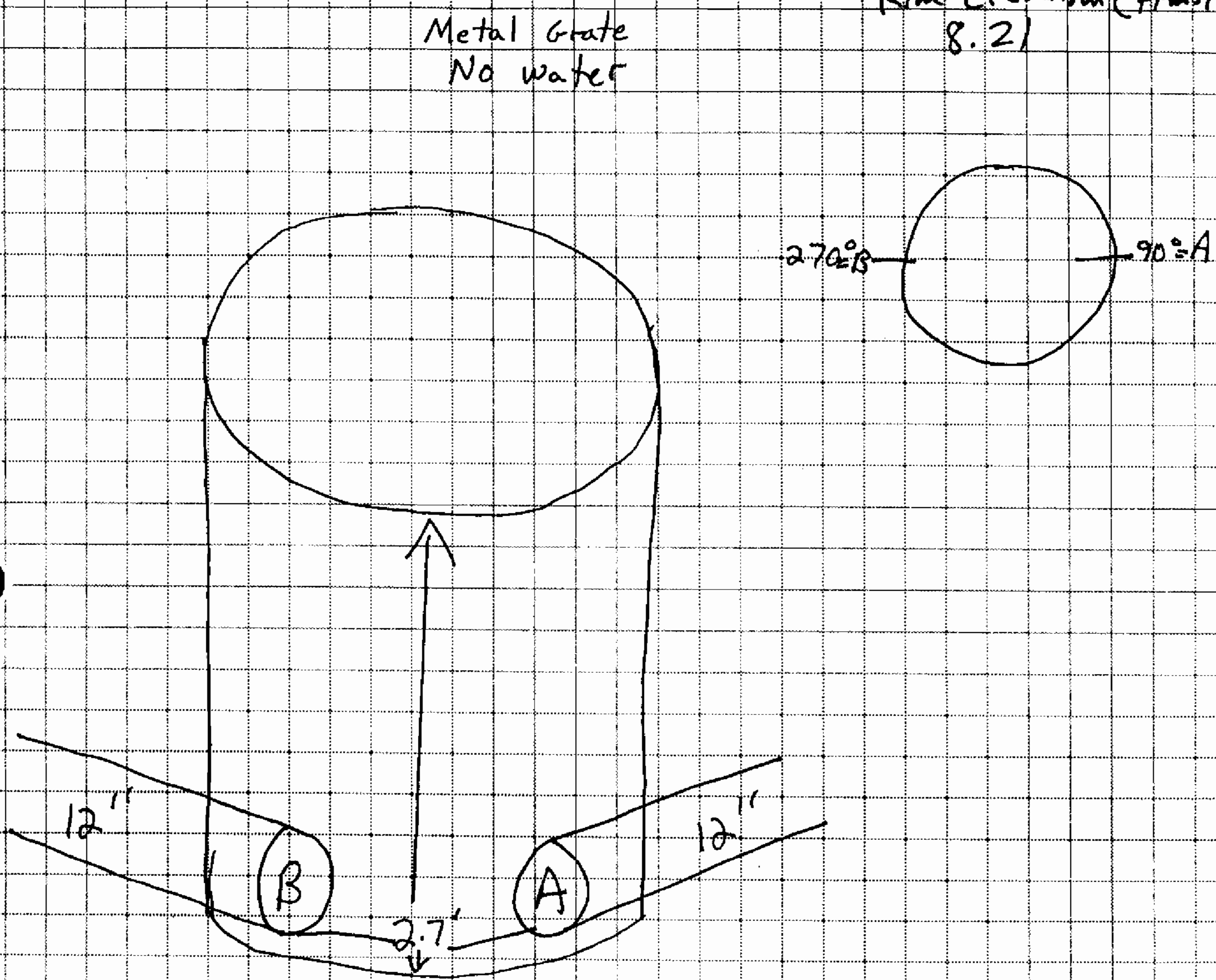
SCALE

Location#- DIA-012
Rim Elevation (ft msl)
8.21



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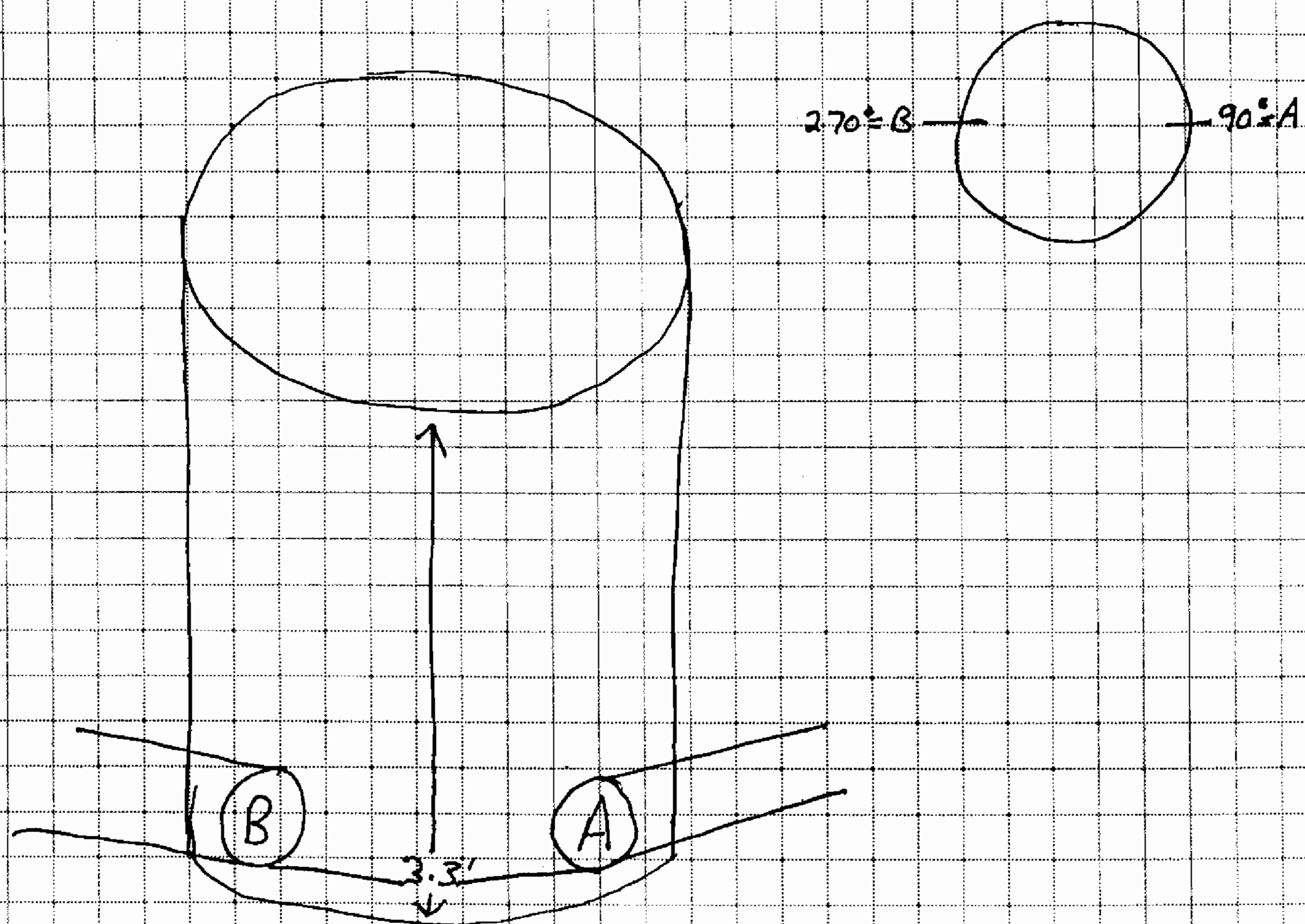
SCALE ______

Location# - DIA-013
RTM Elevation (ft msl)
7.92

Metal Grate
Standing Water



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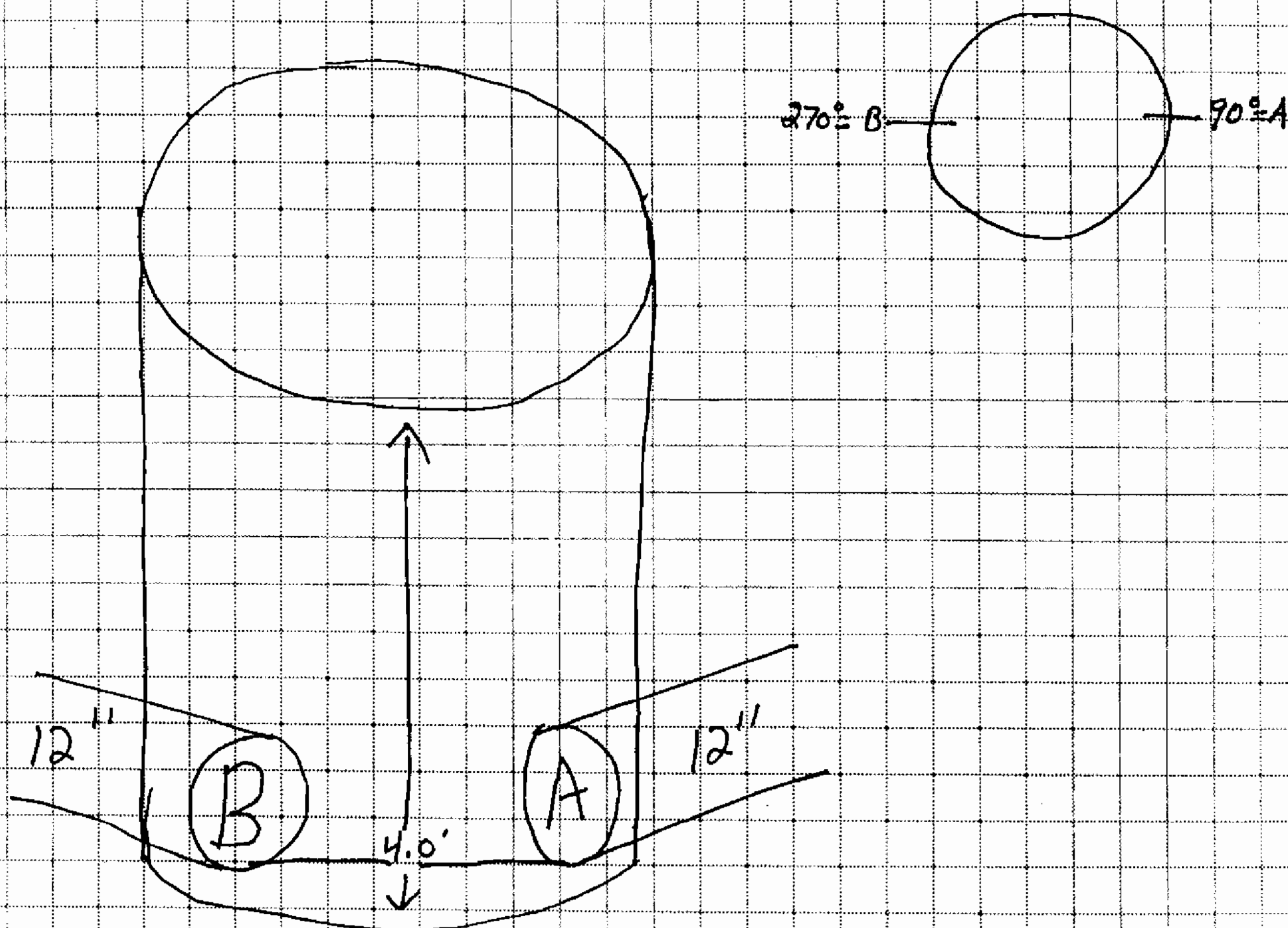
Location#- DIA-014
Rim Elevation (ft msl)
6.80

Metal Grate
Standing Water



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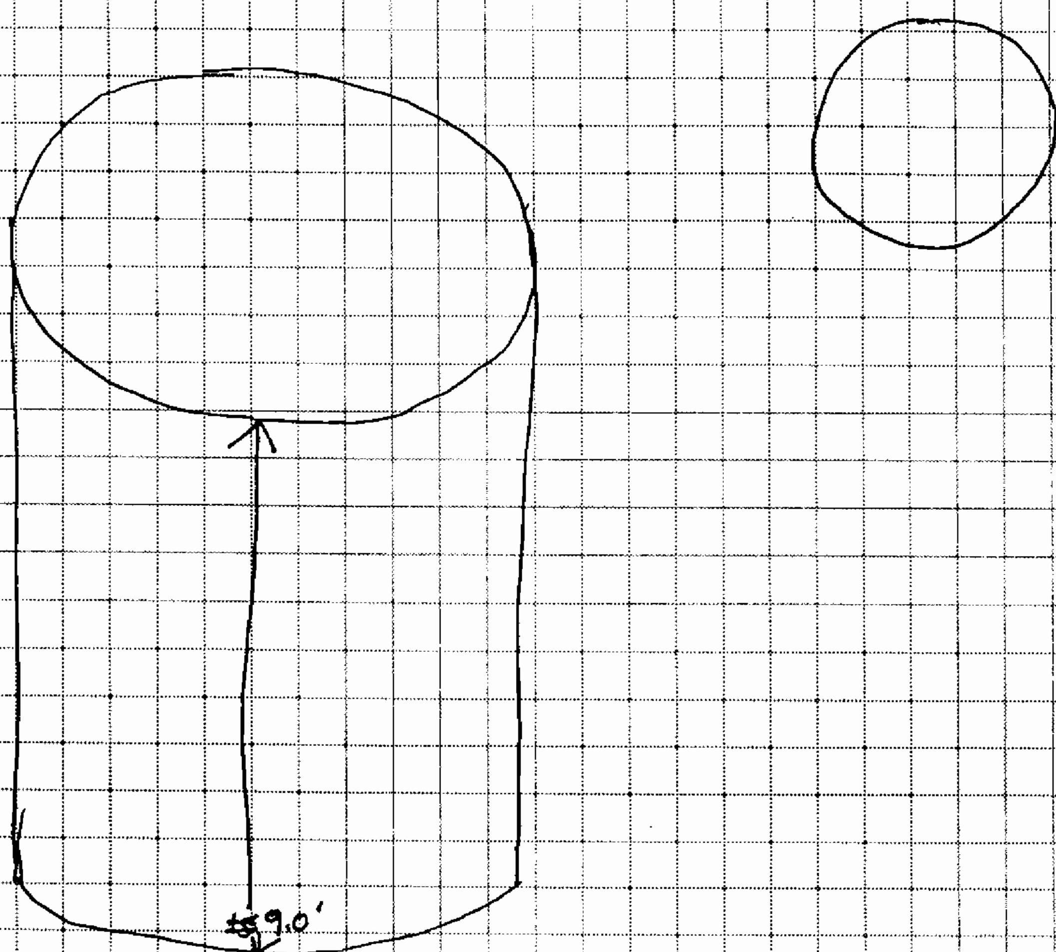
Location# - DIA-015
Rim Elevation (ft msl)
8.07

Metal Grate
No water
No Inverts



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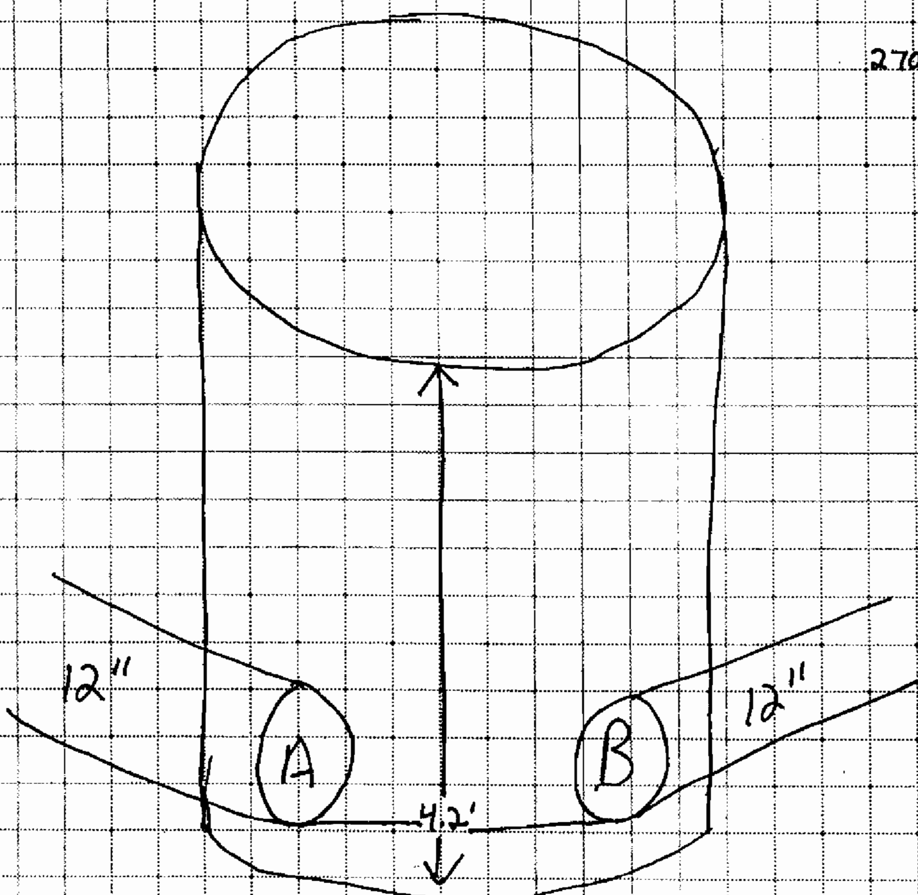
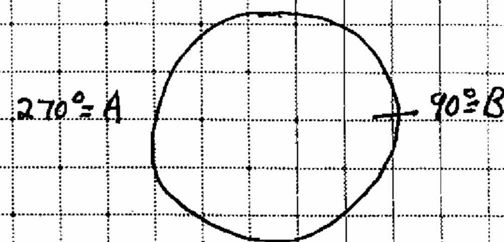
SCALE ______

Location#- DIA-016
Rim Elevation (ft msl)
6.98

Metal Grate
Standing water



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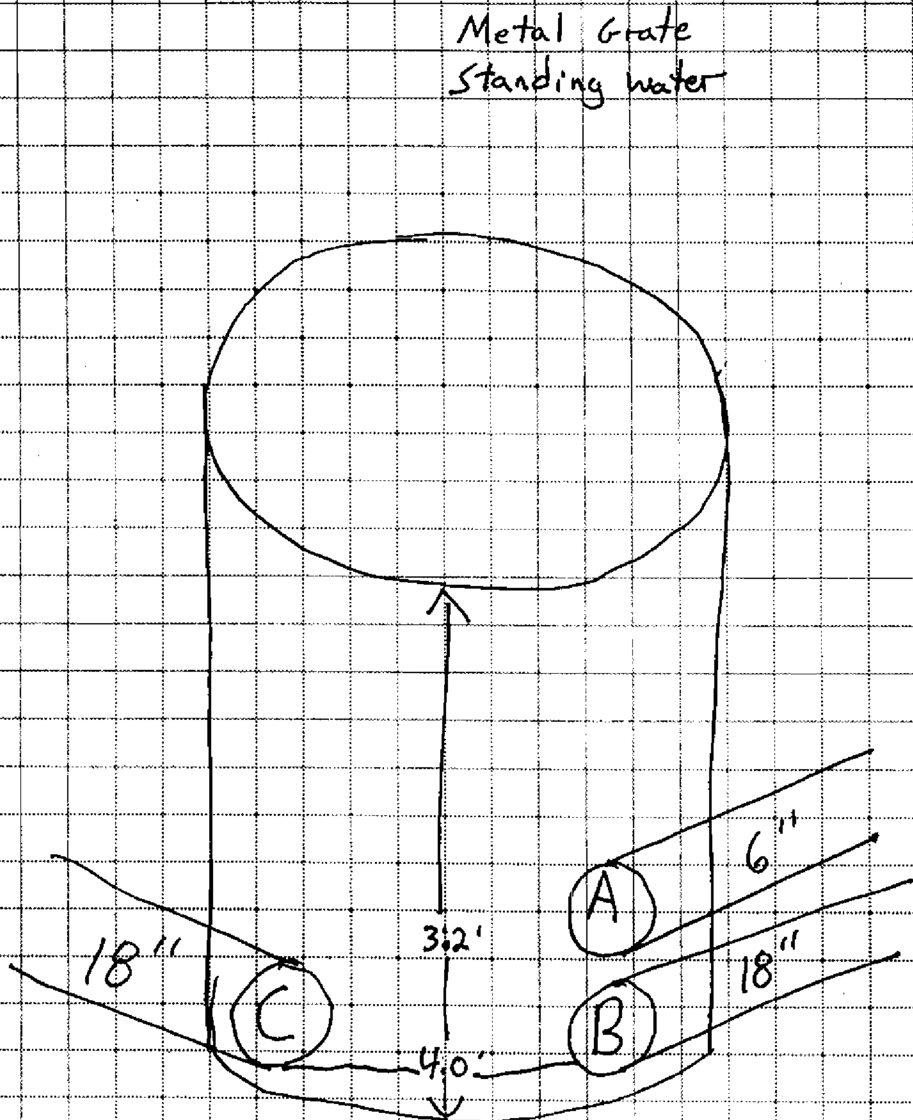
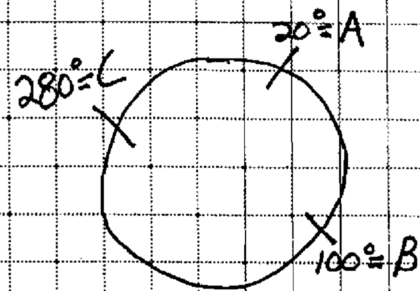
Location #- DIA-017
Rim Elevation (ft msl)
7.95



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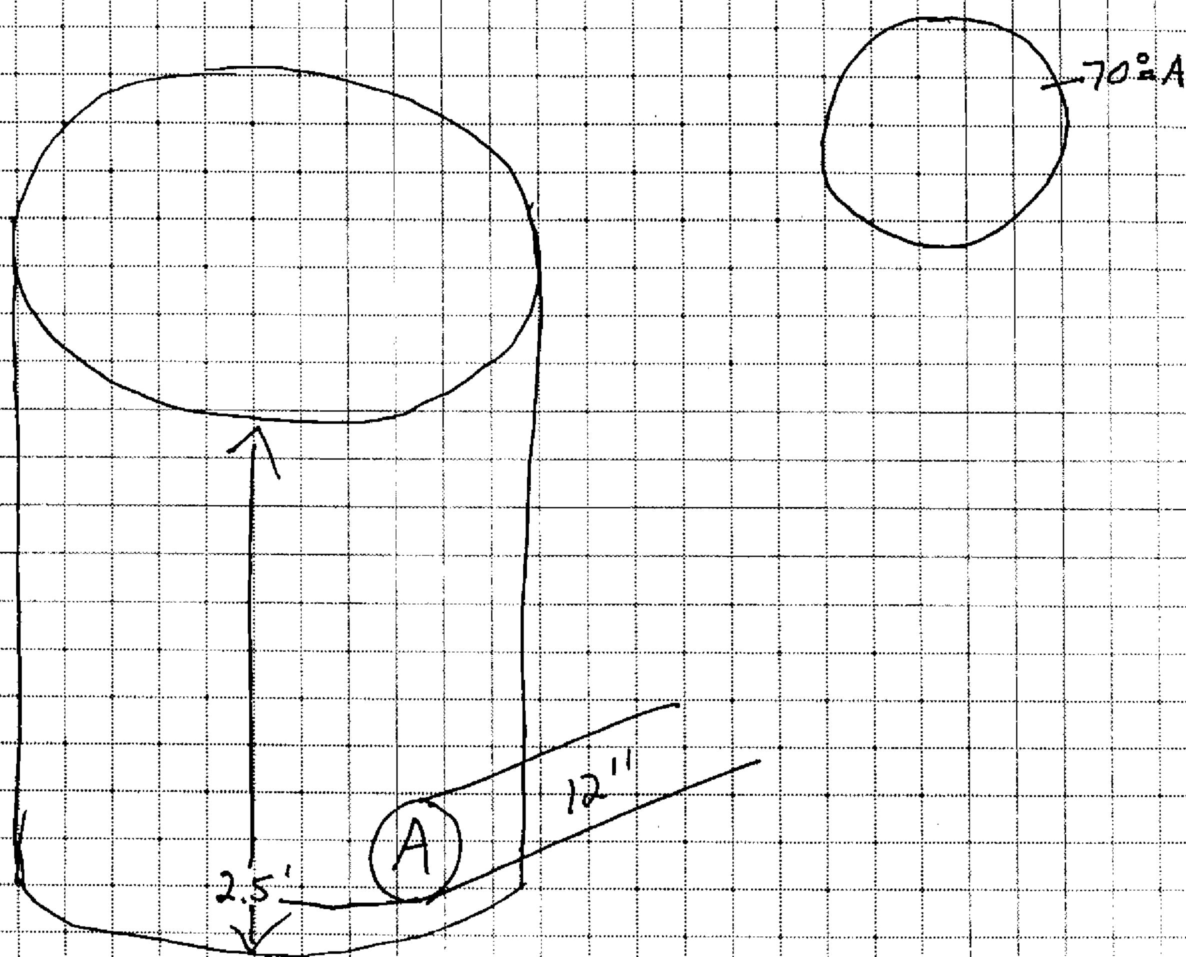
Location# - DIA-018
Rim Elevation (ft msl)
7.67

Metal Grate
No Water



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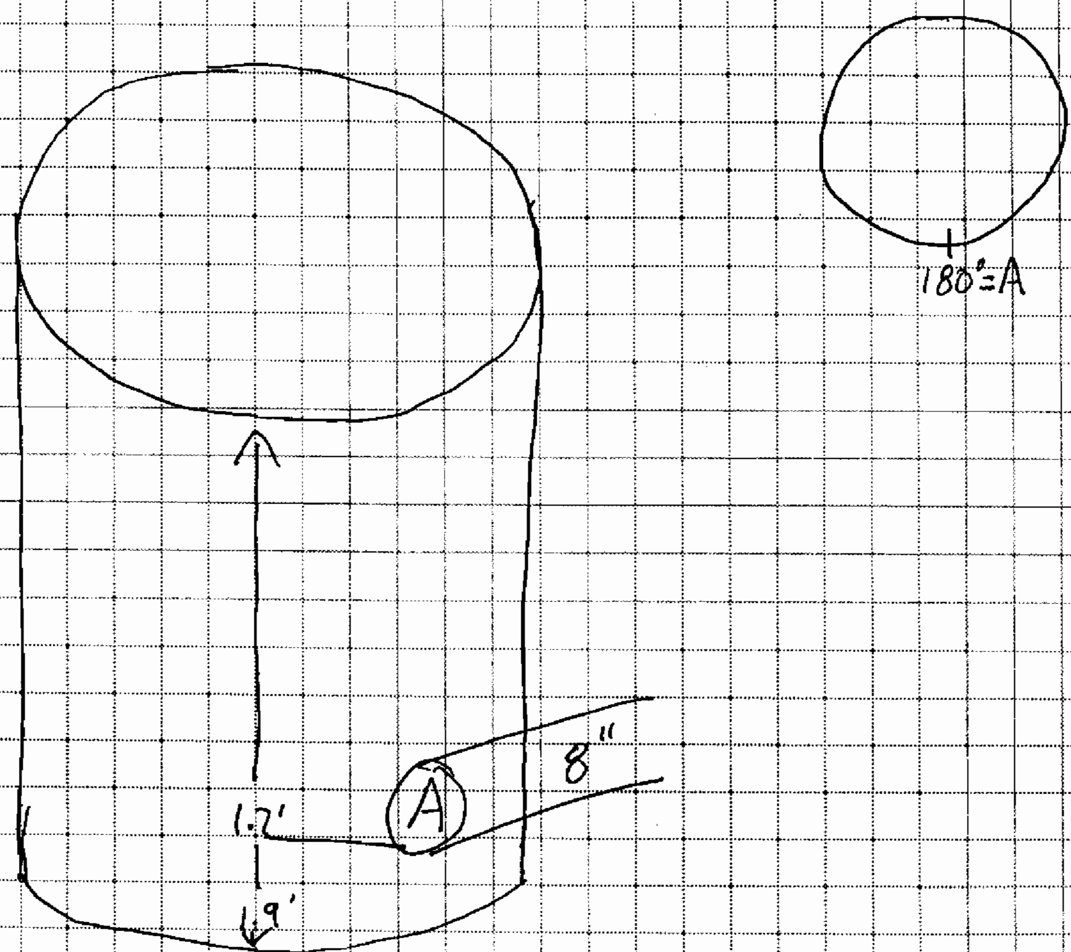
Location# - DIA-019
Rim Elevation (ft msl)
7.61

Metal Grate
standing water



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SHEET NO. ________ TO ________
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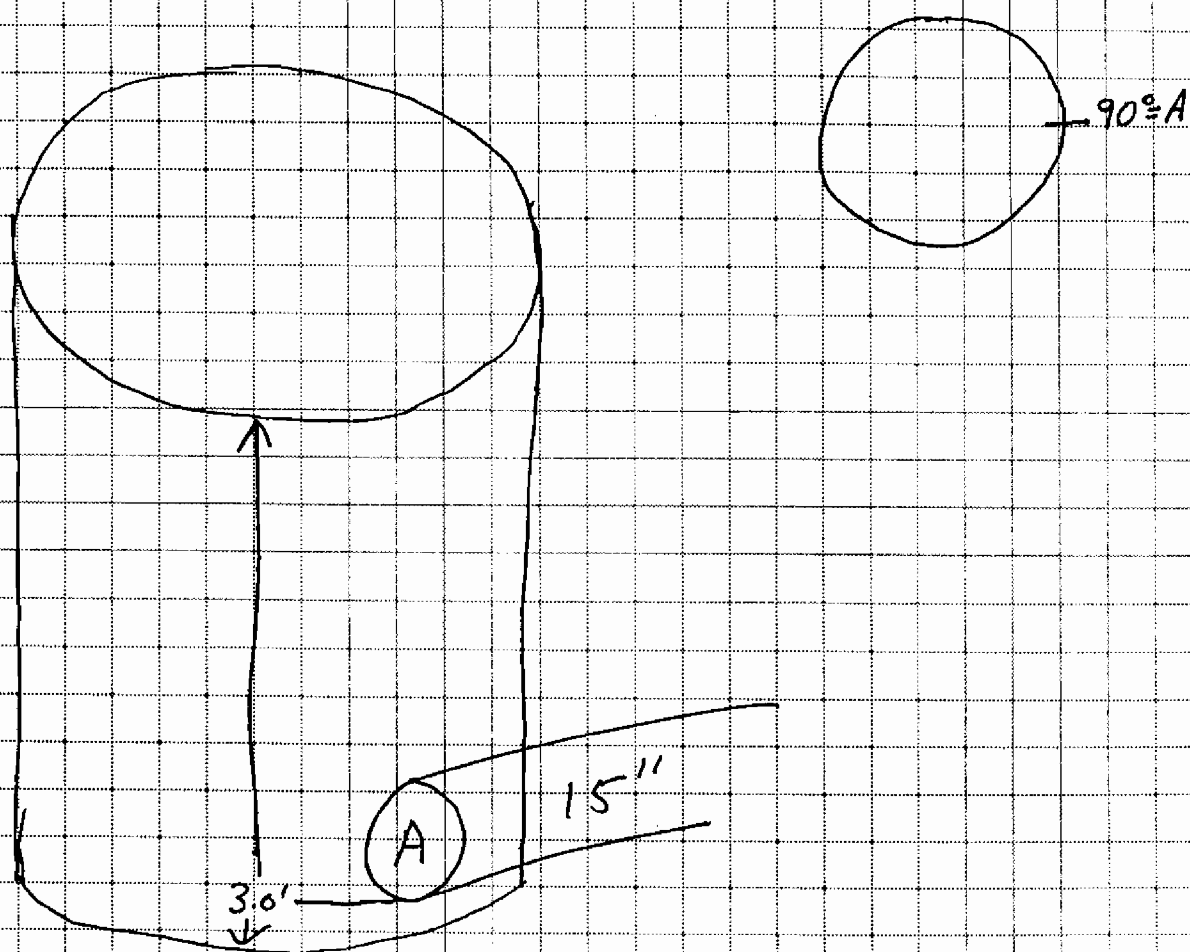
Location#- DIA-022
Rim Elevation (ft msl)
7.16

Metal Grate
Standing water



DATALCP3
12/14/99

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW



| SW846VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-W-0001-1A | | 039-W-0001-1B | | 039-W-0002-1A | | 039-W-0002-1B | | 039-W-0003-1A | | 039-W-0003-1B | |
| | ORIGINAL ID -----> | 039W00011A | | 039W00011B | | 039W00021A | | 039W00021B | | 039W00031A | | 039W00031B | |
| | LAB SAMPLE ID ---> | 37159.01 | | 37159.02 | | 37159.03 | | 37159.04 | | 37159.05 | | 37159.06 | |
| | ID FROM REPORT --> | 039W00011A | | 039W00011B | | 039W00021A | | 039W00021B | | 039W00031A | | 039W00031B | |
| | SAMPLE DATE -----> | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | |
| | DATE ANALYZED ---> | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/22/99 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Water | | Water | |
| | UNITS -----------> | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A |
| CAS # | Parameter | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-01-4 | Vinyl chloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-64-1 | Acetone | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 124-48-1 | Dibromochloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-43-2 | Benzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-88-3 | Toluene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-42-5 | Styrene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 104-51-8 | n-Butylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW



| SW846VOA | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-W-0001-1A | 039-W-0001-1B | 039-W-0002-1A | 039-W-0002-1B | 039-W-0003-1A | 039-W-0003-1B |
| | ORIGINAL ID -----> | 039W00011A | 039W00011B | 039W00021A | 039W00021B | 039W00031A | 039W00031B |
| | LAB SAMPLE ID ---> | 37159.01 | 37159.02 | 37159.03 | 37159.04 | 37159.05 | 37159.06 |
| | ID FROM REPORT --> | 039W00011A | 039W00011B | 039W00021A | 039W00021B | 039W00031A | 039W00031B |
| | SAMPLE DATE -----> | 01/20/99 | 01/20/99 | 01/20/99 | 01/20/99 | 01/20/99 | 01/20/99 |
| | DATE ANALYZED ---> | 01/22/99 | 01/22/99 | 01/22/99 | 01/22/99 | 01/22/99 | 01/22/99 |
| | MATRIX ----------> | Water | Water | Water | Water | Water | Water |
| | UNITS -----------> | UG/L A | UG/L A | UG/L A | UG/L A | UG/L A | UG/L A |
| CAS # | Parameter | 37159 VAL | 37159 VAL | 37159 VAL | 37159 VAL | 37159 VAL | 37159 VAL |
| 1634-04-4 | Methyl tert-butyl ether | 5. U | 5. U | 5. U | 5. U | 5. U | 5. U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW



| SW846VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-W-0004-1A | | 039-W-0004-1B | | 039-W-0005-1A | | 039-W-0005-1B | | 039-W-0006-1A | | 039-W-0006-1B | |
| | ORIGINAL ID -----> | 039W00041A | | 039W00041B | | 039W00051A | | 039W00051B | | 039W00061A | | 039W00061B | |
| | LAB SAMPLE ID ---> | 37159.07 | | 37159.08 | | 37159.09 | | 37159.10 | | 37159.11 | | 37159.12 | |
| | ID FROM REPORT --> | 039W00041A | | 039W00041B | | 039W00051A | | 039W00051B | | 039W00061A | | 039W00061B | |
| | SAMPLE DATE -----> | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | |
| | DATE ANALYZED ---> | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/26/99 | | 01/26/99 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Water | | Water | |
| | UNITS -----------> | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A |
| CAS # | Parameter | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-01-4 | Vinyl chloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-09-2 | Methylene chloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-64-1 | Acetone | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-35-4 | 1,1-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-34-3 | 1,1-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-01-6 | Trichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 124-48-1 | Dibromochloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-43-2 | Benzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR | 5. | UR |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 127-18-4 | Tetrachloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-88-3 | Toluene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-42-5 | Styrene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 104-51-8 | n-Butylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW



| SW846VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-W-0004-1A | | 039-W-0004-1B | | 039-W-0005-1A | | 039-W-0005-1B | | 039-W-0006-1A | | 039-W-0006-1B | |
| | ORIGINAL ID -----> | 039W00041A | | 039W00041B | | 039W00051A | | 039W00051B | | 039W00061A | | 039W00061B | |
| | LAB SAMPLE ID ---> | 37159.07 | | 37159.08 | | 37159.09 | | 37159.10 | | 37159.11 | | 37159.12 | |
| | ID FROM REPORT --> | 039W00041A | | 039W00041B | | 039W00051A | | 039W00051B | | 039W00061A | | 039W00061B | |
| | SAMPLE DATE -----> | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | | 01/20/99 | |
| | DATE ANALYZED ---> | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/22/99 | | 01/26/99 | | 01/26/99 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Water | | Water | |
| | UNITS -----------> | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/L | A |
| CAS # | Parameter | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL | 37159 | VAL |
| 1634-04-4 | Methyl tert-butyl ether | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |

*** Validation Complete ***

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

## Data Validation Report

| | |
|---|---|
| SDG#: | 37159 |
| Date: | March 3, 1999 |
| Client Name: | Ensafe |
| Project/Site Name: | Charleston Zone A |
| Date Sampled: | January 20, 1999 |
| Number of Samples: | 13 Aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Southwest Laboratory of Oklahoma |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fractions: | Volatiles |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Seaylon for
Paul B. Humburg, President

3-12-99.
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

SDG# 37159

## Samples and Fractions Reviewed

Sample Identifications    Analytical Fraction

| ENSAFE ID | MATRIX | VOA | |
|---|---|---|---|
| 039W00011A | WATER | X | |
| 039W00011B | WATER | X | |
| 039W00021A | WATER | X | |
| 039W00021B | WATER | X | |
| 039W00031A | WATER | X | |
| 039W00031B | WATER | X | |
| 039W00041A | WATER | X | |
| 039W00041B | WATER | X | |
| 039W00051A | WATER | X | |
| 039W00051B | WATER | X | |
| 039W00061A | WATER | X | |
| 039W00061B | WATER | X | |
| 039TW0061A | WATER | X | |
| Total Billable Samples (Water/Soil) | | 13 | 0 |

VOA= Volatiles

# DATA ASSESSMENT NARRATIVE

# VOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8260B; the National Functional Guidelines for Organic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

**SDG # 37159**

A validation was performed on the Volatile Data from SDG 37159. The data was evaluated based on the following parameters:

| | | |
|---|---|---|
| * | • | Data Completeness |
| * | • | Holding Times |
| * | • | GC/MS Tuning |
| | • | Calibration |
| * | • | Blanks |
| * | • | Surrogate Recoveries |
| | • | Matrix Spike/Matrix Spike Duplicates |
| * | • | Field Duplicates |
| * | • | Internal Standard Performance |
| * | • | Compound Identification |
| * | • | Compound Quantitation |

* - All criteria were met for this parameter.

**Calibrations**

The initial calibration curve analyzed 1/21/99 exhibited two (2) compounds with RRFs less than 0.05. For the following samples and compounds, all reported positive results are qualified as estimated, J, and non-detect results are rejected, UR.

| | |
|---|---|
| All Samples | acetone (0.024)<br>2-chloroethyl vinyl ether (0.015) |

**Calibrations**

The continuing calibration standard UL7878.D exhibited one (1) compound with a %D greater than 90%. For the following samples and compound, all reported positive results are qualified as estimated, J, and all non-detect results are rejected, UR.

| | |
|---|---|
| 039W00011A | 2-chloroethyl vinyl ether (209.1%) |
| 039W00011B | |
| 039W00021A | |
| 039W00021B | |
| 039W00031A | |
| 039W00031B | |
| 039W00041A | |
| 039W00041B | |
| 039W00051A | |
| 039W00051B | |

The continuing calibration standard UL7878.D exhibited two (2) compounds with RRFs less than 0.05. For the following samples and compounds, all reported positive results are qualified as estimated, J, and non-detect results are rejected, UR.

| | |
|---|---|
| 039W00011A | acetone (0.0275) |
| 039W00011B | 2-chloroethyl vinyl ether (0.034) |
| 039W00021A | |
| 039W00021B | |
| 039W00031A | |
| 039W00031B | |
| 039W00041A | |
| 039W00041B | |
| 039W00051A | |
| 039W00051B | |

The continuing calibration standard UL7903.D exhibited one (1) compound with a %D greater than 90%. For the following samples and compound, all reported positive results are qualified as estimated, J, and all non-detect results are rejected, UR.

| | |
|---|---|
| 039W00061A | 2-chloroethyl vinyl ether (454.5%) |
| 039W00061B | |

**Calibrations (continued).**

The continuing calibration standard UL7878.D exhibited one (1) compound with a RRF less than 0.05. For the following samples and compound, all reported positive results are qualified as estimated, J, and non-detect results are rejected, UR.

| | |
|---|---|
| 039W00061A | acetone (0.025) |
| 039W00061B | |

**Matrix Spike/Matrix Spike Duplicates**

The MS/MSD pair of the following sample exhibited 0% recoveries for the noted compound. The reported non-detect result is rejected, UR.

| | |
|---|---|
| 039W00061A | 2-chloroethyl vinyl ether |

**System Performance and Overall Assessment**

The data required qualifications/rejections.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

**U** = Not detected

**J** = Estimated value

**UJ** = Reported Quantitation limit is qualified as estimated

**UR** = Result is rejected and unusable

**D** = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

**CRQL** = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

**No Action** = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| All Samples | acetone (0.024)<br>2-chloroethyl vinyl ether (0.015) | +/- | J/UR |
| 039W00011A<br>039W00011B<br>039W00021A<br>039W00021B<br>039W00031A<br>039W00031B<br>039W00041A<br>039W00041B<br>039W00051A<br>039W00051B | 2-chloroethyl vinyl ether (209.1%) | +/- | J/UR |
| 039W00011A<br>039W00011B<br>039W00021A<br>039W00021B<br>039W00031A<br>039W00031B<br>039W00041A<br>039W00041B<br>039W00051A<br>039W00051B | acetone (0.0275)<br>2-chloroethyl vinyl ether (0.034) | +/- | J/UR |
| 039W00061A<br>039W00061B | 2-chloroethyl vinyl ether (454.5%) | +/- | J/UR |
| 039W00061A<br>039W00061B | acetone (0.025) | +/- | J/UR |
| 039W00061A | 2-chloroethyl vinyl ether | +/- | J/UR |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

# CHAIN OF CUSTODY RECORD

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN; LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PADUCAH,KY; PENSACOLA,FL; RALEIGH,NC; COLOGNE, GERMANY

COC NO:
PO NO: R 4
REL NO: 81
LAB NAME: SWL

CLIENT: NAVBASE CHARLESTON
PROJECT MANAGER: C VERNOY
LOCATION: ZONE A / SWMU 39
TELE/FAX NO. 843-884-0029
SAMPLERS: (SIGNATURE) Todd K Kafka

ANALYSIS REQUIRED

| FIELD SAMPLE NUMBER | DATE | TIME | SAMPLE TYPE | TYPE/SIZE OF CONTAINER | PRESERVATION TEMP. | PRESERVATION CHEMICAL | NO. OF CONTAINERS | VOAS | | | | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 039W00011A | 1/20/99 | 1020 | H2O | 40 mL VIAL | 4°C | HCL | 1 | X | | | | | | | | | | |
| 039W00011B | | 1020 | | | | | 1 | X | | | | | | | | | | |
| 039W00021A | | 1035 | | | | | 1 | X | | | | | | | | | | |
| 039W00021B | | 1035 | | | | | 1 | X | | | | | | | | | | |
| 039W00031A | | 1045 | | | | | 1 | X | | | | | | | | | | |
| 039W00031B | | 1045 | | | | | 1 | X | | | | | | | | | | |
| 039W00041A | | 1112 | | | | | 1 | X | | | | | | | | | | |
| 039W00041B | | 1112 | | | | | 1 | X | | | | | | | | | | |
| 039W00051A | | 1130 | | | | | 1 | X | | | | | | | | | | |
| 039W00051B | | 1130 | | | | | 1 | X | | | | | | | | | | |
| 039W00061A | | 1140 | | | | | 1 | X | | | | | | | | | | |
| 039W00061B | | 1140 | | | | | 1 | X | | | | | | | | | | |
| 039TW00061A | | 1230 | | | | | 1 | X | | | | | | | | | | |

TKK 1/20/99

| RELINQUISHER: Todd K Kafka | DATE 1/20/99 | RECEIVER: | DATE | RELINQUISHER: | DATE | RECEIVER: | DATE |
|---|---|---|---|---|---|---|---|
| PRINTED: Todd K Kafka | TIME 1400 | PRINTED: | TIME | PRINTED: | TIME | PRINTED: | TIME |
| COMPANY: EnSafe | | COMPANY: | | COMPANY: | | COMPANY: | |

METHOD OF SHIPMENT: FEDEX
SHIPMENT NO. 233 1865 182
SEND RESULTS TO:

COMMENTS: 14 day turnaround time
NNA VOA LIST

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

# ATTACHMENT E

# VERTICAL PROFILING DATA PACKAGE AND MULTI LEVEL WELL INSTALLATION AND SAMPLING PROCEDURES

*The following information was provided by Columbia Environmental Technologies, LLC, Columbia, MD.*

# VERTICAL PROFILING DATA PACKAGE AND MULTI LEVEL WELL INSTALLATION AND SAMPLING PROCEDURES

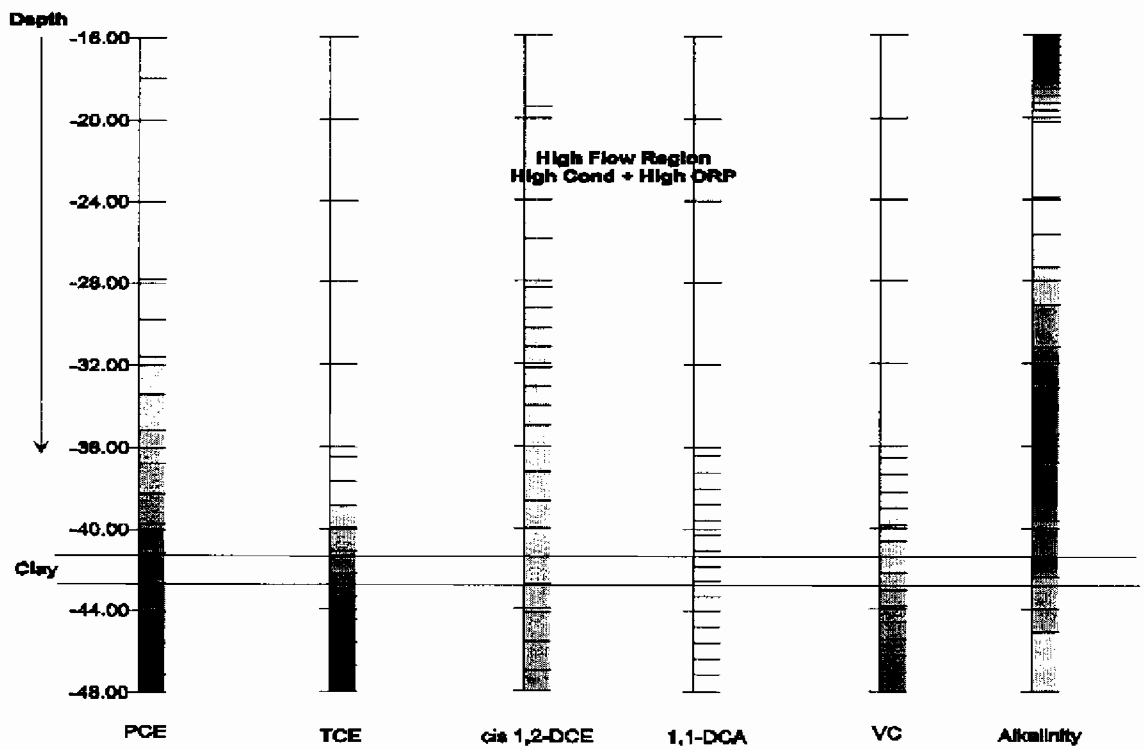
Observations:

- Two samplers, 0.010-inch slotted PVC well screen and the Solinist Stainless Steel Drivepoint Piezometer provided comparable data at the 20-feet on two separate days.
- Solinist Waterloo Profiler appeared to provide sediment free groundwater samples relatively quickly when the sample screens were not clogged.
- The Solinist Waterloo Profiler sample ports clogged with sand in conditions of flowing sand.
- Distinct variations in geochemical parameters were observed with depth.
- No BTEX or fuel compounds were observed.
- PCE and a full chain of reductive dechlorination daughter products through vinyl chloride was observed at depths of 36 and 48 feet.
- Dissolved oxygen was measured with a YSI Model GP-55 membrane probe. DO readings ranged from 2.2 to 5.4 mg/L. These levels do not indicate anaerobic conditions existed for reductive dechlorination. However, the lowest levels of 2.2 and 2.4 mg/L did correlate to highest levels of alkalinity, a relationship expected with reductive dechlorination.
- Measurement of hydraulic conductivity using the method proposed by Hurt during EPA Seminar on MNA appears feasible using the Solinist drive point piezometer. It may also be feasible with other samplers with a short length (< 18-inches). The addition of a conductivity measurement to the geochemical data would enable a team to determine contaminant flux in a vertical profile. The additional time involved in gaining this parameter can be minimized through practice.

- Productivity while performing the vertical profiles can be optimized by driving more than one borehole at a time. One possible scenario would be to profile an upper zone with one borehole and a lower zone with a second borehole immediately adjacent to the first.

*The following information was provided by Columbia Environmental Technologies, LLC, Columbia, MD.*

**Vertical Profile of Single Borehole**
**SWMU-39**




1

# Draft Multi-Channel Well Fabrication and Installation Protocol

## 1. General Overview

The Precision Multi-Channel monitoring well system can be used to monitor seven discrete water-bearing zones within a single borehole. Data such as water depth, electrical conductivity, turbidity, pH, temperature, and samples for chemical analysis can be obtained from each zone. The advantage of the polyethylene multi-channel wells is that only one borehole is required to monitor up to seven different intervals; a significant time and cost savings over conventional well installation.

The multi-channel well is typically constructed from 1.70" outside diameter (OD) polyethylene tubing containing internal vertical partitions that form six channels around a seventh central channel. After the borehole is completed, the multi-channel well can be fabricated in the field. Lithologic information from the soil core is used by the geologist to determine the location of screened intervals as well as the completion depth. After the tubing is cut to the proper length, the well completion details can be marked on the tubing and sampling ports drilled into individual channels at the selected depths. Fine-mesh stainless steel filter screen is then wrapped around each inlet port interval and secured with clamps. Sand is placed over the screen inside non-expanding fine-mesh polyester sleeves. Packers typically composed of ¼" uncoated bentonite pellets contained in coarse-mesh nylon sleeves are installed immediately above and below each screened interval. The pre-built well is lowered inside the previously installed Enviro-Core casing to total depth and the drive casing is then removed. The bentonite packers fully hydrate within several hours to seal the intervening water-bearing zones. A protective cover can be installed at the surface to complete the well.

The primary safety issue is ensuring that proper caution is exercised when using power tools such as portable drills and hand tools, including knives and saws, while fabricating wells.

Quality assurance and quality control issues during well fabrication and installation involve ensuring that the detailed geological information regarding screened interval locations, and packer interval depths and lengths which are obtained from borehole data are accurately transferred onto the well tubing prior to fabrication. It is critical that well channels have ports drilled in the channel center at each selected depth interval; and also that channels are completely sealed internally using the indicated sealant during construction to preserve discrete channel integrity. A cross-contamination issue involves the diffusion over time of chemicals present in the groundwater across the polyethylene channel septum between channels. In order to minimize diffusion effects, the well must be completely purged using a bailer or peristaltic pump just prior to sampling. While handling the well tubing and well materials during fabrication and prior to installation, it is important to avoid contacting the ground or other suspect surfaces by placing visquene sheeting on the ground surface to provide a relatively clean working surface. Pulling a visquene tube over the well after fabrication and before installation keeps the well dry and clean.

Local oversight agencies require permits to be filed before borehole installation and well completions can begin. Usually a diagram and logsheet of the proposed well completion is submitted with the appropriate fees several weeks before work can begin. Coordination with regulatory agencies is important for multi-channel installation due to the relatively recent development of this technology and hesitance of full agency acceptance.

## 2. Alternative Methods

Not Applicable

## 3. Equipment, Tools, and Materials

Equipment required for multi-channel well construction includes a small generator (400 watt) for power tools and a rack to hold the well during fabrication. A steam-cleaner attached to a stainless steel steam-cleaning box can be used as a well tubing cleaning and straightening device. Items need for well construction are:

- portable drill (pn 1101)
- drill bit13/32" (pn 1106), and drill collar (pn1103)
- hot melt CS-7 glue (pn 1110), and applicator gun(pn 1111)
- plastic port template (pn 1104)
- sheet metal cutters (pn 1116)
- Oetiker clamping tool (pn 1122), and clamps (pn 1120)
- Band-it clamping tool (pn 1170), and clamps (pn 1172)
- hammer and die for shaping well bottom screen wrap (pn 1128)
- form funnel for bentonite pellets (pn 1140)
- scoop (pn 1134)
- wax marking pencils (pn 1162)
- centralizers (pn 1148)
- tape measure, 100' (pn 1158)
- polynet expandable netting, 2-4" (pn 1136)
- stainless steel filter screen, 80x80 mesh (pn 1114)
- polyester screen sleeves, 51 x 51 mesh (pn 1130)
- hose clamps, 1 ¾ " (pn 1150)

- tie-wraps, 8" (pn 1118)
- hacksaw (pn 1164)
- visquene tube, 6" wide (pn 1157)
- black vinyl caps, 1.5" (pn 1154)
- polyethylene multi-channel tubing, 1.7" OD (pn 1152)
- packing tape, 3/4"(pn 1115)
- electrical tape, 3/4" (pn 1112)
- uncoated bentonite tablets, 1/4" (pn 1138)
- sand, #2/12 or #30 (pn 1131/1132)
- generator and power cord (pn 1168/1119)
- ear plugs (pn 518)
- EC-5 butyrate (pn 225)
- clampstand (pn 1160)
- stainless steel steam cleaning box (pn 1176)
- 2" Schedule 40 PVC, 5' (pn 132)
- 2" locking well cap (pn 196)
- black visquene sheeting

## 4. Specific Procedures

### Well Fabrication Set-up

To begin fabrication, the multi-channel tubing must be cut to the correct length including total well depth and the type of well surface completion. In order to cut tubing to the proper length, the total well depth referenced from existing ground surface and the well surface completion detail must be known. **This information must be supplied by the client in writing.** If the well will protrude above ground surface, then the amount of stickup is added to the total well depth to obtain the correct tubing length. Conversely, if the well will be recessed below ground level, then the length of recess is subtracted from total well depth to obtain finished tubing length. Usually wells are recessed 0.2 ft bgs inside a steel or concrete well box. As a general rule (unless otherwise indicated), cut tubing ten feet longer than total well length to provide enough tubing material for convenient handling during installation.

Spread sufficient visquene on the ground surface away from obvious staining or loose ground surface to provide a clean and safe working surface and to keep all well materials and tools from contacting the ground surface. Set up the well clampstand in the middle of the visquene, place sandbags over the clamp leg to anchor. Secure the cleaned multi-channel well tubing to the clampstand. Make sure that sufficient materials such as centralizers, polyester sand sleeves, and sized filter screens have been previously fabricated and stockpiled. In conjunction with the client representative, a well diagram must be prepared before fabrication that specifies significant well design details and parameters.

After the tubing is cut to length it can then be decontaminated and straightened by running through a steam-cleaning box. The tubing is steam-cleaned using the multi-channel steam cleaning stainless steel box clamped onto an available stand. Utilizing two personnel, the tubing is slowly fed through the box and straightened as it emerges with Channel #1 oriented down while feeding past the steam-cleaning head. The tubing is steadily pulled through the steam-cleaner, as it may melt if stopped while in contact with hot steam-cleaning box surfaces. As the tubing exits the steam-cleaner, it is placed on black visquene, covered with black visquene, and weighted down to cool straight. If multiple wells will be fabricated together they can all be cut, decontaminated, and straightened before proceeding further. The wells should be individually identified using an indelible pen marked on masking tape placed on the well tubing. Secure straightened tubing for the first well to be built to the clampstand. Cap and tape all tubing ends with 1.5" vinyl caps after steam-cleaning to keep tubing interior clean.

## Well Design Layout

With the first tubing length (Well #1) clamped horizontally in the clampstand or set on the visquene, layout of the well design onto the polyethylene tubing can begin. The well completion details obtained from the well layout drawing supplied by the client are transferred to the tubing exterior. Annotation onto the tubing of the well completion details, such as the filter screen and bentonite packer locations, is done using a wax pencil (china marker). The annotation of the well tubing should be performed with client assistance. If well fabrication is done in the shop prior to mobilizing to the jobsite, then a diagram supplied by the client must be used as a guide and parameters such as sand size and packer length must be specified on the diagram before fabrication can commence.

A shallow longitudinal groove on the tubing exterior in the center of Channel #1 is used as the layout reference when measuring along the tubing. By convention, the location of adjacent Channel #2 is found by counting clockwise around tubing (oriented while looking down on the well). Unreel sufficient measuring tape footage to allow for the entire well to be marked. Secure the measuring tape with black electrical tape onto the bottom of the tubing alongside the shallow groove (for example, if the well is 50 feet long, tape the 50' increment at the exact tubing bottom). Begin measuring along the groove. **Use a wax pencil for all tubing markings.** Using the well diagram prepared by the client, locate and mark the middle of each screened interval onto the appropriate channel exterior (identify each screen interval as #1, #2, etc., for each channel).

After all screened intervals have been marked at the correct depth on the correct channel, proceed to mark the ports using the plastic template with six notches indicating the correct hole locations. Begin by clamping the tubing vertically in the clamp with the well top pointing up. Start at

Channel #1 for screened interval #1, find the longitudinal groove, align the arrow on the template with the vertical middle of the screened interval, and use six circled dots to mark the four inlet ports and two lower port locations as indicated by the template notches. Mark all other ports for the remaining channels. Be sure to keep the template oriented with the four sampling ports up towards the well top. Mark on the tubing the top limit of the uppermost bentonite packer, and also mark the intersection of the well tubing with the ground surface (0.0 ft bgs).

Allow for centralizer placement approximately every five feet; centralizers require approximately six inches of tubing per placement. Do not place centralizers between the sand filterpack and the immediately adjacent packers. **Be careful not to overlap centralizer legs and packer material because the centralizer legs will not compress when the well is lowered inside the borehole if there is intervening packer material, which could hang up the well.** If necessary, the sandpack and packer lengths can be shortened several inches each to allow for centralizer placement during layout.

**Port Drilling and Sealing**

Following completion of design layout, the client must double-check tubing annotation against the client-supplied well diagram to ensure that the well design details have been correctly transferred onto the tubing. When the tubing annotation has been verified, drilling of well ports can be performed. At a minimum, six holes per channel are drilled for each screened interval. For expediency, all well tubing lengths can be drilled if more than 3 or 4 wells will be built on the same day.

Plug in the hot melt gun. The four top holes (sampling ports), and the bottom two holes are drilled using the 13/32" drill bit. Before drilling, place a light on the floor shining up towards the tubing in order to backlight the tubing and illuminate the tubing interior. Place the metal drill collars securely on both drill bits approximately ¼" from the drill tip (small hose clamps provide a more secure drillstop). Locate the port markings on the longitudinal groove on Channel #1, and with the 13/32" drill bit pressed firmly against the tubing, drill the four inlet ports in the center of the channel. Drill all inlet ports for the entire well. The holes should be located in a reasonably straight line down the center of each channel. Avoid contacting the channel septum with the drill bit, which would result in a channel breach. It will be necessary to periodically clean tubing material from the bit flights (clean after every drilled hole) while drilling the ports to keep the bit open and prevent drilled polyethylene from remaining inside the channels. A razor knife tip can be used to clean bit flights. If more than 3 to 4 wells are to be built together, then all inlet ports can be drilled for all wells.

After drilling all ports for one well, the hot melt sealant/glue/adhesive (CS-7) can be applied. Counting down from the top port on channel #1, one yellow ear plug (Cabot Safety, NRR29) is inserted into the fifth port to form a bed for the hot melt sealant that will be placed in the fifth port. The sixth port is a vent hole for pressure equalization and doesn't receive injected material. Place one plug into the hole with the long plug axis parallel with the long axis of the channel and allow to expand. With the hot melt gun ready, inject the hot melt material into port #5 until the material is in contact with the underlying silicon caulk and approximately ¼" below port #4. Remove the hot melt gun and immediately seal port #5 with electrical tape to prevent hot melt material from escaping. Reclamp the tubing for work on screened interval #2 located at channel #2.

Locate channel #2 by rotating the tubing one chamber clockwise from the groove (looking down on the tubing top). Find the annotation for screened interval #2 on channel #2 and repeat the sealing procedure performed for interval and channel #1. Repeat the procedure for the remaining indicated channels until all holes are sealed. Continue to rotate the tubing clockwise as each channel is completed before working on the next channel. Remove the electrical tape after the sealant has cooled for 2-3 minutes. Now place the well bottom up and remove the vinyl end cap to work on the well bottom. Plugs are used to block off the six channel bottoms. Insert one plug into the central seventh channel if it will not be used. Insert and recess one plug approximately ¾" into each channel to be sealed and inject hot melt material in two lifts on top of each plug until each glue is flush with tubing end. If less than seven channels will be utilized for a given well, the deepest channel can be either screened across the channel bottom or screened through the channel side, depending on client preference (see "Bentonite Packer Installation" for construction details). Replace and tape the vinyl end cap on the well bottom.

**Filter Screen and Sandpack Installation**

Place the middle screened interval of the well in the clamp with the tubing oriented horizontally. The stainless steel filter screens (80 x 80 mesh, 0.07"screen opening) consist of pre-cut 4" by 6" rectangles. Starting at the middle screened interval of the well, wrap the filter screen around the four inlet ports (4" screen axis placed top to bottom across inlet ports), center the screen top to bottom with screen overlap away from holes and temporarily secure screen with one plastic tie wrap in the screen middle. Use the Oetiker clamping tool and Oetiker steel clamps (or Band-it clamping tool and stainless steel clamps) to tightly secure screen top and bottom leaving 1/8" screen reveal outside each clamp edge. Inspect screen placement to ensure clamps have not covered any portion of the inlet ports. If the seventh channel will be screened, remove the vinyl end cap and place the stainless steel screen end that has been previously shaped using the hammer and die onto the well end with screen extending 2" up tubing side and tightly secure with the clamping tool and one clamp. Leave 1/8" reveal on upper edge of clamp. Replace and tape the vinyl end cap on the well bottom. Clamp the filter screen for channel #7 following placement of the bentonite packers as described in the next subsection entitled "Bentonite Packer Installation".

The sandpack is held in place using 4" by 12" polyester filter screen sleeves (51 x 51 mesh, 0.011" screen opening) when measured flat. **The sleeves are constructed before well fabrication by cutting 12" wide strips of material from the roll and then cutting 9" rectangles from the**

**12" wide strips. The rectangles are then folded over to form a 4" tube measured flat and sewn with a ½" overlap seam using nylon thread.** The sleeve is placed over the steel filter mesh and centered top and bottom. The lower sleeve end is tightened around the tubing using a double fold and secured with a steel clamp leaving a ¼" reveal. The specified sand size (usually #2/16 or #30) is poured into the sleeve to 70% full and then the sleeve is held taut by a double fold, stretched over the sand and secured with a second steel clamp with a ¼" reveal. While the sand is poured into the sleeve, the sleeve can be lightly tapped to firmly pack sand. **Be careful not overpack the sand filter and cause bulging which can hang up the well during installation.** An adjacent packer can now be installed at the location indicated on the annotated tubing.

**Bentonite Packer Installation**

The bentonite packers are located on either side of each sandpack and are installed by working outward away from the middle sandpack previously installed toward each end of the well tubing. Reclamp the tubing in a horizontal position and select one end of the middle sand filterpack for packer placement. **Make sure sufficient 15" lengths of EC-5 butyrate packer protectors are cut to length and split before fabricating bentonite packers.** Begin by sliding a 14" length of red polynet over the well tubing to the correct position next to the sand filterpack, indicated by tubing annotation, and secure the polynet end next to the filterpack with a steel clamp leaving ¼" reveal outside the clamp edge. Then slide the stainless steel form funnel inside the polynet and position firmly against the clamp. Position tubing oriented vertically and begin filling funnel with ¼" uncoated bentonite pellets while lightly tapping the funnel until 80% full. Slowly, but firmly, remove funnel by gently tapping against funnel while pulling up on funnel. When funnel is removed, stretch polynet and secure top with second clamp leaving a ¼" reveal.

Packers can be a maximum of 2 feet in length but must be secured with steel clamps at maximum intervals of one foot. Place EC-5 split butyrate sleeves over each bentonite packer and secure with packing tape top and bottom as each packer is fabricated. It is important to form a reasonably straight-sided cylinder for each packer to facilitate smooth well installation. Be careful not to build the bentonite packers longer than the protector sleeves to avoid bentonite bulging either above and below the sleeve protectors. The butyrate packer protectors should extend ½" beyond each packer end. Check that the split plastic packer protectors do not have more than a 3/8" gap after taping. **If the gap is wider than 3/8", then the packer diameter is too large and the well may not fit inside the EC-5 casing during well installation.**

Continue working from the well middle outwards while alternately applying stainless steel filter screens, sand filterpacks, and building packers until one half of well is finished. After one well half is fabricated, work outward from middle on other well half until entire well has completed sand filterpack and bentonite packer sections. After all well components are installed, check that all steel clamps are secure. At this point, apply screen for channel #7. Use the hammer and die to form the bottom filter screen by placing a steel screen section across the die. Set the die on a hard surface and pound the cylindrical hammer with a heavy maul until screen has reached a 1" long cylindrical form. Place formed steel screen over tubing end and clamp with 2 band-it clamps leaving ¼" of tubing reveal.

### Centralizer Installation

The last step for well completion is to install plastic centralizers. The centralizers center the well tubing inside the borehole and are made of split 3" sections of Class 200 PVC pipe (0.1" wall) with three plastic legs (1/8" x ¾"). Each leg is secured to the PVC with two stainless steel bolts and nuts (6/32" x 1/2"). **The centralizers are constructed before well fabrication**. Centralizers are spaced at approximately 5 ft intervals and oriented with legs pointing towards well top. They are secured using one band-it clamp. When well fabrication is completed, cover well with visquene tube protector with ends taped closed to keep well clean.

*This procedure was provided by Precision Sampling Incorporated, Richmond, CA. and reprinted with their permission*

## Well Installation

After the borehole is completed, the total borehole length is measured from the borehole bottom expendable tip to the top of the EC-5 casing using a weighted measuring tape. The amount of EC-5 casing stickup is measured from ground surface and subtracted from the total borehole depth to obtain the borehole depth referenced to ground surface. When the proper borehole depth has been reached, the multi-channel well can be installed. The tip can be knocked out and the well is re-measured. Several personnel can carry the well from the fabrication area to the borehole location holding only the sand filter sections as carrying handles). The visquene sleeve can be removed by pulling or cutting off while taking care not to damage any well components. After the well has been laid down on visquene next to the boring with the bottom pointed towards the rig, the plastic sleeve protectors are carefully removed using a razor knife for tape removal (be careful not to cut the red packer sleeve material). The well bottom is then inserted inside the EC-5 casing and the well firmly and continuously pushed down until seated at the borehole bottom. After the well is fully installed the 0.0' mark on the well tubing should be even with the ground surface.

The well should slide down inside the EC-5 casing with only moderate resistance utilizing three or four personnel. If undue resistance is encountered during installation, then de-ionized (DI) water can be poured inside the EC-5 casing for lubrication. When the well is seated, the EC-5 casing is removed while continually exerting downward pressure on top of the well tubing to prevent the well from being raised. When all EC-5 casing is removed, additional DI water is poured inside and outside the well tubing to allow the bentonite pellets to hydrate within each packer. Place a vinyl well cap on the well top. Grout can be poured into the annular space between the well exterior and borehole from ground surface to the top of the upper bentonite packer to complete the surface seal and a wellbox can be installed for surface protection.

*This procedure was provided by Precision Sampling Incorporated, Richmond, CA. and reprinted with their permission*

## Wellbox Installation

The wellbox is installed by digging out a 10" wide by 12" deep hole and cementing in the wellbox using a mixture of portland cement, sand, rockite, and bentonite powder. The well diagram should be consulted to determine what type of surface completion is indicated.

If an aboveground completion is required, then a five-foot piece of steel pipe with a locking lid is used. The well tubing is cut at the appropriate length to fit inside the monument and the monument is set approximately 18 inches below ground surface with the tubing recessed approximately 3 inches inside the monument. A level is used to vertically orient the monument. Bracing can be used to keep the pipe vertical as the cement hardens. If the well is completed below grade, then the well tubing is cut off at the appropriate height below grade using a pipe cutter or hacksaw and the wellbox cemented in place over the tubing. The top of the wellbox lid should be raised approximately ½" above ground surface to prevent surface water runoff from entering the wellbox. If a locking wellcap is required, a short section of 2" ID Schedule 40 PVC can be placed over the well tubing that is recessed approximately 3 inches inside the wellbox. The PVC can be grouted in place inside the wellbox. Before the wellbox cement and PVC grout have hardened make sure the wellbox lid fits correctly and does not contact the locking wellcap on top of the PVC. Other types of well boxes, stovepipe or flush mounted, can be constructed depending on client needs.

## 5. Decontamination

Decontamination is performed by steam-cleaning the well tubing prior to fabrication.

## 6. Waste Disposal

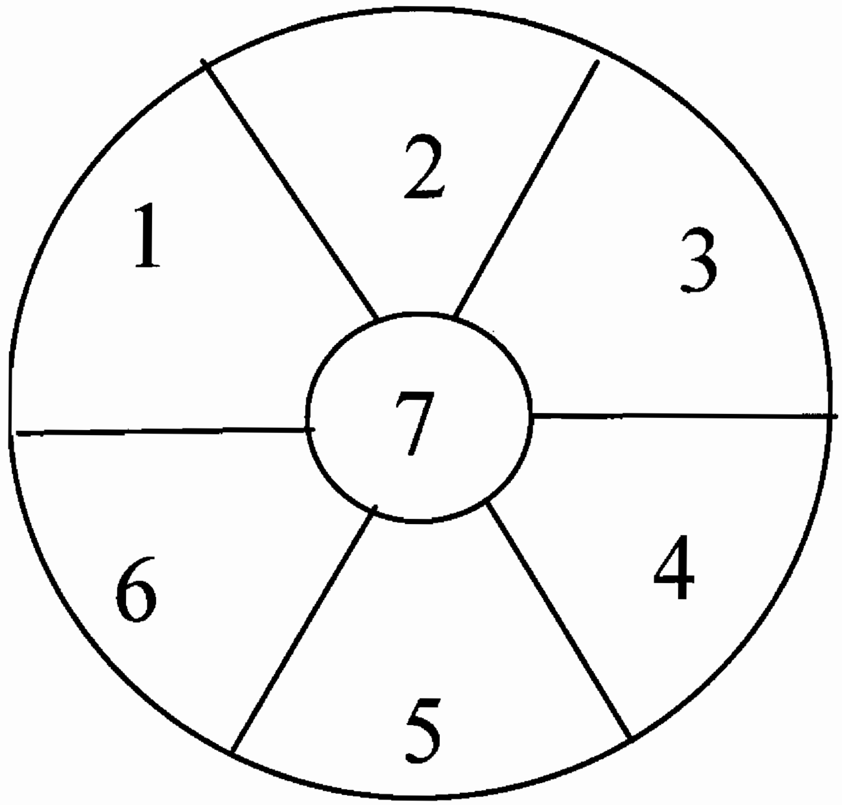
Dispose of all trash generated during well fabrication such as visquene, scrap metal, etc., by placing in appropriate receptacle.

## 7. Optional Methods

The well can be placed directly inside an uncased borehole if the surrounding material is sandy and the borehole depth is relatively shallow. The naturally occurring sand will collapse around the tubing and form a sandpack.

# 03924M PORT LAYOUT SCHEMATIC

STAND FACING FRONT OF WELL 03924M; BLDG. 1639 TO RIGHT




The most shallow interval is always identified as Port 1 (19 ft in this case) and identified by the outer groove on the tubing. Ports 2-6 are oriented clockwise from Port 1. Port 7 is always the deepest interval to be sampled and is always the center chamber.

## VOLUME CALCULATIONS

PORTS # 1-6 (OUTER)

- approx. largest radius = 0.3" or 0.025'.
- Multiply length of water in chamber by 0.015 to obtain 1 chamber volume (GAL)
- Purge 3 volumes before sampling.

PORT #7 (INNER)

- radius = 0.25" or 0.021'.
- Multiply length of water in chamber by 0.01 to obtain 1 chamber volume (GAL)
- Purge 3 volumes before sampling

HELPFUL VOLUME CONVERSIONS

- 4 QTS = 1 GAL
- 32 OZ = 1 QT
- 128 OZ = 1 GAL

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# MULTI-LEVEL WELL SAMPLING FORM

ZONE: A — WELL ID: NBCA\03924M — DATE: 10/26/99

SITE: SWMU 39 — PERSONNEL: T. KAFKA — JOB #: 2901-08-014

## PORT#1
Sampling ID: 039GW241C2

DEPTH (FT): 21.35 — Pump type: Peristaltic

DTW (FT): 8.58 — tubing type: 3/16" OD Teflon

LWC (FT): 12.77 — *0.015 — 1 VOL: 0.19 g — 3 VOL: 0.57 g

NOTES: good recharge

**PURGING** START: 1345 END: 1354

| time--> | 1349 | 1352 | 1354 | |
|---|---|---|---|---|
| vol (g) | 0.25 | 1 | 1.5 | |
| pH | 5.82 | 5.73 | 5.68 | |
| EC (ms/cm) | 0.341 | 0.329 | 0.325 | |
| Turbidity (NTU) | 188 | 88 | 79 | |
| DO (mg/L) | 0 | 0 | 0 | |
| Temp (C) | 22 | 22 | 22 | |
| Salinity (%) | 0.01 | 0.01 | 0.01 | |

**SAMPLING** START: 1400 END: 1402

## PORT#2
Sampling ID: 039GW242C2

DEPTH (FT): 25.25 — Pump type: Peristaltic

DTW (FT): 8.45 — tubing type: 3/16" OD Teflon

LWC (FT): 16.8 — *0.015 — 1 VOL: 0.25 g — 3 VOL: 0.75 g

NOTES: good recharge

**PURGING** START: 1330 END: 1338

| time--> | 1333 | 1335 | 1337 | |
|---|---|---|---|---|
| vol (g) | 0.5 | 1 | 1.2 | |
| pH | 6.42 | 6.3 | 6.23 | |
| EC (ms/cm) | 0.333 | 0.336 | 0.338 | |
| Turbidity (NTU) | 185 | 110 | 70 | |
| DO (mg/L) | 0 | 0 | 0 | |
| Temp (C) | 21.6 | 21.6 | 21.6 | |
| Salinity (%) | 0.01 | 0.01 | 0.01 | |

**SAMPLING** START: 1340 END: 1342

## PORT#3
Sampling ID: 039GW243C2

DEPTH (FT): 30.37 — Pump type: Peristaltic

DTW (FT): 8.52 — tubing type: 3/16" OD Teflon

LWC (FT): 21.85 — *0.015 — 1 VOL: 0.33 g — 3 VOL: 0.99 g

NOTES: good recharge

**PURGING** START: 1311 END: 1321

| time--> | 1315 | 1317 | 1318 | 1320 |
|---|---|---|---|---|
| vol (g) | 0.5 | 1 | 1.2 | 1.5 |
| pH | 6.11 | 5.86 | 5.82 | 5.78 |
| EC (ms/cm) | 0.225 | 0.25 | 0.2 | 0.194 |
| Turbidity (NTU) | 610 | 72 | 66 | 60 |
| DO (mg/L) | 0 | 0 | 0 | 0 |
| Temp (C) | 21.3 | 21.3 | 21.3 | 21.3 |
| Salinity (%) | 0 | 0 | 0 | 0 |

**SAMPLING** START: 1325 END: 1327

## PORT#4
Sampling ID: 039GW244C2

DEPTH (FT): 36.15 — Pump type: Peristaltic

DTW (FT): *ND — tubing type: 3/16" OD Teflon

LWC (FT): ~27.6 — *0.015 — 1 VOL: 0.4 g — 3 VOL: 1.2 g

* assume 8.5' since meter faulty

NOTES: good recharge

**PURGING** START: 1252 END: 1303

| time--> | 1254 | 1258 | 1301 | 1303 |
|---|---|---|---|---|
| vol (g) | 0.5 | 1 | 1.5 | 1.8 |
| pH | 5.96 | 5.72 | 5.63 | 5.6 |
| EC (ms/cm) | 0.198 | 0.177 | 0.167 | 0.163 |
| Turbidity (NTU) | 620 | 77 | 78 | 67 |
| DO (mg/L) | 0 | 0 | 0 | 0 |
| Temp (C) | 21.3 | 21.1 | 21.1 | 21.1 |
| Salinity (%) | 0 | 0 | 0 | 0 |

**SAMPLING** START: 1305 END: 1307

## PORT#5
Sampling ID: 039GW245C2

DEPTH (FT): 41.3 — Pump type: Peristaltic

DTW (FT): *ND — tubing type: 3/16" OD Teflon

LWC (FT): ~32.8 — *0.015 — 1 VOL: 0.5 g — 3 VOL: 1.5 g

*assume 8.5' since meter faulty

NOTES: good recharge

**PURGING** START: 1234 END: 1243

| time--> | 1237 | 1240 | 1243 | |
|---|---|---|---|---|
| vol (g) | 0.5 | 1 | 1.5 | |
| pH | 6.25 | 6.19 | 6.15 | |
| EC (ms/cm) | 0.269 | 0.267 | 0.263 | |
| Turbidity (NTU) | 999 | 184 | 93 | |
| DO (mg/L) | 0 | 0 | 0 | |
| Temp (C) | 21.3 | 21.1 | 21.1 | |
| Salinity (%) | 0.01 | 0.01 | 0.01 | |

**SAMPLING** START: 1245 END: 1247

## PORT#6
Sampling ID: 039GW246C2

DEPTH (FT): 45.5 — Pump type: Peristaltic

DTW (FT): *ND — tubing type: 3/16" OD Teflon

LWC (FT): 37 — *0.015 — 1 VOL: 0.56 g — 3 VOL: 1.7 g

*assume 8.5' since meter faulty

NOTES: good recharge

**PURGING** START: 1214 END: 1227

| time--> | 1218 | 1222 | 1224 | 1227 |
|---|---|---|---|---|
| vol (g) | 0.5 | 1 | 1.5 | 2 |
| pH | 6.16 | 6.11 | 6.07 | 6.06 |
| EC (ms/cm) | 0.275 | 0.28 | 0.279 | 0.28 |
| Turbidity (NTU) | 999 | 700 | 94 | 75 |
| DO (mg/L) | 0 | 0 | 0 | 0 |
| Temp (C) | 21.4 | 21.1 | 21.1 | 21.1 |
| Salinity (%) | 0.01 | 0.01 | 0.01 | 0.01 |

**SAMPLING** START: 1230 END: 1232

# MULTI-LEVEL WELL SAMPLING FORM

ZONE: A
SITE: SWMU 39
WELL ID: NBCA\03924M
PERSONNEL: T. KAFKA
DATE: 10/26/99
JOB # 2901-08-014

**PORT#7** Sampling ID: 039GW247C2

| | | | |
|---|---|---|---|
| DEPTH (FT) | 49.35 | Pump type | Peristaltic |
| DTW (FT) | *ND | tubing type | 3/16" OD Teflon |
| LWC (FT) | ~40.9 | *0.01 | 1 VOL 0.41 g |
| *assume 8.5' since meter faulty | | | 3 VOL 1.2 g |

NOTES: good recharge; DTW assumption appears correct

**PURGING** START: 1150 END: 1204

| | | | | |
|---|---|---|---|---|
| time--> | 1154 | 1158 | 1201 | |
| vol (g) | 0.5 | 1 | 1.5 | |
| pH | 6 | 5.89 | 5.84 | |
| EC (ms/cm) | 0.24 | 0.233 | 0.228 | |
| Turbidity (NTU) | 999 | 214 | 117 | |
| DO (mg/L) | 0 | 0 | 0 | |
| Temp (C) | 21.9 | 21.5 | 21.4 | |
| Salinity (%) | 0 | 0 | 0 | |

**SAMPLING** START: 1205 END: 1207

PRECISION

# MULTI-LEVEL WELL CONSTRUCTION DETAILS

BORING DESIGNATION: NBCA\Ø3924M

INSTALLATION DATE: 10/9/99 BY: SC Cert #57

DRILLING METHOD: DPT - 3.5" OD Casing

CONTRACTOR: Precision Sampling Inc.

WELL DESIGNATION: Ø3924M

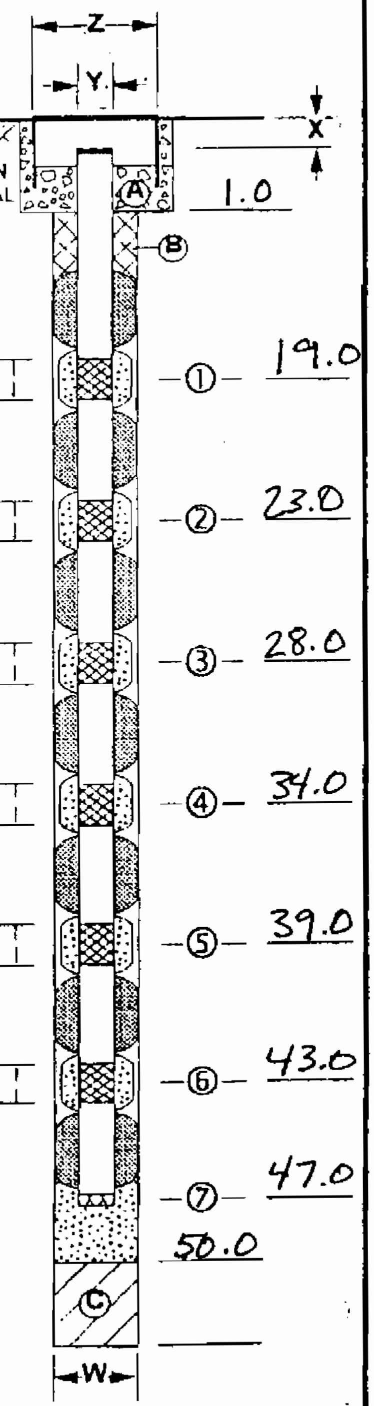
## MATERIALS DATA

- Monument Footing (A) ______
- Annular Seal (B) ______
- Bottom Seal (C) ______

## DIMENSIONS

- (W) Borehole Diameter: 3.5"
- (X) Stick-up: 2.5'
- (Y) Tubing Diameter: 1.7"
- (Z) Protective Covering Diameter: NA
- Well Centralizer Depths: ______

| BENTONITE PACKER INTERVAL | SAND PACK INTERVAL | SCREEN INTERVAL | | |
|---|---|---|---|---|
| 16.9<br>17.6 | | 18.9<br>19.1 | 1 | 19.0 |
| 20.1<br>21.6 | | 22.9<br>23.1 | 2 | 23.0 |
| 25.6<br>26.3 | | 27.8<br>28.1 | 3 | 28.0 |
| 30.5<br>31.1 | | 33.9<br>34.1 | 4 | 34.0 |
| 36.9<br>37.4 | | 38.9<br>39.2 | 5 | 39.0 |
| 40.8<br>41.5 | | 42.1<br>43.1 | 6 | 43.0 |
| 44.9<br>45.6 | | | 7 | 47.0 |




SECTION VIEW
*(Not to Scale)*

## NOTES:

Bentonite/Portland grout 1-9 ft bgs
Bentonite pellets 9-13 ft bgs
Native collapse 13-16.9 ft bgs
No filter packs used since flowing sands would collapse against screens.
Screen is stainless steel mesh equivalent of 0.010 ft slot size
Aboveground well completion

SITE: Zone A - SWMU 39

PROJECT NO: Charleston Naval Complex

N. 380998.55 E. 2315465.69

WELL PERMIT NO: HW-99-080 (09/27/99)

DATALCP3
12/15/99

CHARLESTON - ZONE A
CHARLESTON ZONE A - QUARTERLY GW
SDG# 40873

Page: 1
Time: 16:43

| SW-VOA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 039-G-W241-C2 | | 039-G-W242-C2 | | 039-G-W243-C2 | | 039-G-W244-C2 | | 039-G-W245-C2 | | 039-G-W246-C2 | |
| | ORIGINAL ID -----> | 039GW241C2 | | 039GW242C2 | | 039GW243C2 | | 039GW244C2 | | 039GW245C2 | | 039GW246C2 | |
| | LAB SAMPLE ID ---> | 40873.07 | | 40873.06 | | 40873.05 | | 40873.04 | | 40873.03 | | 40873.02 | |
| | ID FROM REPORT --> | 039GW241C2 | | 039GW242C2 | | 039GW243C2 | | 039GW244C2 | | 039GW245C2 | | 039GW246C2 | |
| | SAMPLE DATE -----> | 10/26/99 | | 10/26/99 | | 10/26/99 | | 10/26/99 | | 10/26/99 | | 10/26/99 | |
| | DATE ANALYZED ---> | 11/05/99 | | 11/05/99 | | 11/05/99 | | 11/05/99 | | 11/05/99 | | 11/04/99 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Water | | Water | |
| | UNITS -----------> | UG/L | | UG/L | | UG/L | | UG/L | | UG/L | | UG/L | |
| CAS # | Parameter | 40873 | VAL | 40873 | VAL | 40873 | VAL | 40873 | VAL | 40873 | VAL | 40873 | VAL |
| 74-87-3 | Chloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 74-83-9 | Bromomethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-01-4 | Vinyl chloride | 3. | J | 2. | J | 5. | U | 1. | J | 20. | | 35. | J |
| 75-00-3 | Chloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-09-2 | Methylene chloride | 8. | U | 12. | U | 8. | U | 7. | U | 12. | U | 5. | U |
| 67-64-1 | Acetone | 5. | UR | 5. | UR | 5. | UR | 6. | J | 10. | J | 10. | U |
| 75-15-0 | Carbon disulfide | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-35-4 | 1,1-Dichloroethene | 1. | J | 5. | U | 5. | U | 5. | U | 3. | J | 5. | J |
| 75-34-3 | 1,1-Dichloroethane | 1. | J | 5. | U | 5. | U | 2. | J | 6. | | 5. | J |
| 67-66-3 | Chloroform | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 107-06-2 | 1,2-Dichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-05-4 | Vinyl acetate | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 78-87-5 | 1,2-Dichloropropane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-01-6 | Trichloroethene | 7. | | 5. | | 1. | J | 3. | J | 14. | | 25. | J |
| 124-48-1 | Dibromochloromethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 71-43-2 | Benzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 2. | J |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | UJ | 5. | UJ | 5. | UJ | 5. | UJ | 5. | UJ | 5. | U |
| 75-25-2 | Bromoform | 5. | U | 5. | U | 5. | U | 5. | U | 3. | J | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 127-18-4 | Tetrachloroethene | 5. | | 2. | J | 2. | J | 5. | | 23. | | 57. | J |
| 108-88-3 | Toluene | 5. | U | 2. | J | 2. | J | 2. | J | 5. | U | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 100-42-5 | Styrene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | 75. | | 67. | | 28. | | 50. | | 200. | | 320. | J |
| 1330-20-7 | Xylene (Total) | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |
| 1634-04-4 | Methyl tert-butyl ether | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U | 5. | U |

*** Validation Complete ***

# CHARLESTON - ZONE A
## CHARLESTON ZONE A - QUARTERLY GW
## SDG# 40873



SW-VOA

| | |
|---|---|
| SAMPLE ID -------> | 039-G-W247-C2 |
| ORIGINAL ID -----> | 039GW247C2 |
| LAB SAMPLE ID ---> | 40873.01 |
| ID FROM REPORT --> | 039GW247C2 |
| SAMPLE DATE -----> | 10/26/99 |
| DATE ANALYZED ---> | 11/04/99 |
| MATRIX ----------> | Water |
| UNITS -----------> | UG/L |

| CAS # | Parameter | 40873 | VAL |
|---|---|---|---|
| 74-87-3 | Chloromethane | 5. | U |
| 74-83-9 | Bromomethane | 5. | U |
| 75-01-4 | Vinyl chloride | 20. | |
| 75-00-3 | Chloroethane | 5. | U |
| 75-09-2 | Methylene chloride | 7. | U |
| 67-64-1 | Acetone | 5. | U |
| 75-15-0 | Carbon disulfide | 5. | U |
| 75-35-4 | 1,1-Dichloroethene | 3. | J |
| 75-34-3 | 1,1-Dichloroethane | 8. | |
| 67-66-3 | Chloroform | 5. | U |
| 107-06-2 | 1,2-Dichloroethane | 5. | U |
| 78-93-3 | 2-Butanone (MEK) | 5. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 5. | U |
| 56-23-5 | Carbon tetrachloride | 5. | U |
| 108-05-4 | Vinyl acetate | 5. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 5. | U |
| 75-27-4 | Bromodichloromethane | 5. | U |
| 78-87-5 | 1,2-Dichloropropane | 5. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 5. | U |
| 79-01-6 | Trichloroethene | 17. | |
| 124-48-1 | Dibromochloromethane | 5. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 5. | U |
| 71-43-2 | Benzene | 5. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 5. | U |
| 110-75-8 | 2-Chloroethyl vinyl ether | 5. | U |
| 75-25-2 | Bromoform | 5. | U |
| 591-78-6 | 2-Hexanone | 5. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 5. | U |
| 127-18-4 | Tetrachloroethene | 28. | |
| 108-88-3 | Toluene | 5. | U |
| 108-90-7 | Chlorobenzene | 5. | U |
| 100-41-4 | Ethylbenzene | 5. | U |
| 100-42-5 | Styrene | 5. | U |
| 156-60-5 | trans-1,2-Dichloroethene | 5. | U |
| 156-59-2 | cis-1,2-Dichloroethene | 180. | |
| 1330-20-7 | Xylene (Total) | 5. | U |
| 1634-04-4 | Methyl tert-butyl ether | 5. | U |

*** Validation Complete ***

# HEARTLAND
ENVIRONMENTAL SERVICES, INC.

## Data Validation Report

| | |
|---|---|
| SDG#: | 40873 |
| Date: | December 10, 1999 |
| Client Name: | Ensafe |
| Project/Site Name: | Charleston Zone A |
| Date Sampled: | October 26, 1999 |
| Number of Samples: | 8 Aqueous Sample(s) with 0 MS/MSD(s) |
| Laboratory: | Southwest Laboratory of Oklahoma |
| Validation Guidance: | National Functional Guidelines for Organic and Inorganic Data, February, 1994 |
| QA/QC Level: | EPA DQO Level III |
| Method(s) Utilized: | SW846 Third Edition |
| Analytical Fraction: | Volatiles |

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

for Erica K. Ketcham
Paul B. Humburg, President

12/13/99
Date

4127 Plaza 94 South • St. Charles, MO 63304
(636) 936-1332 • Fax (636) 936-1335

. **SDG# 40873**

## Samples and Fractions Reviewed

Sample Identifications Analytical Fraction

| ENSAFE ID | MATRIX | VOA | |
|---|---|---|---|
| 039GW241C2 | WATER | X | |
| 039TW241C2 | WATER | X | |
| 039GW242C2 | WATER | X | |
| 039GW243C2 | WATER | X | |
| 039GW244C2 | WATER | X | |
| 039GW245C2 | WATER | X | |
| 039GW246C2 | WATER | X | |
| 039GW247C2 | WATER | X | |
| Total Billable Samples (Water/Soil) | | 8 | 0 |

VOA= Volatiles

# DATA ASSESSMENT NARRATIVE

# VOLATILE ORGANICS

**General**

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8260B for GC/MS Volatiles; the National Functional Guidelines for Organic Data Validation, 2/94, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

**SDG # 40873**

A validation was performed on the Volatile Data from SDG 40873. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- • Calibration
- • Blanks
- * • Internal Standard Performance
- • Surrogate Recoveries
- • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- • Compound Quantitation

* - All criteria were met for this parameter.

**Calibrations**

The continuing calibration standard I53912.D exhibited one (1) compound with a RRF less than 0.05. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results were rejected, UR.

| | |
|---|---|
| 039GW245C2 | acetone (0.042) |
| 039GW245C2 | |
| 039GW244C2 | |
| 039GW243C2 | |
| 039GW242C2 | |
| 039GW241C2 | |

The continuing calibration I53912.D exhibited one (1) compound with a %D greater than 50% but less than 90%. For the following samples and non-compliant compound, the reported positive and non-detect results are qualified as estimated, J/UJ.

| | |
|---|---|
| 039GW245C2 | 2-chloroethyl vinyl ether (68.8%) |
| 039GW245C2 | |
| 039GW244C2 | |
| 039GW243C2 | |
| 039GW242C2 | |
| 039GW241C2 | |

**Blanks**

The method and trip blanks associated with the field samples in this SDG exhibited contamination for which qualifications were required. The end user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into considerations when applying the 5X and 10X criteria to field samples.

| Associated blank | Compound | Concentration | Action Level |
|---|---|---|---|
| VBLK1 | acetone | 9 ug/L | 90 ug/L |
| VBLK2 | methylene chloride | 2 ug/L | 20 ug/L |
| | chloroform | 2 ug/L | 10 ug/L |
| 039TW241C2 | methylene chloride | 8 ug/L | 80 ug/L |

DATA ASSESSMENT NARRATIVE
VOLATILE ORGANICS



**Blanks (continued)**

| Samples | Compound | Qualifications |
|---|---|---|
| 039GW246C2 | acetone | U |
| 039GW245C2<br>039GW244C2<br>039GW243C2<br>039GW242C2<br>039GW241C2<br>039GW247C2 | methylene chloride | U |

**Surrogate Recoveries**

The following sample exhibited a surrogate recovery above the QC limits. The reported positive results are qualified as estimated, J.

| Sample | Surrogate | %R |
|---|---|---|
| 039GW246C2 | dibromofluoromethane | 121% |

**Matrix Spike /Matrix Spike Duplicates**

The MS/MSD pair of the following sample exhibited 6% recovery in the MS and 0% recovery for 2-chloroethyl vinyl ether in the MSD The reported non-detect result reported in the unspiked sample is rejected, UR.

039GW247C2

**Compound Quantitation**

For the following sample, the reported results are not used in favor of the results reported from the original analysis of the samples. Both analyses of the sample exhibited similar internal standard area recoveries.

039GW246C2

## DATA ASSESSMENT NARRATIVE
## VOLATILE ORGANICS



**System Performance and Overall Assessment**

The data, as reported, required qualifications/rejections.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

## BLANK QUALIFICATION CODES

| | |
|---|---|
| CRQL = | The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported. |
| U = | The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported. |
| No Action = | The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers. |

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | COMPOUND ID | DL | QL |
|---|---|---|---|
| 039GW245C2 | acetone (0.042) | +/- | J/UR |
| 039GW245C2 | | | |
| 039GW244C2 | | | |
| 039GW243C2 | | | |
| 039GW242C2 | | | |
| 039GW241C2 | | | |
| 039GW245C2 | 2-chloroethyl vinyl ether (68.8%) | +/- | J/UJ |
| 039GW245C2 | | | |
| 039GW244C2 | | | |
| 039GW243C2 | | | |
| 039GW242C2 | | | |
| 039GW241C2 | | | |
| 039GW246C2 | acetone | +B | U |
| 039GW245C2 | methylene chloride | +B | U |
| 039GW244C2 | | | |
| 039GW243C2 | | | |
| 039GW242C2 | | | |
| 039GW241C2 | | | |
| 039GW247C2 | methylene chloride | + | U |
| 039GW246C2 | All compounds | + | J |
| 039GW247C2 | 2-chloroethyl vinyl ether | - | UR |
| 039GW246C2 | All E flagged results | +E | Do Not Use |
| 039GW246C2DL | All except corresponding D flagged results | +/- | Do Not Use |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result