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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION WORK
PLAN ADDENDUM ZONE F CNC CHARLESTON SC
2/15/2001
CNC CHARLESTON

RCRA Facility Investigation Work Plan Addendum – Zone F



**Charleston Naval Complex
North Charleston, South Carolina**



SUBMITTED TO
**U.S. Navy Southern Division
Naval Facilities Engineering Command**

CH2M-Jones

February 2001

*Revision 1
Contract N62467-99-C-0960*

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Code 18713
15 Feb 01

Mr. John Litton, P.E.
Director, Division of Hazardous and Infectious Waste Management
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF ZONE F RCRA FACILITY INVESTIGATION WORK PLAN

Dear Mr. Litton,

The purpose of this letter is to submit the RCRA Facility Investigation Work Plan Addendum for Zone F (Final) located at Naval Station Annex in Charleston, SC. The work plan addendum is submitted to fulfill the requirements of condition II.C.1 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and the U.S. Environmental Protection Agency (EPA.)

This document has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process and has been distributed under separate cover letter by CH2M Hill. Appropriate certification is provided under that correspondence. We request that the Department and the EPA review this document and provide comments or approval whichever is appropriate.

If you should have any questions, please contact Matthew Humphrey or myself at (843) 743-9985 and (843) 820-5551 respectively.

Sincerely,

ROBERT A. HARRELL, JR., P.E.
Environmental Engineer
BRAC Division

Copy to:
SCDHEC (4)
USEPA (Dann Spariosu)
CSO Naval Base Charleston (Matt Humphrey)
CH2M-Hill (Dean Williamson)



CH2MHILL

February 13, 2001

CH2M HILL

3011 S.W. Williston Road

Gainesville, FL

32608 3928

Mailing address:

P.O. Box 147009

Gainesville, FL

32614-7009

Tel 352.335.7991

Fax 352.335.2959

John Litton, P.E.
Director
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Dear Mr. Litton:

Enclosed please find four copies of the Final Zone F RFI Work Plan Addendum, Naval Station Annex, at the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

Please contact me if you have any questions or comments.

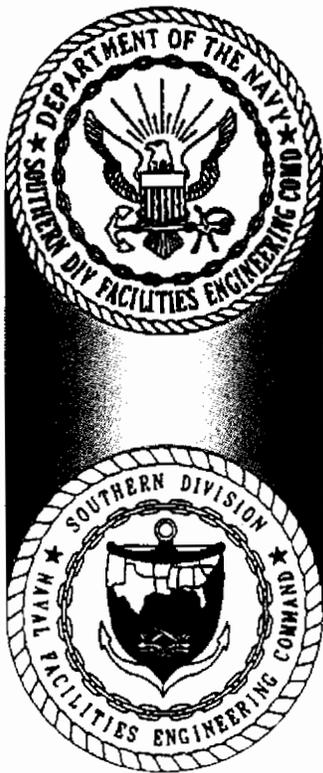
Sincerely,

Dean Williamson
(8)

Dean Williamson, P.E.

xc: Tony Hunt/Navy, w/att
✓ Rob Harrell/Navy, w/att
Mihir Mehta/SCDHEC
Gary Foster/CH2M HILL w/att

RCRA Facility Investigation Work Plan Addendum – Zone F



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

PREPARED BY
CH2M-Jones

E022001017GNV

*February 2001
158814.ZF.PR.00*

*Revision 1
Contract N62467-99-C-0960*

Certification Page for RCRA Facility Investigation (RFI) Work Plan Addendum, Zone F, Naval Station Annex

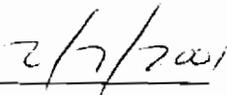
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

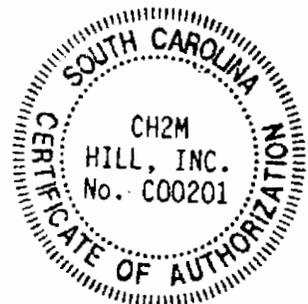
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Dean Williamson, P.E.



Date



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- 1 **Appendices**
- 2 **A** Site-Specific Soil Screening Levels
- 3 **B** Results of Work Plan Addendum Scoping Meetings
- 4 **C** Work Plan Addendum Revision 0 Comments
- 5 **D** SCDHEC No Further Action Correspondence for Site 24 (AOC 609)

1 Acronyms and Abbreviations

2	1,2-DCA	1,2-dichloroethane
3	1,1-DCE	1,1-dichloroethene
4	AOC	area of concern
5	AST	aboveground storage tank
6	BEQ	benzo(a)pyrene equivalent
7	bgs	below ground surface
8	BTEX	benzene, toluene, ethylbenzene, and xylene
9	CA	corrective action
10	CLEAN	Comprehensive Long Term Environmental Action Navy
11	CNC	Charleston Naval Complex
12	COPC	chemical of potential concern
13	CSAP	Comprehensive Sampling and Analysis Plan
14	CVOC	chlorinated volatile organic compound
15	DAF	dilution attenuation factor
16	Detachment	U.S. Naval Detachment
17	DPT	direct push technology
18	DRO	diesel range organics
19	E/A&H	EnSafe Inc./Allen & Hoshall
20	EnSafe	EnSafe Inc.
21	EPA	U.S. Environmental Protection Agency
22	ESDSOPQAM	EPA Environmental Services Division <i>Standard Operating</i>
23		<i>Procedures and Quality Assurance Manual</i>

1 **Acronyms and Abbreviations, Continued**

2	FD	fuel distribution
3	FDS	fuel distribution system
4	ft ²	square feet
5	ft bls	feet below land surface
6	GRO	gasoline range organics
7	IDW	investigative-derived waste
8	IM	interim measure
9	µg/kg	micrograms per kilogram
10	µg/L	micrograms per liter
11	MCL	maximum concentration limit
12	MTBE	methyl tributyl ethylene
13	MW	monitoring well
14	NFA	no further action
15	NSA	Naval Station Annex
16	OWS	oil/water separator
17	PAH	polycyclic aromatic hydrocarbon
18	PCB	polychlorinated biphenyl
19	PCE	tetrachloroethene
20	RA	rapid assessment
21	RBC	risk-based concentration
22	RCRA	Resource Conservation and Recovery Act
23	RFA	RCRA Facility Assessment

1 **Acronyms and Abbreviations, Continued**

2	RFI	RCRA Facility Investigation
3	SCDHEC	South Carolina Department of Health and Environmental Control
4	SME	soil and materials engineers
5	SPLP	synthetic precipitation leaching procedure
6	SSL	soil screening level
7	SVOC	semivolatile organic compound
8	SWMU	solid waste management unit
9	TCE	trichloroethene
10	TPH	total petroleum hydrocarbon
11	TTNUS	Tetra Tech NUS, Inc.
12	UST	underground storage tank
13	VOC	volatile organic compound

SECTION 1.0

Introduction

1 1.0 Introduction

2 1.1 Background

3 As part of the U.S. Naval Comprehensive Long-Term Environmental Action Navy
4 (CLEAN) Program, the following Resource Conservation and Recovery Act (RCRA)
5 Facility Investigation (RFI) Work Plan Addendum (WPA), Revision 1, has been
6 prepared for Zone F of the Charleston Naval Complex (CNC). This addendum is
7 intended to function as a supplemental document to the *Zone F RFI Work Plan*, dated
8 December 31, 1997, prepared by EnSafe Inc. (EnSafe). Refer to EnSafe's *Zone F RFI Work*
9 *Plan* for specific details regarding site geology, hydrogeology, soil and groundwater
10 sampling methodology, and risk assessment evaluation protocol. Specific sampling and
11 analysis plan directives contained herein are intended to supplement those of the *Final*
12 *Zone F Work Plan Addendum, Revision 0* (EnSafe, 1999). Data collected from samples
13 proposed in Revision 0 are provided in Section 2.0 of this WPA.

14 1.2 Site Background and Setting

15 Zone F of the CNC, as depicted in Figure 1-1, includes solid waste management units
16 (SWMUs) 4, 36, 109, and 175; as well as areas of concern (AOCs) 607, 609, 611, 613, 615,
17 616, 617, 619, 620, and 709 (F). AOC 709 (F) is differentiated from the AOC 709 identified
18 in Zone H in the RCRA permit; this AOC may be renamed in the future to avoid
19 confusion. SWMU 4 and SWMU 36 are located within the respective boundaries of AOC
20 619 and AOC 620. Therefore, AOC 619/SWMU 4 and AOC 620/SWMU 36 are
21 addressed as combined sites. AOC 613, AOC 615, and SWMU 175 were combined
22 because of their close proximity, similar chemicals of potential concern (COPCs), and/or
23 related historical usage. AOC 616 – Paint Shop, Former Building 1201, was identified for
24 No Further Action (NFA) status as a result of the *Zone F RCRA Facility Investigation*
25 *Report, Revision 0* (EnSafe, March 31, 1999).

26 1.3 Screening Process for Determining COPCs

27 COPCs are identified as constituents with concentrations that exceed background *and*
28 applicable residential risk-based concentrations (RBCs), soil screening levels (SSLs), or
29 maximum concentration limits (MCLs). These criteria are termed *screening criteria*. Some

1 AOCs are adjacent to Zone E and are clearly in an industrial area that may remain as
2 such for future industrial use. Industrial exposure RBCs could be appropriate screening
3 concentrations for those sites. AOCs east of Hobson Avenue (109; 613/615/175; 616;
4 617; 004/619; and 036/620) are likely classified for industrial use. AOCs west of Hobson
5 Avenue (607; 609; 611; and 709) are likely future residential areas.

6 Surface soil data were screened against background concentrations as well as RBCs and
7 SSLs. Subsurface soil data were screened against background concentrations and SSLs.
8 Groundwater data were screened against background concentrations and MCLs. RBCs
9 were used for constituents with no MCLs. Sediment collected from these sites generally
10 does not directly impact aquatic organisms; screening comparisons would include
11 surface soil concentrations and human exposure RBCs. If sediment is transported
12 through the storm drains to surface water bodies, then the sediment may be screened
13 against concentrations considered protective of aquatic organisms.

14 SSLs for soil-to-groundwater transfer were developed using site-specific parameters for
15 soil leaching ratios and dilution attenuation factors (DAFs). SSL derivation is described
16 in Appendix A, and SSLs for each constituent identified at each AOC are tabulated in
17 the appendix. Alternate SSL values are also provided in the appendix; these are
18 calculated using surface infiltration parameters reflective of impermeable site surface
19 features such as building or pavement coverage.

20 **1.4 Review of Oil/Water Separator Locations**

21 Zone F AOCs and SWMUs were reviewed for the presence of oil/water separators
22 (OWSs) as potential sources for potential releases. No OWSs were identified at any of
23 the sites except AOC 613 and AOC 615. Evaluation of the OWS areas is discussed in
24 Section 2.0 of this Work Plan Addendum.

25 **1.5 Sample Numbering and Identification**

26 RFI sample locations addressed in this document are each assigned a station number
27 comprised of nine characters, in accordance with the format presented below:

28 *Example: F620SB001*

29 *F* – Zone designation (The zone designation may have been omitted for Zone F samples
30 for the purpose of this document.)

- 1 **620** – AOC/SWMU designation
- 2 **SB** – Soil boring; Other possible designations are **GW** – groundwater well; **SP** – soil
3 probe; **GP** – groundwater probe; **M0** – sediment sample location; or **SW** – surface water
4 sample location
- 5 **001** – Station identification number
- 6 Sample numbers use the station identifier with up to four characters appended, such as
7 01 for surface or 02 for subsurface soil.

8 **1.6 Work Plan Addendum Scoping Meetings**

9 The sampling and analysis plan contained in Section 2.0 was developed in part based on
10 meetings and correspondence between representatives of the U.S. Environmental
11 Protection Agency (EPA), Navy, EnSafe, CH2M-Jones, and South Carolina Division of
12 Health and Environmental Control (SCDHEC). Meetings to review the scope of work
13 were held between CH2M-Jones and SCDHEC on October 9, 2000; October 26, 2000; and
14 November 14, 2000. Results of these meetings are presented in Appendix B, along with
15 the basis for the WPA presented in the meetings. The WPA presents specific elements of
16 these meetings and correspondence as they relate to the development of a rationale for
17 the sampling and analysis plan.

18 Appendix C presents SCDHEC's December 17, 1999, and December 21, 1999, comments
19 pertaining to the *Work Plan Addendum, Revision 0*, in addition to responses by EnSafe
20 dated May 5, 2000. Clarifications to the responses made by CH2M-Jones, as they pertain
21 to this WPA, are also included in Appendix C.

22 **1.7 Organization of the Zone F RFI Work Plan Addendum**

23 This WPA contains four sections, including this introductory section:

- 24 **1.0 Introduction** – Presents the purpose of the RFI WPA and background information.
- 25 **2.0 Scope of Work** – Presents an overview of historical site usage, as well as historical
26 site investigation(s) sampling and analysis results for each SWMU and/or AOC, with
27 the exception of AOC 616, as noted above. The sampling and analysis results in Section
28 2.0 for each AOC/SWMU address COPCs in soil and/or groundwater. Section 2.0 also
29 includes a proposed sampling and analysis plan for each SWMU and/or AOC
30 identified for further investigative activities. The objective of the sampling and analysis

1 plan is to delineate the vertical and horizontal extent of COPC impacts in soil and/or
2 groundwater, based on findings associated with the historical data. Figures are included
3 for each SWMU and/or AOC that summarize historical soil and groundwater sample
4 locations, pertinent analytical results, approximate extent of impacts that have not been
5 fully delineated, and proposed sample and/or monitor well locations.

6 **3.0 Sampling Protocol and Analysis** – Describes procedures to be implemented for
7 sampling during the investigation of soil and groundwater, including monitor well
8 installation and investigative-derived waste (IDW) management.

9 **4.0 References** – Lists all references used to prepare this WPA.

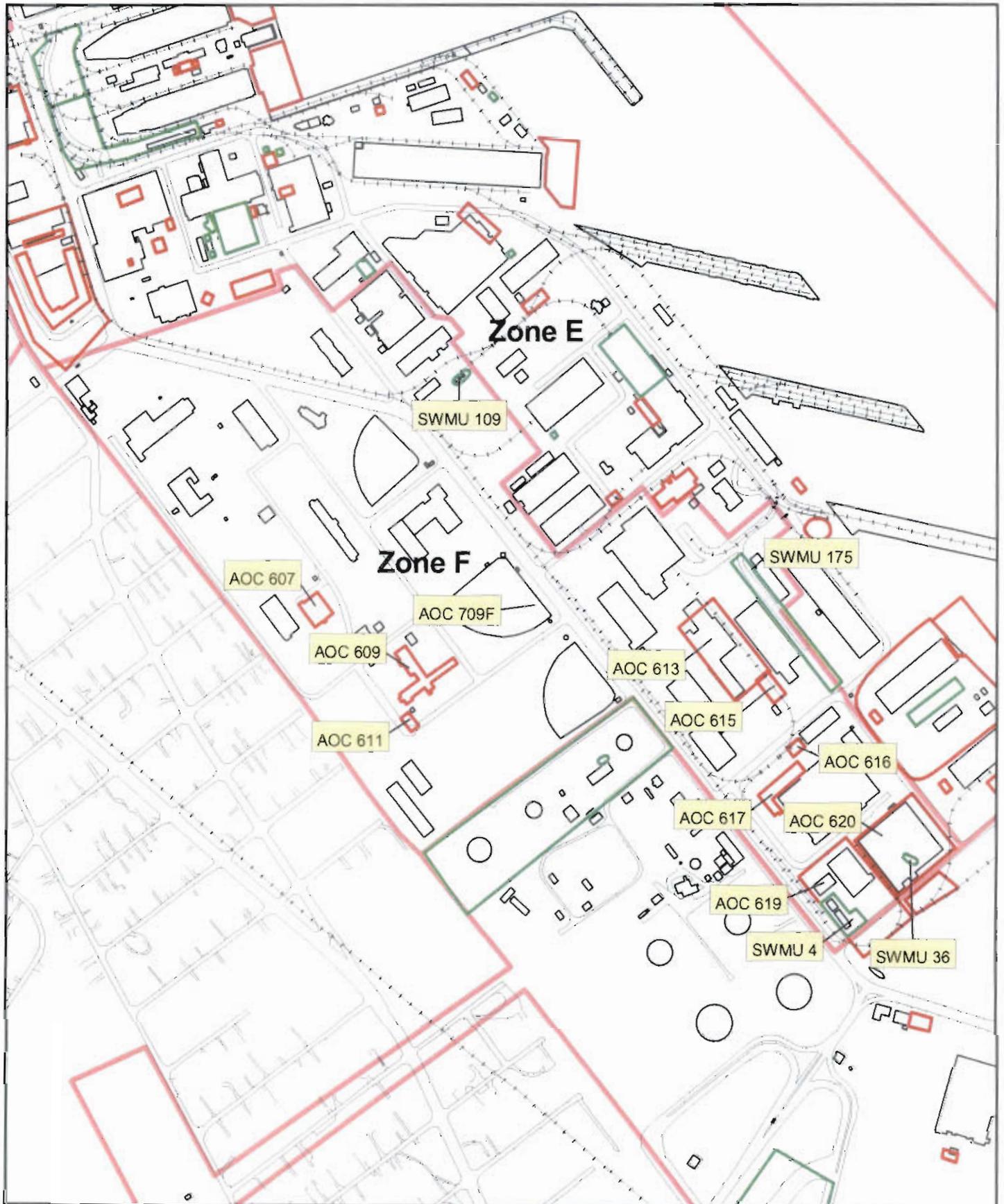
10 **Appendix A** contains site-specific soil screening levels.

11 **Appendix B** contains the results of Work Plan Addendum Scoping Meetings.

12 **Appendix C** contains the Work Plan Addendum, Revision 0, Comments.

13 **Appendix D** contains SCDHEC's No Further Action Correspondence for Site 24 (AOC 609).

14 Tables and figures appear at the end of their respective sections.



- Railroads
- Roads - Lines
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary



Figure 1-1
Zone F Map
 AOC and SWMU Locations
 Charleston Naval Complex

SECTION 2.0

Scope of Work

2.0 Scope of Work

This section outlines the scope of work for completion of the RFI at each AOC or SWMU within Zone F. Sites in which contamination has been effectively delineated as a result of the 1999 sampling effort that followed the *Zone F Work Plan Addendum, Revision 0*, are described, with rationale provided for no further investigation. Sites in which additional sampling is needed to delineate contamination are described, with proposed sampling locations and parameters.

2.1 SWMU 109 – Abrasive Blast Media Storage Area

2.1.1 General Description and Historic Usage

SWMU 109 is located in an industrial area east of Hobson Avenue, adjacent to the Zone E boundary. The site consists of three hoppers identified as Buildings 1364, 1365, and 1393. The buildings were used for temporary storage of abrasive blast media unloaded from trains and subsequently transferred to other vehicles for transportation to blasting locations (remote from SWMU 109). Material stored at the site included aluminum oxide and “black beauty” blast media, along with other blasting material such as sodium bicarbonate. The site was designated a SWMU because of the unused blast media spilled on the ground surface surrounding the buildings.

A sump pit located between the hoppers and extending northward, below the railroad lines, was used to collect spillage of blast media during unloading. Aerial photographs of the site show a cover over the pit and the unloading area. The hoppers and cover have been removed, leaving the concrete base slabs, sump pit, and foundations. The sump pit is filled with stone and sand, and the surrounding area is paved with asphaltic concrete. As part of the RFI, material in the pit (sediment) was sampled, in addition to 10 soil sample locations surrounding the hopper area and groundwater from two wells. Figure 2.1-1 shows the actual site configuration and an aerial photograph.

The building locations shown on the RCRA Facility Assessment (RFA) and earlier RFI documents do not reflect their actual configurations (EnSafe/Allen & Hoshall [E/A&H], June 1995; E/A&H, June 1996; E/A&H, July 1996). The building locations had been reproduced from earlier CNC base maps; however, aerial photographs show the three buildings much closer together. The actual spill area may exceed the SWMU boundary

1 presented in the RFA and reproduced in the figure, as blast media was observed on the
2 ground surface extending approximately 50 feet away from the former building
3 locations. The spill area extends into the Zone E area; background concentrations at this
4 SWMU may be more accurately represented by Zone E background values.

5 **2.1.2 Historic Site Investigation Summary**

6 Surface soil samples from 10 locations and subsurface soil samples from seven locations
7 were collected from the area surrounding the hoppers. Sediment samples were collected
8 from the sump pit and from a stormwater catch basin south of the site. Two
9 groundwater wells were installed and sampled; well F109GW001 was sampled four
10 times and well F109GW002 was sampled once. Surface and subsurface soil at three
11 sample locations were resampled to evaluate leaching ratios for soil-to-groundwater
12 migration SSL development. SSLs developed from site-specific leaching ratios and DAF
13 values are listed in Appendix A. Sample locations are presented in Figure 2.1-2.

14 **Results of Soil Sampling**

15 Benzo(a)pyrene equivalents (BEQs) were detected in the surface soils at concentrations
16 reflective of typical industrial and railroad usage, with a maximum detected BEQ
17 concentration of 661 milligrams per kilogram (mg/kg), which is below the base-wide
18 background concentration of 1,304 mg/kg. Other polycyclic aromatic hydrocarbons
19 (PAHs) and benzoic acid were also detected in surface and subsurface soils below
20 screening criteria. Aroclor-1260 (a polychlorinated biphenyl [PCB] compound), traces of
21 pesticides, and dioxins were also detected below applicable screening criteria. No
22 volatile organic compounds (VOCs) were detected with concentrations above the
23 screening criteria.

24 The following metals were detected in surface soils above residential screening criteria:
25 antimony, arsenic, lead, iron, and vanadium. Iron releases to surface soil may be
26 expected to occur in industrial areas with heavy railroad use, and concentrations do not
27 exceed industrial risk-based surface exposure criteria (61,000 mg/kg). Therefore, iron
28 will not be further delineated.

29 Antimony and vanadium concentrations were also below industrial-based risk
30 screening concentrations, and will not be further delineated. However, lead (maximum
31 concentration 793 mg/kg) and arsenic (maximum concentration 134 mg/kg) exceeded
32 both Zone F and Zone E background concentrations and industrial risk-based

1 comparison criteria. Lead also exceeded the screening level of 400 mg/kg used to screen
2 for the soil-to-groundwater migration pathway.

3 Lead and arsenic concentrations in surface soil are presented in Figure 2.1-3. Except for
4 one sample at F109SB004, arsenic concentrations are within or below 10 percent of the
5 background values in Zones F and E; therefore, the high concentration of arsenic has
6 been adequately delineated. The apparently ubiquitous occurrence of arsenic in soils
7 and groundwater in the Charleston area is believed to be naturally occurring. The
8 provenance of arsenic in the South Carolina Coastal Plain and Charleston area is
9 currently being evaluated.

10 **Results of Sediment Sampling**

11 Metals and semivolatile organic compounds (SVOCs) detected in a sediment sample
12 collected from the sump pit, F109M0001, were compared to surface soil background
13 concentrations and surface soil RBCs, and soil-to-groundwater migration SSLs. The
14 sump pit does not drain to the storm drainage system; therefore, it would not be
15 compared to aquatic receptor criteria. The material in the sump pit had concentrations
16 within the same range as the adjacent surface soil concentrations, and no constituent
17 exceeded surface soil comparison criteria.

18 A sediment sample collected at F109M0002 within a catch basin approximately 150 feet
19 south of SWMU 109 contained sediment with abnormally high metals concentrations.
20 The high concentrations do not correspond to the surface soil concentrations at SWMU
21 109; the origin of this sediment is unknown. The following constituents exceeded
22 surface soil background values and sediment comparison criteria: chromium, copper,
23 lead, nickel, and zinc.

24 **Results of Groundwater Sampling**

25 Groundwater from two monitor wells located within the SWMU 109 area was sampled
26 for pesticides, PCBs, VOCs, SVOCs, and metals. Metals were the only constituents
27 detected. Except for iron, none of the metals identified in the soil (antimony, arsenic,
28 lead, or vanadium) was detected in the groundwater at concentrations exceeding
29 comparison criteria. Iron was detected at a maximum concentration of 1,740 micrograms
30 per liter ($\mu\text{g/L}$) below the approximate background concentration of 22,000 $\mu\text{g/L}$.

1 **2.1.3 Data Gaps**

2 **Soil**

3 Lead concentrations exceeding 400 mg/kg were detected north and east of the SWMU
4 in the 1999 sampling event conducted to evaluate SSLs. Lead was detected in the same
5 locations at concentrations below background during the 1996 RFI sampling. Additional
6 data in this area of the site are required to evaluate the higher concentrations.

7 **Sediment**

8 Although the metals concentrations of the sediment at 109M0002 do not consist (**are not**
9 **consistent?**) with the SWMU 109 surface soil metals concentrations, no alternate source
10 for the contamination appears to exist in the immediate vicinity. The metals
11 concentration of the blast media will be compared to the sediment concentrations to
12 evaluate if the blast media is a potential source. Sediment transported through the
13 sewers is being evaluated in the Zone J investigation.

14 **Groundwater**

15 No gaps have been identified in the groundwater data set.

16 **2.1.4 Proposed Sampling and Analysis**

17 Four additional soil borings are proposed to evaluate the elevated lead detected in the
18 northeast portion of SWMU 109. The proposed locations are shown in Figure 2.1-4. Soil
19 will be sampled at depths of both 0-1 foot and 3-5 feet below grade, and analyzed for
20 lead. Two samples of the blast media on the surface also will be collected from this area
21 and analyzed for RCRA metals. Samples will be collected and analyzed as detailed in
22 Section 3.0 of this WPA.

23 **2.2 AOC 607 – Former Dry Cleaning/Laundry Building 1189**

24 **2.2.1 General Description and Historic Usage**

25 AOC 607 is located in Zone F near the CNC boundary, west of Hobson Avenue and
26 approximately 250 feet from an off-base residential area. AOC 607 is surrounded by
27 lawns, playgrounds, and other light commercial/residential structures and land uses.
28 The AOC consists of a one-story building and surrounding area, as shown in Figure 2.2-
29 1. The former dry cleaning operation occurred from 1942 to 1986. From 1986 to closure
30 in 1995, only laundry operations were conducted. This site was designated an AOC
31 because of the potential for solvent contamination in the soil and groundwater. The

1 actual limits of impacted groundwater extend north and west of the AOC boundary, as
2 shown in Figure 2.2-1.

3 **2.2.2 Site Investigation Summary – Historic and Recent**

4 RFI samples consisted of soil borings, soil probe samples, direct-push groundwater
5 probe samples, and groundwater samples from permanent monitoring wells. Most
6 recently, soil gas and air samples were collected from within and surrounding the
7 adjacent Building 225, and additional wells have been installed. Also, water samples
8 were collected from the sewer (designated as "surface water" samples), and sediment
9 samples were collected from catch basins on the north and south sides of Building 1189.

10 RFI wells were installed in three water-bearing zones, identified as *shallow, intermediate,*
11 *and deep.* Potentiometric surface maps from all three zones indicate a general flow
12 direction towards a leaking sewer line located west of Building 1189. After identifying
13 tetrachloroethene (PCE) in the groundwater, EnSafe conducted a dual phase vacuum
14 extraction pilot study at the site and an aquifer pumping test of the lower zone (EnSafe,
15 June 2000).

16 Surface and subsurface soil at three sample locations were resampled to evaluate
17 leaching ratios for soil-to-groundwater migration SSL development. SSLs developed
18 from site-specific leaching ratios, in addition to DAF values, are listed in Appendix A.
19 Sample locations are shown in Figure 2.2-1.

20 Seven additional shallow groundwater wells screened in the shallow water-bearing
21 zone were installed in January 2001, in conjunction with soil gas and air sampling at the
22 adjacent Building 225. The well locations, designated as *proposed shallow wells,* are shown
23 in Figure 2.2-2. Soil gas and ambient air sampling are not part of this RFI.

24 **Results of Soil Sampling**

25 Ten soil borings were drilled and sampled at the site, collecting samples from 0-1 foot
26 and 3-5 feet below grade. Twelve additional locations were sampled solely for surface
27 soil. Direct-push technology (DPT) was used to collect soil samples at 64 locations at
28 various depths. In general, drilled soil samples were analyzed for VOCs, SVOCs, and
29 metals, while direct-push samples were analyzed only for VOCs and SVOCs.

30 BEQs were detected in the surface and subsurface soils at concentrations below the
31 base-wide background concentrations. No other VOCs, SVOCs, pesticides, PCBs, or

1 metals were detected at concentrations that exceeded both background and residential
2 RBCs in surface soils.

3 Trichloroethene (TCE), PCE, and vinyl chloride (VC) were detected in surface and
4 subsurface soil exceeding SSLs in the immediate area of Building 1189. PCE (SSL = 25
5 $\mu\text{g}/\text{kg}$) was detected at maximum concentrations of 317 $\mu\text{g}/\text{kg}$ in surface soil and 1,070
6 $\mu\text{g}/\text{kg}$ in subsurface soil. One soil probe sample at an unspecified depth contained PCE
7 at 2,200 $\mu\text{g}/\text{kg}$. TCE (SSL = 26 $\mu\text{g}/\text{kg}$) was detected at maximum concentrations of 2
8 $\mu\text{g}/\text{kg}$ in surface soil and 143 $\mu\text{g}/\text{kg}$ in subsurface boring samples. Finally, VC (SSL =
9 3.8 $\mu\text{g}/\text{kg}$) was detected at maximum concentrations of 211 $\mu\text{g}/\text{kg}$ in surface soil and
10 34 $\mu\text{g}/\text{kg}$ in subsurface soil.

11 The areal extent of PCE, TCE, and VC in soil exceeding SSLs has been delineated by the
12 direct-push borings surrounding Building 1189. It is likely that the CVOCs (chlorinated
13 volatile organic compounds) in soil extend to the water table.

14 **Results of Sediment Sampling**

15 Traces of CVOCs were detected in the sediment samples; concentrations were reported
16 near the detection limits. SVOCs were primarily PAHs; BEQs from the sediment
17 samples ranged from 2.6 mg/kg to 57 mg/kg.

18 Metals detected in the sediment samples were primarily within the background
19 concentration range for the Zone F surface soils. Exceptions to this include cadmium,
20 copper, lead, nickel, vanadium, and zinc.

21 Subsequent to the sampling event, this sediment was removed by the U.S. Naval
22 Detachment (Detachment).

23 **Results of Water Sampling**

24 Three water samples collected from the sewer manholes were analyzed for VOCs. PCE,
25 TCE, and degradation products were detected in the samples, with PCE concentrations
26 as high as 1,300 $\mu\text{g}/\text{L}$. This represents infiltration into the sewer of impacted
27 groundwater.

28 **Results of Groundwater Sampling**

29 PCE has been detected in the groundwater at concentrations indicative of both
30 dissolved and undissolved products. PCE and daughter products TCE, DCE, and VC
31 are primarily measured beneath Building 1189 and east of Building 225. Total VOC
32 concentrations measured between 1996 and 1999 are delineated on Figure 2.2-3 (CH2M-

1 Jones, 2000). A sewer line separating Building 1189 from Building 225 appears to be the
2 limiting edge of the contaminant plume in the westward direction.

3 Dissolved CVOCs in the shallow groundwater were detected once in monitor well
4 F607GW003, west of Building 225. Between 1996 and 2000, the well had been sampled
5 nine times, with detections of TCE (1 J $\mu\text{g}/\text{L}$) and PCE (25 $\mu\text{g}/\text{L}$) from the sixth
6 sampling event on June 30, 1999. Previous and subsequent sampling events had not
7 detected CVOCs above reporting limits. The well is within 150 feet of the property line
8 adjacent to a residential area. CVOCs have not been detected above reporting limits in
9 groundwater sampled from wells screened in a deeper water-bearing zone west of well
10 F607GW003.

11 Lead was detected at concentrations exceeding background and MCLs in the perimeter
12 wells, primarily screened in the deeper water-bearing zone. Lead concentrations
13 generally ranged up to 70 mg/kg, with one exception of 245 mg/kg at well F607GW002,
14 on the eastern edge of the site. The elevated lead result was from the first quarter
15 sampling event; lead was not detected at that well during the other sampling events,
16 nor was lead detected in the groundwater from monitor wells closer to the AOC. In
17 addition, site soil samples did not contain lead concentrations above background levels.
18 This one lead result appears to be an anomaly and is not representative of groundwater
19 at the well location or at the site in general.

20 **2.2.3 Data Gaps**

21 **Soil and Sediment**

22 No data gaps have been identified with respect to soil contamination. CVOCs with
23 concentrations greater than SSLs have been delineated within the surface and
24 subsurface soils. Sediment from the catch basins has been removed from the site.

25 **Groundwater**

26 A single detection of PCE in F613GW004, the westernmost monitor well screened in the
27 shallow water-bearing zone, indicates the possibility that the plume may not be totally
28 delineated to the west. Although no VOCs were detected from 11 samples taken from
29 groundwater probes west of Building 225, no permanent monitor well was screened in
30 the shallow water-bearing zone adjacent to the residential area. Data from such a well
31 could be used to evaluate the extent of any contaminants that may be identified near
32 Building 225.

2.2.4 Proposed Sampling and Analysis

As Figure 2.2-2 indicates, seven additional wells have been recently installed at AOC 607 in the shallow water-bearing zone. Two of the wells are located along Avenue D, west of Building 225. These wells will be sampled to evaluate the western edge of dissolved CVOCs. Two sampling events are proposed to complete the delineation; one round of samples was collected in January 2001.

To further evaluate the elevated lead measurement in groundwater at the eastern edge of AOC 607, monitor well F607GE002 will be resampled once for lead analysis.

Sample collection and analysis are detailed in Section 3.0 of this WPA.

2.3 AOC 609 – Service Station, Building 1346

2.3.1 General Description and Historical Usage

AOC 609 is the site of Building 1346, a former automotive maintenance facility, including a former waste oil underground storage tank (UST) and ancillary piping. The facility was operated within the northern section of existing Building 1346.

Historical service station activities in the AOC 609 area include those of Building 1262, the Navy Exchange Service Station, located southeast of Building 1346. Building 1262 was constructed during the early 1950s. Based on review of aerial photographs, a series of aboveground storage tanks (ASTs) were installed adjacent to this building, which were apparently used for storage of fuels, oils, etc. Building 1262 was dismantled to provide space for construction of Building 1346 in 1962. The former location of Building 1262 is illustrated in Figure 2.3-1.

A series of five USTs, all constructed of steel and used to store motor fuel, were installed at the site in the early 1960s (one 10,000-gallon tank and four 4,000-gallon tanks). The tanks were removed in 1978 and replaced with three new 10,000-gallon steel tanks. A 550-gallon waste oil UST was also added in 1978. The USTs were removed from service in 1991 after a tank tightness test revealed a leak(s) in the system. Three new 10,000-gallon fiberglass units were installed in 1991 that, at the time of this writing, are present; however, fuel dispensing is no longer practiced at the site.

Releases associated with the fuel USTs are designated "Site 25." The releases have been investigated in conjunction with the SCDEHC UST program. Therefore, Site 25 issues do not pertain to the subject discussion of AOC 609. Further information regarding Site 25

1 is included in the *Rapid Assessment Report for Site 25, Building 1346* (Tetra Tech NUS, Inc.
2 [TTNUS], January 2000). A corrective action (CA) plan for Site 25 is under development
3 by CH2M-Jones.

4 Release(s) associated with the 550-gallon waste oil tank are designated "Site 24" and are
5 the sole investigative sources for AOC 609. The waste oil tank was removed in 1996. The
6 UST received waste oil from a series of drains inside the maintenance garage of Building
7 1346. The tank was inspected upon removal and observed to be in good condition.
8 However, a loose connection and stained soil was noted in the conveyance piping from
9 maintenance garage drains, about 4 feet from the tank. Both the tank and conveyance
10 piping were extracted in a single excavation.

11 AOC 609 is located west of Hobson Avenue. Future use of this area may potentially be
12 considered residential. Currently, almost 100 percent of AOC 609 is paved.

13 **2.3.2 Historical Site Investigation Summary**

14 All soil boring and monitor well locations described in the text that follows are depicted
15 in Figure 2.3-1.

16 **Results of Soil Sampling**

17 Ten soil samples were collected by the Supervisor of Shipbuilding, Conversion and
18 Repair, USN, Portsmouth Environmental Detachment, Charleston, SC
19 (SPORTENVDETHASN) during removal of the waste oil UST in 1996. Samples were
20 collected at approximately 7 feet below grade within the tank pit area and
21 approximately 4 to 5 feet below grade within the conveyance piping corridors. Soil
22 samples collected during the SPORTENVDETHASN assessment were analyzed for
23 metals; benzene, toluene, ethylbenzene, and xylene (BTEX); SVOCs; and total petroleum
24 hydrocarbons (TPH). Analytical results for these samples are summarized in the *UST*
25 *Assessment Report* prepared by SPORTENVDETHASN, dated September 1996. With
26 the exception of naphthalene (detected at less than applicable SSLs), BTEX and SVOCs
27 were not detected in any of the ten soil samples submitted for analysis. Low levels of
28 arsenic, chromium, and lead were detected at concentrations less than applicable SSLs.

29 Six soil borings (609SB001 through 609SB006) were advanced during EnSafe's 1996-1997
30 RFI to assess soil quality in the area of the former waste oil UST and conveyance piping.
31 The locations of these borings are presented in Figure 2.3-1. Surface (0-1 foot bgs) and
32 subsurface (3-5 feet bgs) samples were collected from borings 609SB001, 609SB002,

1 609SB003, and 609SB005. Surface samples only were collected from 609SB004 and
2 609SB006. Laboratory analysis included metals, VOCs, and SVOCs.

3 In 1999, EnSafe advanced six additional soil borings (609SB007 through 609SB012) in the
4 area of the former waste oil UST in an attempt to delineate metals impacts in shallow
5 soil. Each boring included surface and subsurface sampling. All samples were analyzed
6 only for metals. EnSafe also performed a synthetic precipitation leaching procedure
7 (SPLP) evaluation that included the installation of new borings in areas 609SB001 and
8 609SB002, identified during the 1996 investigation.

9 Concentrations of PAHs exceeding background BEQ levels established by CH2M-Jones
10 were not detected in any surface or subsurface soil samples. Furthermore, no VOCs
11 were detected at concentrations exceeding applicable RBCs or SSLs.

12 Antimony, arsenic, copper, and lead were identified in soil at concentrations exceeding
13 applicable Zone F background, SSL, and/or residential RBC values. All of these metals
14 were delineated to respective background, SSL, and/or residential RBC values within
15 Zone F during EnSafe's 1999 assessment; therefore, no further investigation is required.

16 **Results of Groundwater Sampling**

17 In 1996, Soil and Materials Engineers (SME) installed seven monitor wells surrounding
18 the building, SMEGW001 and SMEGW003 through SMEGW008. The wells were
19 installed to a depth of approximately 12 feet below grade, with the exception of
20 SMEGW006, which was installed to approximately 30 feet. SMEGW001 and
21 SMEGW003 through SMEGW008 were sampled once in late 1996, then quarterly
22 beginning in May 1997 to November 1997 (four sampling events total). During the 1996
23 sampling event, all samples were analyzed for metals, pesticides/PCBs, VOCs, SVOCs,
24 and cyanide. Pesticides/PCBs and cyanide were eliminated from the target parameter
25 list during subsequent events.

26 Four existing monitor wells, designated TTNUS-MW01 through TTNUS-MW-04, were
27 installed by TTNUS in 1999. All wells were installed to a depth of approximately 12 feet
28 below grade. A fifth, deeper well (TTNUS-MW05D) was also installed in 1999. TTNUS-
29 MW01 through TTNUS-MW05D were sampled in September 1999. All samples were
30 analyzed for metals, PAHs, and BTEX/ methyl tributyl ethylene (MTBE).

31 EnSafe also installed two additional shallow wells (609GW001 and 609GW002) in 1999
32 at the southern periphery of the site to define Site 25 impacts. Both wells were sampled

1 in May 1999 for the following parameters: metals, pesticides/PCBs, SVOCs, and VOCs.
2 609GW001 and 609GW002 were resampled in October 1999 only for metals and VOCs.

3 It is important to note that a distinct groundwater VOC/SVOC plume associated with
4 the historical fuel release(s), located at the south side of Building 1346 (SMEGW005
5 area), exists at the site. This is not associated with the historical waste oil release(s),
6 located to the northwest of Building 1346 (SMEGW004 area). The fuel plume (Site 25)
7 will be addressed in accordance with the SCDHEC UST program and is not considered
8 relevant to the AOC 609 investigation.

9 Aluminum has been detected at concentrations exceeding the MCL (200 µg/L) in two
10 wells, SMEGW001 and SMEGW007, located at the extreme east and west periphery of
11 the site. The presence of aluminum in isolated areas is not attributable to the historical
12 waste oil release, but rather to turbid groundwater, characteristic of silty clay conditions
13 that predominate in the shallow subsurface. The concentration of aluminum in
14 SMEGW004, located near the source area, was significantly less than the MCL during all
15 four sampling events performed by EnSafe. No further investigation of aluminum is
16 necessary.

17 Arsenic has been detected exceeding Zone F background concentrations (16.2 µg/kg)
18 and the MCL of 10 µg/L in several shallow groundwater wells at the site. The arsenic
19 "plume" does not correlate to the waste oil UST as a possible source (i.e., there is no
20 trend of higher concentrations radiating outward from the former waste oil UST). The
21 maximum concentration of arsenic, 105 µg/L, was detected in 609GW002, located at the
22 extreme southeast corner of the site. Arsenic appears to be randomly distributed, with
23 considerable fluctuation in concentration occurring over the course of the four sampling
24 events conducted by EnSafe. These results are likely attributable to the presence of
25 dredge fill material in the shallow subsurface. Accordingly, arsenic impacts will be
26 addressed base wide. No further attempt to "delineate" the extent of arsenic is necessary
27 at AOC 609.

28 **2.3.3 Data Gaps**

29 No data gaps with regard to soil or groundwater impacts at AOC 609 were identified.

30 It should be noted that an NFA letter has been issued for Site 24 by the SCDHEC
31 Groundwater Quality Section, Bureau of Water, based on review of the *Final Assessment*
32 *Report* (TTNUS, February 2000). A copy of the letter, dated March 2000, is included in
33 Appendix D.

2.4 AOC 611 – Grease Rack and Hobby Shop, Former Building 1264

2.4.1 General Description and Historic Usage

AOC 611 is the site of former Building 1264, which was used as an automotive hobby shop housing a grease rack. The structure used for vehicle maintenance was located at the intersection of Beatty Street (previously called Enterprise Avenue) and Borie Street, west of Hobson Avenue. The building site is currently unpaved, with a concrete transformer vault near its northeast corner. A portion of the currently defined AOC boundary extends into the paved intersection. The hobby shop was in use from the 1950s to the 1960s. Materials potentially released at the site include petroleum products, solvents, degreasers, paints, and lead.

North of AOC 611 is Building 1346, a former service station. Approximately 100 feet to the northeast of AOC 611, a groundwater remediation system is in operation, which is associated with a fuel release from a former service station near Building 1346 (Site 24).

2.4.2 Historic Site Investigation Summary

Seven soil borings were advanced at AOC 611 in 1996/1997; soil samples from 0-1 foot and 3-5 feet below grade were analyzed for metals, VOCs, and SVOCs. These sample locations were labeled F611SB001 through F611SB007, and are shown on Figure 2.4-1. Elevated levels of PAHs and metals were detected in the surface soil, and, in 1997, the Environmental Detachment (SPORTENVDETHASN) performed an IM soil removal at AOC 611. The surface soil from locations F611SB001, F611SB002, F611SB006, and F611SB007 was removed and replaced as a result of the IM.

After the IM, additional samples from locations F611SB008 through F611SB014 were collected for RFI metals analysis. The surface and subsurface soil samples were located south of the AOC, beneath the road and in the lawn area south of Borie Street. In addition, subsurface soil at two sample locations (F611SB001 and F611SB002) was resampled for cyanide, VOCs, SVOCs, pesticides/PCBs, and metals, along with SPLP of those parameters, to evaluate leaching ratios for soil-to-groundwater migration of SSL development. SSLs developed from site-specific leaching ratios, in addition to DAF values, are listed in Appendix A.

As part of the SWMU 037 and AOC 699 investigations, two surface soil samples were collected using DPT near the eastern edge of the lawn area south of Borie Street. These

1 samples were located at the outer edge of the sampling area identified for AOC 611.
2 Samples were analyzed for cyanide, metals, and VOCs.

3 **Results of Soil Sampling**

4 BEQs were detected in the surface soils at concentrations within background levels
5 except at F611SB006, near the eastern edge of the unpaved area. BEQ concentrations also
6 exceeded SSLs for benzo(a)anthracene and benzo(b)fluoranthene in surface soil at
7 F611SB006. This area was subsequently remediated during the IM. However, BEQs were
8 not delineated in the southeastern direction from F611SB006. Other SVOCs and VOCs in
9 both surface and subsurface soil did not exceed residential RBCs or SSLs.

10 PCBs were analyzed from a duplicate surface soil sample obtained from F611SB007
11 before the IM. An Aroclor-1260 concentration of 370 µg/kg was detected, which was
12 above the RBC of 320 µg/kg. Two subsurface soil samples (3-5 feet below grade)
13 beneath the IM area were analyzed for PCBs; none were detected. PCBs were not
14 analyzed as part of the IM confirmation sampling.

15 Dioxins were detected in the duplicate sample (F611SB007) within or below the same
16 order of magnitude as the RBCs; these compounds are not related to site usage;
17 therefore, further delineation is not warranted.

18 Metals concentrations in the 1996/1997 surface soil samples exceeded comparison
19 criteria at several locations within the IM area. The area of elevated concentrations of
20 arsenic, copper, cadmium, and mercury was delineated by adjacent samples with
21 concentrations below comparison criteria. However, lead was detected as high as 567
22 mg/kg, compared to RBC of 400 mg/kg and background of 180 mg/kg. Lead was not
23 delineated in the northern or eastern directions. Lead concentrations in surface soil and
24 IM confirmation samples are presented in Figure 2.4-2.

25 Arsenic, chromium, and vanadium concentrations that slightly exceeded comparison
26 criteria (above background levels and residential RBCs) were detected at LF699SP023.
27 These elevated concentrations are bounded toward AOC 611 by other soil samples
28 within acceptable criteria; it is concluded that they are not related to past operations at
29 AOC 611.

30 **2.4.3 Interim Measures for AOC 611**

31 IMs, described in the *Completion Report, Interim Measure for AOC 611*,
32 SPORTENVDETCHASN, January 29, 1998, included removal of approximately 280

1 cubic yards of RCRA Metals and PAH-contaminated surface soil. The area excavated
2 and removed measured approximately 75 feet by 100 feet by 1 foot in depth,
3 encompassing the entire unpaved area near the previous hobby shop location, shown in
4 Figure 2.4-1. Confirmatory samples obtained from the base of the excavation indicated
5 two exceedances of arsenic and benzo(a)pyrene above RBCs; therefore, additional soil
6 was removed and the areas were resampled.

7 Concentrations of arsenic and benzo(a)pyrene in the resampled areas were below
8 background values. Some confirmation samples were diluted due to matrix interference,
9 most likely from petroleum compounds not included in the PAH list. This dilution did
10 not effect the delineation effort because the maximum possible BEQ content calculated
11 for these samples, using the higher (non-detect) reporting limits, was less than the base-
12 wide background BEQ concentration.

13 Subsurface soils were not addressed by the IM. In addition, IM confirmation samples
14 were not analyzed for PCBs, although PCBs would not be expected to migrate
15 significantly through the soil.

16 **2.4.4 Data Gaps**

17 The following data gaps have been identified with regard to the existing RFI sampling:
18 Lead concentrations exceeding background concentrations (180 mg/kg) and the RBC of
19 400 mg/kg were detected within the IM area and were not delineated to the north or
20 east.

21 BEQs were identified at concentrations exceeding background values only at the eastern
22 edge of the area subsequently removed during the IM, at sample F611SB006. No
23 samples were collected east or northeast of this area to delineate BEQs.

24 Aroclor-1260 was detected in a duplicate sample at 370 mg/kg, above the 320 mg/kg
25 RBC. The soil from this sample area was removed during the IM. PCBs were not
26 delineated during the RFI sampling, nor were they analyzed from the IM confirmation
27 samples.

28 **2.4.5 Proposed Sampling and Analysis**

29 To delineate lead concentrations to the north and east of the IM area, three locations will
30 be sampled for surface (0-1 foot) and subsurface (3-5 ft) soil and analyzed for lead. The
31 lead concentrations have been delineated to the south and west.

1 To complete the delineation of BEQs above background concentrations, two borings are
2 proposed to sample surface soil for PAH analysis. These borings will be located
3 northeast of the IM area, and southeast of Borie Street.

4 Five surface soil samples are proposed to delineate PCBs at AOC 611, surrounding the
5 IM area. Three samples within the IM area also will be collected at the approximate
6 elevations of the base of the excavation (1-2 feet below current grade). Because of the
7 relatively immobile nature of PCBs, deeper subsurface samples will not be collected at
8 any of these locations. If PCBs are detected above comparison criteria, additional
9 horizontal and lateral delineation will be conducted.

10 Therefore, a total of eight soil borings will be sampled: two for surface soil only (0-1
11 foot); three for shallow subsurface soil only (1-2 feet below grade); and three for both
12 surface and subsurface soil (0-1 foot and 3-5 feet below grade). Samples will be collected
13 and analyzed using methods described in Section 3.0 of this WPA. Proposed sample
14 locations are shown in Figure 2.4.3.

15 **2.5 AOC 613/AOC 615/SWMU 175 – Old Locomotive Repair** 16 **Shop, Former Building 1169; Old Chain Locker, Building** 17 **1391; and Crane Painting Area Near Building 1277**

18 **2.5.1 General Description and Historic Use**

19 **AOC 613**

20 AOC 613 is the site of former Building 1169, a locomotive and crane repair shop at the
21 present location of Building 242. The shop operated from the 1930s until 1985, when the
22 building was demolished. Maintenance activities included changing oil, repairing
23 hydraulic systems, and equipment overhaul. Materials potentially released included oil,
24 grease, diesel fuel, and cleaning solvents.

25 **AOC 615**

26 AOC 615 is the site of the former Building 1391, located adjacent to and southeast of
27 Building 1169. The chain locker was used to store and service anchor chain between
28 1970 and 1977. Epoxies and resins were stored in large tanks on site; epoxy and resin
29 wastes were also reportedly stored in drums behind the building.

1 **SWMU 175**

2 SWMU 175 is the former crane painting area, located on an asphalt-paved road
3 northeast of Building 1170 and southwest of Building 1277. The area was used to repaint
4 cranes used throughout the pier area. SWMU 175 was investigated to evaluate a
5 possible release of blast media, paint constituents, heavy metals, and solvents.

6 **Locations and Characteristics of AOC 613/AOC 615/SWMU 175**

7 These three sites are located to the east of Hobson Avenue (see Figure 2.5-1) in a highly
8 industrial area and are anticipated to continue with industrial use in the future. The
9 Zone E/F boundary is located near the centerline of SWMU 175; several of the
10 combined site sample locations are within Zone E. The combined site area is
11 approximately five percent unpaved (lawn or gravel/dirt surface), with new Buildings
12 242 and 1170 occupying approximately one third of the area.

13 Several USTs and OWSs are located within the AOC 613/615/175 area. USTs near
14 Buildings 242, 240, and 1170 have been closed or are currently under investigation.
15 TTNUS conducted a rapid assessment (RA) on the UST at Building 242, Site 22, as part
16 of the SCDHEC UST Program. Contaminants associated with the waste oil UST include
17 benzene (maximum detected concentration 56 µg/L) and MTBE (maximum detected
18 concentration 42 µg/L); PAHs were not detected, and RCRA metals concentrations were
19 below MCLs. *The Sampling and Analysis Plan for Zone F/Site 22 – Building 242*, August
20 2000, has been submitted by CH2M-Jones. Additional RAs have been conducted at Site
21 20, located near Building 240, and at Site 23, located southwest of Building 242.

22 Four OWSs are or were located adjacent to Building 242 within the AOC 613 area,
23 named OWS Building 241-B, OWS Building 241-C, OWS Building 241-D, and Tank
24 Building 242. It should be noted that Building 241 is located north of AOC 613, outside
25 of the area of investigation. OWS Building 240 is inside Building 240, at the southern
26 end of AOC 615. Figure 2.5-2 shows the locations of the current or former OWSs within
27 AOC 613/615/175.

28 **2.5.2 Historic Site Investigation Summary**

29 The area was initially investigated as part of a baseline environmental evaluation in
30 1966. After petroleum product was discovered in a monitoring well, the area was
31 considered under the SCDHEC petroleum program and as part of the fuel distribution
32 system (FDS) investigation.

1 Initially, RFI sampling involved soil and groundwater samples from 65 direct-push
2 locations over a grid area on approximate 50-foot centers, excluding the buildings. The
3 soil samples were analyzed for metals, VOCs, and SVOCs. Most of the groundwater
4 probe samples were also analyzed for analyzed for metals, VOCs, and SVOCs;
5 approximately one-quarter of them were analyzed for VOCs only.

6 Direct-push probes from five additional locations within the AOC 613/615/175 area
7 were sampled for soil in conjunction with the utility corridor investigation, SWMU 37.
8 Soil data from these samples include metals and VOCs. Three of the original AOC 613
9 RFI locations were resampled, at surface and subsurface depths, for the SPLP
10 evaluation. Direct-push probes from 11 SWMU 37 and AOC 699 locations in the AOC
11 613/615/175 area were sampled for groundwater and analyzed for metals and VOCs.

12 Soil borings were sampled at 29 locations for the AOC 613/615/175 RFI. Five additional
13 borings in the area were installed for the FDS study, and five for the AOC 504
14 investigation. The AOC 504 and FDS samples were analyzed for herbicides, pesticides,
15 PCBs, metals, VOCs, and SVOCs, and some for TPH. The AOC 613 locations were
16 sampled at 0-1 foot and 3-5 feet below grade, and analyzed for metals and SVOCs.

17 Two sediment samples were collected from the stormwater catch basins, and analyzed
18 for metals, VOCs, and SVOCs.

19 Two FDS wells were installed within the SWMU 175 area, labeled FDSGW17A and
20 FDSGW17B. The wells are considered for the Zone F and Zone G investigations, and
21 have used both "F" and "G" designations in their label prefixes. General Engineering
22 Laboratories, Inc. installed eight groundwater wells as part of the site assessment in the
23 AOC 613/615/175 area; the wells are labeled GELGW014; GELGW012; GELGW013;
24 GELGW008; GELGW005; GELGW006; GELGW007; and GELGW011. Well GELGW014
25 is also prefixed for Zones F and G; the other GEL wells are prefixed "F."

26 Eight groundwater wells were installed by EnSafe for the AOC 613/615/175 RFI,
27 screened in the shallow water-bearing zone. These are labeled F613GW001 and
28 F613GW003 through F613GW008, and F240GW003. Monitor well F613GW02D is
29 screened in the lower water-bearing zone.

30 Groundwater monitor wells were also installed by the CNC at three UST areas within
31 the AOC613/615/175 area of investigation. Data from these wells have not been
32 reviewed for the purposes of this RFI, and the wells are not shown in Figure 2.5-1.

1 RFI monitor wells were sampled between one and six times between November 1996
2 and November 1999. Samples were analyzed for VOCs, SVOCs, and metals, with
3 F613GW006 also being sampled for pesticides and PCBs in 1999.

4 **Results of Sediment Sampling**

5 Sediment samples contained SVOCs, primarily BEQs within the range of background
6 concentrations identified for surface soil at the CNC. Metals concentrations were similar
7 to surface soil background levels.

8 **Results of Soil Sampling**

9 **VOCs**

10 VOCs were detected at low levels in the soil probe and soil boring samples. CVOCs
11 were detected in 13 samples, all lower than RBCs. Soil concentrations measured from
12 probe samples and soil borings were compared with site-specific SSLs, and are listed in
13 Appendix A. Methylene chloride and 1,1,2,2-tetrachloroethane concentrations exceeded
14 SSLs in three isolated samples. Methylene chloride was detected in one of six samples
15 collected at GELGW014 but not at other site wells. 1,1,2,2-tetrachloroethane has not been
16 detected in groundwater from any monitor wells at the site. VOCs do not need further
17 delineation in surface or subsurface soil at AOC 613/615/175.

18 **SVOCs**

19 BEQs were detected in the surface soils at concentrations within background levels
20 except in the following three areas: 1) at F613SB009 east of SWMU 175, with BEQ at 2042
21 µg/kg; 2) at F613SP051 along railroad lines in AOC 615 (1775 µg/kg); and 3) at
22 F613SB001 and F613SB022 near the northwest corner of AOC 613, remote from known
23 AOC 613 activities (maximum BEQ = 1772). The first two areas have been delineated to
24 background levels, but the third area has not been sampled to the southwest of the
25 elevated values. These areas are shown in Figure 2.5-3.

26 Subsurface soil from location F613SP022 contained benzo(a)anthracene, dibenzofuran,
27 and 2-methylnaphthalene concentrations in excess of SSLs. This location is between
28 Buildings 242 and 255; the elevated concentrations have been delineated. In addition,
29 benzo(a)anthracene was measured above SSLs at F613SP051; this area also has been
30 delineated. These compounds have not been detected in groundwater from wells in the
31 vicinity F613SP022 or F613SP051.

1 **Metals**

2 Metals that exceeded screening criteria (Zone F background and residential RBC
3 concentrations) in surface soil samples, both from direct-push samples and from soil
4 borings, were aluminum, antimony, arsenic, copper, iron, lead, mercury, thallium, and
5 vanadium. Iron is a component of the soils in Zone F and is an essential nutrient;
6 therefore, iron will not be further evaluated at AOC 613/615/175. Aluminum,
7 antimony, copper, mercury, thallium, and vanadium concentrations were all less than
8 the industrial RBC. In this industrial site, which extends into Zone E, the industrial
9 RBCs are appropriate screening criteria for these metals.

10 Arsenic was detected above background levels in many areas of the CNC and does not
11 appear related to SWMU or AOC activities. The apparently ubiquitous occurrence of
12 arsenic of soils and groundwater in the Charleston area is believed to be naturally
13 occurring. The provenance of arsenic in the South Carolina Coastal Plain and in the
14 Charleston area is currently being evaluated. Arsenic with concentrations as high as 69.9
15 mg/kg, compared to the Zone F background value of 19.9 mg/kg and Zone E
16 background concentration of 23.9 mg/kg, was measured at various areas throughout
17 AOC 613/615/175. Along the northern edge of the AOC 613 area of investigation,
18 samples contained arsenic as high as 24.1 mg/kg, statistically equivalent to the Zone E
19 background concentration of 23.9 mg/kg. Further delineation of arsenic is warranted
20 only in the area of F613SP024, as shown in Figure 2.5-4.

21 From approximately 100 soil samples, four surface samples contained lead
22 concentrations above Zone F background values (180 mg/kg), with one sample
23 (F613SB002) above the 400 mg/kg RBC, at a concentration of 3,980 mg/kg. This lead
24 value is not representative of the general area in which it was detected and has been
25 bounded on all sides by samples with lead concentrations below the RBC. One
26 subsurface soil sample, at F613SB026, contained lead concentrations above the 400
27 mg/kg SSL, at 6,620 mg/kg. This sample was located approximately 1,000 feet away
28 from the location with the elevated surface soil concentration; groundwater near
29 F613SB026 has not shown elevated lead concentrations. This measurement appears to be
30 an anomaly at the site; therefore, no further delineation of lead concentrations is
31 warranted at AOC 613/615/175.

32 Surface soil and subsurface soil samples from both borings and probes were also
33 compared to site-specific SSLs. The sample from F613SP027 contained antimony at 15.6
34 mg/kg in surface soil, compared to SSL of 6.7 mg/kg. Antimony concentrations in

1 samples surrounding this location were below the SSL; this area has been delineated.
2 Lead concentrations above the 400 mg/kg SSL are discussed in the preceding
3 paragraph. Groundwater data from the site do not indicate antimony or lead
4 concentrations in excess of MCLs.

5 **Results of Groundwater Sampling**

6 **VOCs**

7 Chlorinated solvents and daughter products (PCE, TCE, 1,1-DCE, 1,2-DCE, and VC)
8 were identified near the center of the site at 613GP039 and 613GW004, and at the north
9 side of the site. At AOC 613, Geoprobe samples collected in 1996 during the RFI
10 contained relatively large amounts of solvents in an isolated area near the center of the
11 site (613GP039), and minor amounts at the north side. Groundwater monitoring wells
12 installed near 613GP039 contained constituents at concentrations 2 orders of magnitude
13 lower than the probe samples. Samples from groundwater monitoring wells installed at
14 the north side revealed very limited concentrations, showing similar reductions in
15 concentration. Figure 2.5-5 shows the areas with detected PCE, TCE, and 1,2-DCE,
16 concentrations.

17 The Environmental Baseline Study performed by GEL reported petroleum product in
18 monitoring well GELGW014, near the buried fuel lines. The first RFI sample collected
19 from this well contained benzene at 3,800 µg/L and toluene at 4,900 µg/L. The
20 concentration of benzene likely resulted from a release of light petroleum product from
21 the fuel line, rather than from heavier oils or greases potentially released from the
22 locomotive repair shop.) Subsequent samples from this and adjacent wells contained
23 benzene concentrations no greater than 4 µg/L. As shown in Figure 2.5-6, benzene has
24 been delineated in groundwater. Toluene was detected only once at this well, although
25 it has consistently been detected in the deeper well 613GW02D at concentrations no
26 greater than 24 µg/L (compared to the MCL of 1000 µg/L). Benzene is adequately
27 delineated at this site.

28 **SVOCs**

29 One detection of pentachlorophenol at 2J µg/L (compared to the typical reporting limit
30 of 50 µg/L) was identified at well GEL013 during one of four sampling events. This
31 detection was not reproduced in other sampling events, nor was the compound detected
32 in any other site well or Geoprobe location. As such, this single detection is not
33 considered sufficiently significant to warrant further delineation of this compound.

1 PAHs, consisting of 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene,
2 phenanthrene, and pyrene, were all detected in the first sampling event at GELGW014
3 at concentrations indicative of fuel product. Subsequent sampling events contained
4 these compounds at concentrations 3 to 4 orders of magnitude lower than the first
5 sampling event. These PAHs, along with naphthalene, are concentrated around the area
6 defined by GEL014 and 613GW006. In addition, naphthalene has been identified at low
7 concentrations at the southern edge of the site, defined by area GEL005 and 613GP065.
8 These two areas are bounded by samples that have no detected SVOCs above screening
9 criteria and have been adequately delineated.

10 **Metals**

11 A number of metals were detected at various sampling events, with exceedances of
12 RBCs and background values. Of these, Al, Sb, Cd, Cr, Pb, Tl, V, and Zn occur at
13 extremely variable concentrations, not reproducible over time. This pattern of variability
14 could be attributed to naturally occurring metals in the aquifer's clayey soils; fine soil
15 particles could have been inadvertently included in the samples. Therefore, no further
16 delineation is recommended for these metals.

17 Manganese was also detected in excess of MCLs and background concentrations.
18 Manganese is a major component of the clayey soils in this area and is naturally
19 occurring at variable concentrations. For example, the highest concentration detected at
20 the site, 7,940 µg/L, was detected at 613GW001 on September 4, 1997. Of interest is that
21 the subsequent sampling event at that location contained groundwater with manganese
22 at 51 µg/L. Because manganese is naturally occurring in the site clays and the
23 detections are not consistent, no further delineation of this metal is recommended.

24 Arsenic was detected at concentrations in excess of background concentrations near the
25 northeast corner of the site, at well locations GELGW014 and FDSGW17B, shown on
26 Figure 2.5-3. This area is bounded by monitoring wells that have routinely recorded
27 concentrations within or less than the background levels. The groundwater in the
28 southwest corner of the site also had sporadic exceedances of background values.
29 Therefore, further review of arsenic is recommended as part of the base-wide
30 consideration of naturally occurring arsenic.

31 Iron was likely released at this site, although it is also a naturally occurring metal in the
32 aquifer's clay soils. Concentrations of iron in excess of the background (22,300 µg/L)
33 were detected at GELGW011 and 613GW005, near 11th Street to the south. However,
34 these concentrations do not appear to be related to site operations (i.e., high

1 concentration area is remote from the source area). An additional exceedance area near
2 613GW006 and GELGW014 appears to be bounded by other wells with samples near or
3 below background values. Therefore, no further delineation of iron in groundwater is
4 recommended.

5 **2.5.3 Data Gaps**

6 **Soil**

7 BEQs have been determined to be within background levels at AOC 613/615/SWMU
8 175, except for a few isolated areas. These areas have been delineated, with the
9 exception of the area around F613SB002. Additional surface soil samples to the west of
10 this area are needed to bind the area of elevated BEQs.

11 Sample locations along the northern edge of AOC 613 have shown concentrations of
12 aluminum, arsenic, chromium, and vanadium in surface soil in excess of Zone F
13 background concentrations and residential RBCs. However, AOC 613/615/175,
14 extending into Zone E, is located in a highly industrial area that is anticipated to remain
15 industrial. The concentrations fall within Zone E background concentrations and
16 industrial RBCs; therefore, further evaluation of metals in this area is not required.

17 Other areas with arsenic exceeding background concentrations have been delineated,
18 with the exception of location F613SP024 along the western edge of AOC 613. Arsenic at
19 this location was measured at 44.8 mg/kg, compared to background concentrations of
20 19.9 mg/kg and 23.9 mg/kg. Arsenic has not been delineated to the west of F613SP024.

21 **Groundwater**

22 CVOCs have been intermittently identified along the north edge of AOC 613, in
23 monitoring wells in the central section of the site. Relatively large concentrations of
24 TCE, PCE, and DCE identified at F613GP039 in 1996 were not reproduced in adjacent
25 well F613GW004. Although direct-push groundwater samples collected northeast of this
26 area did not reveal CVOCs, there is no permanent monitoring well in that direction, in
27 the SWMU 175 area. However, traces of TCE and decomposition products were
28 identified in probe samples northwest of F613GP039, between Buildings 242 and 1174.
29 Monitoring wells in this vicinity should be sampled to evaluate current concentrations.

30 Concentrations of inorganic elements in the groundwater have been variable and could
31 be caused by particulates in the samples. These concentrations are not reproducible over
32 time and therefore are not indicative of releases from the AOCs or SWMU. Arsenic has

1 been routinely identified at concentrations above background near the northern corner
2 of SWMU 175, although these concentrations are also variable. The area of elevated
3 arsenic in groundwater at these sites has been delineated. Arsenic will be reviewed
4 under the base-wide considerations, and will not be further evaluated at AOC
5 613/615/175.

6 **OWSs**

7 Five OWSs were located within the area of AOC 613/615/175, shown on Figure 2.5-2.
8 With the exception of OWS 241-D at the north corner of Building 242, RFI samples have
9 been collected within 5 to 30 feet of each unit. Groundwater samples from direct-push
10 probes or from monitoring wells have been collected near the separators, and analyzed
11 for VOCs, SVOCs, and metals. Groundwater from these samples is included in the AOC
12 613/615/175 evaluation.

13 There is no RFI groundwater data adjacent to the OWS located at the north corner of
14 Building 242, or evidence that it has been reviewed as part of the UST program. The
15 condition of this OWS will be inspected; if there is no indication of cracking or leaks,
16 then it will not warrant further consideration.

17 **2.5.4 Proposed Sampling and Analysis**

18 Soil borings and monitoring wells will be constructed and samples will be collected and
19 analyzed using methods described in Section 3.0 of this WPA.

20 **Soil**

21 Two sample locations are proposed to complete the delineation and elevated
22 concentration of arsenic detected at F613SP024 along the western edge of the AOC 613
23 area of investigation. Surface and subsurface (0-1 foot and 3-5 feet below grade) samples
24 will be collected at locations shown in Figure 2.5-7, and analyzed for arsenic.

25 BEQs will be delineated by collecting surface and subsurface soil samples at two
26 locations near F613SB022, as shown in Figure 2.5-7. The samples will be analyzed for
27 PAHs.

28 Therefore, a total of four soil borings will be sampled for surface and subsurface soil.
29 Samples will be collected and analyzed using methods described in Section 3.0 of this
30 WPA.

1 **Groundwater**

2 To thoroughly delineate the dissolved solvent measurements downgradient from
3 F613GP039, a new monitoring well (F613GW009) is proposed near F613GP040, as
4 shown in Figure 2.5-7. The well will be screened in the shallow water-bearing zone and
5 constructed similar to existing wells at the site.

6 Following completion of F613GW009, groundwater will be sampled for the presence of
7 CVOCs in F613GW009, F613GW003, F613GW004, and FGELGW012. Samples will be
8 analyzed for VOCs.

9 **OWSs**

10 An additional file review will be conducted for OWS 241-D. The unit will be inspected
11 to evaluate if further consideration should be given regarding potential releases from
12 this unit.

13 **2.6 AOC 617 – Galvanizing Plant, Former Building 1176**

14 **2.6.1 General Description and Historical Usage**

15 AOC 617 is the site of a former galvanizing plant, designated Building 1176, which
16 operated from the early 1940s to approximately 1985. Shortly thereafter, Building 1176
17 was demolished to facilitate the expansion of Building 69, a shipping and supply
18 warehouse located immediately south of AOC 617.

19 Information is limited regarding specific details of historical plating operations
20 conducted at the site. Available records indicate the former presence of a single 3,000-
21 gallon UST used for chemical storage. Historical records also indicate the presence of a
22 series of large (approximately 15 by 20 feet) rectangular aboveground tanks within the
23 building, used for acid, caustic, and chemical storage. The tanks were apparently
24 removed in conjunction with demolition of the building.

25 There is no record of a release(s) from any of the aforementioned tanks. Virtually 100
26 percent of AOC 617 is currently paved; historical drawings also indicate that this area
27 was paved during Building 1176 operation. AOC 617 is located in an industrial area east
28 of Hobson Avenue. Future use of this area is expected to remain industrial.

29 Materials released, stored, or disposed of at AOC 617 include zinc solutions and
30 inorganic acids. CPOCs include VOCs, acids, and heavy metals. Figure 2.6-1 provides
31 for a site map that shows RFI sample locations.

2.6.2 Historical Site Investigation Summary

Results of Soil Sampling

Four soil borings (617SB001 through 617SB004) were advanced during EnSafe's 1996-1997 RFI. Figure 2.6-1 depicts soil boring locations. Surface (0-1 foot bgs) and (3-5 feet bgs) samples were collected from each boring. Laboratory analyses included metals (all samples), VOCs (all samples), SVOCs (all samples), pesticides/PCBs (617SB002, 617SB003, and 617SB004 only), and cyanide (617SB002, 617SB003, and 617SB004 only).

In 1999, EnSafe performed an SPLP evaluation, which included the installation of new borings in previously sampled areas identified during the 1996 investigation. New borings were installed in the immediate vicinity of 617SB003 and 617SB004, and new soil surface and subsurface soil samples were collected. The samples were analyzed for metals, VOCs, SVOCs, pesticides/PCBs, and cyanide, as well as SPLP analysis of the same.

Concentrations of PAHs exceeding background BEQ levels established by CH2M-Jones were detected in subsurface soil samples recovered from 617SB003 and 617SB004.

Compound-specific PAH concentrations for all samples were subsequently compared to applicable SSLs. The following PAH compounds were identified in soil at concentrations exceeding applicable SSLs: benzo(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene.

Figure 2.6-2 provides a summary of the referenced PAH concentrations in shallow soil. Benzo(a)anthracene (SSL = 1,700 µg/kg) was detected at concentrations of 5,900 µg/kg (1996) and 7,500 µg/kg (1999) in subsurface soil samples collected from 617SB003; and 5,700 µg/kg (1996) and 100 µg/kg (1999) in soil samples collected from 617SB004.

Benzo(b)fluoranthene (SSL = 5,200 µg/kg) was detected at concentrations of 3,700 µg/kg (1996) and 6,000 µg/kg (1999) at 617SB003. Dibenz(a,h)anthracene (SSL = 1,600 µg/kg) was detected at concentrations of 1,600 µg/kg (1996) and 1,800 µg/kg (1999) at 617SB003. No metals, VOCs, pesticides/PCBs, or other compounds were detected in soil exceeding applicable SSLs or residential RBCs.

Results of Groundwater Sampling

Two monitoring wells (617GW001 and 617GW002) were installed during EnSafe's 1996-1997 RFI. 617GW001 was sampled once in late 1996, then quarterly from May 1997 to November 1997 (four sampling events total). 617GW002 was sampled quarterly from May 1997 to February 1998 (also four sampling events). A third monitoring well,

1 617GW003, was installed during the 1999 phase of work and was sampled in May 1999.
2 All groundwater samples were analyzed for the presence of VOCs, SVOCs, and metals.
3 The 1999 sample collected from 617GW003 was also analyzed for pesticides/PCBs.
4 Several groundwater samples were also collected using direct-push technology during
5 EnSafe's utility corridor investigation (designated as "L" borings). Geoprobe locations
6 in the area of the site include: LF037GP035; LF037GP036; LF037GP039; LF037GP040;
7 LF037GP041; LF699GP015; and LF699GP016. Samples collected from these probes were
8 analyzed for VOCs, SVOCs, metals, and cyanide. The data were used to perform a
9 qualitative evaluation of groundwater impacts in the area and to determine the possible
10 need for additional monitoring wells. Inorganic analytical data generated from
11 geoprobe samples are generally considered to be less accurate than corresponding
12 conventional monitoring well data (i.e., concentrations of inorganics are typically
13 exaggerated), because of the absence of a sand pack or well screen to screen out
14 formation solids.

15 No VOCs or SVOCs were detected above MCLs in any of the groundwater or
16 groundwater probe samples. Average pH levels measured during the well purging
17 activity ranged from 5.6 to 6.6 after stabilization. Zinc was detected in three
18 groundwater samples at concentrations exceeding the MCL (5,000 µg/L); concentrations
19 from well samples ranged as high as 145,000 µg/L. Zinc concentrations measured in
20 Geoprobe samples ranged as high as 427,000 µg/L. Locations of these samples, with
21 corresponding analytical results and dates of sample collection, are shown on
22 Figure 2.6-3.

23 Arsenic was detected in groundwater samples collected from 617GW001 at
24 concentrations exceeding the MCL of 10 µg/L and background concentration of 16.2
25 µg/L on two occasions, one of which was a "J" value. In 1996, the "J" value was 31.7
26 µg/L. Successive sample results for arsenic in 617GW001 were 7.9 ("J"), 18.6 ("="), and
27 5.1 ("J") µg/L (all 1997 data).

28 **2.6.3 Data Gaps**

29 **Soil**

30 As shown on Figure 2.6-2, the extent of benzo(a)anthracene, benzo(b)fluoranthene, and
31 dibenz(a,h)anthracene impacts in the area of 619SB003 needs to be delineated to the
32 south, east, and west (delineation to the north is accomplished by 619SB002).

1 **Groundwater**

2 As shown on Figure 2.6-3, zinc impacts appear to be concentrated at the south half of
3 AOC 617, with apparent plume dispersal to the north and east, in the direction of
4 groundwater flow (the direction of groundwater flow is based on review of historical
5 groundwater contour plots generated from 1997 elevation data) (E/A&H, December
6 1997). The zinc plume is delineated to the south and west (upgradient) by groundwater
7 samples collected from groundwater probes. The plume is delineated to the north and
8 east (to the extent possible; drilling activity inside Building 69 is not feasible) by a
9 combination of geoprobe and groundwater monitoring well data, including monitoring
10 wells GELGW011 and 613GW005. However, additional plume characterization near the
11 apparent source area is required.

12 **2.6.4 Proposed Sampling and Analysis**

13 **Soil**

14 CH2M-Jones recommends three new soil borings (619SB005, 619SB006, and 619SB007) to
15 delineate PAH impacts to subsurface soil in the area of 619SB003. Locations of these
16 proposed borings are illustrated on Figure 2.6-4. Samples recovered from these borings
17 at the 3-5 feet depth interval will only be analyzed for SVOCs.

18 **Groundwater**

19 To characterize the zinc groundwater plume immediately downgradient of the apparent
20 source area, CH2M-Jones recommends installing one new monitoring well (617GW004).
21 617GW004 will be advanced approximately 40 feet north of 617GW003, as shown on
22 Figure 2.6-4. This location was selected to address the following concerns: 1) the
23 downgradient edge of the zinc plume exceeding the MCL of 5,000 µg/L is not well
24 defined; and 2) storm and sanitary sewer corridors in the area may influence shallow
25 groundwater flow, and a new well is needed on the upgradient side of these corridors.

26 617GW004 will be screened in the shallow water-bearing zone and constructed similar
27 to existing wells at the site. Following completion of 617GW004, all four AOC 617 wells
28 will be sampled on a quarterly basis for two consecutive events. Groundwater samples
29 from these quarterly events will be analyzed for the following metals: arsenic, cadmium,
30 chromium, nickel, antimony, and zinc

31 Monitoring wells will be constructed and samples will be collected and analyzed using
32 methods described in Section 3.0 of this Work Plan Addendum.

2.7 AOC 619/SWMU 4 – Pesticide Storage Building and Former Oil Storage Yard

2.7.1 General Description and Historical Usage

AOC 619 is the site of a former waste oil storage yard, which was active from 1955 to 1982. Historical records indicate that site activities included storage, transfer, and distribution of petroleum waste and/or fuel via subsurface conveyance piping and two 15,000-gallon aboveground storage tanks (ASTs). The ASTs were constructed in 1964. Waste oil and sludge delivered to the site using rail cars was transferred into the tanks for temporary storage until 1980, at which time they were upgraded for gasoline storage, including installation of a concrete containment sump.

Two former buildings, Building 175 and Facility 3908, were demolished in 1986. There are no records of any spills or releases associated with historical activities at these buildings or at the site in general. AOC 619 was paved in 1980; approximately 80 percent of the site area is paved or beneath roof structure. The site is east of Hobson Avenue in an industrial area. Continued industrial use in this area is anticipated. Existing buildings at the site are designated 1824, 1836, 1316, and 381 and are depicted on Figure 2.7-1.

SWMU 4, located within the southwest corner of AOC 619, consists of Buildings 1316 and 381. Building 1316 (500 square feet [ft²]) was constructed in 1944 and was used for tool storage. Building 381 (2,000 ft²) was constructed in 1981. Building 381 consists of a pesticide formulation and mixing room and equipment wash area, as well as sink and floor drains, which are connected to the sanitary sewer system. Building 381 was used for pesticide storage until 1985, after which time the building was used for general storage.

Building 1824, located at the northeast corner of AOC 619, was constructed in 1990. This building, which comprises 17,800 ft², is used to store hazardous waste and features a loading dock on the south side. Building 1836, located immediately west of Building 1824, was constructed in 1981 and comprises 4,000 ft² of floor space and is used for general storage.

Materials released, stored, or disposed of at AOC 619/SWMU 4 include pesticides, paint, solvents, and petroleum products.

2.7.2 Historical Site Investigation Summary

Results of Soil Sampling

Nineteen soil borings (SWMU 4 borings 004SB001 through 004SB004; and AOC 619 borings 619SB001 through 619SB015) were advanced during EnSafe's 1996 - 1997 RFI. Figure 2.7-1 depicts soil boring locations for these and subsequent phases of work. Surface (0-1 foot bgs) and subsurface (3-5 feet bgs) samples were collected from all borings, except 619SB002, 619SB005, 619SB006, 619SB007, 619SB008, and 619SB011. Subsurface samples were not collected from the latter borings because of the shallow depth of the water table and/or subsurface obstructions. Laboratory analyses for the soil samples collected from SWMU 4 included metals, pesticides/PCBs, organophosphate pesticides, herbicides, VOCs, and SVOCs. Laboratory analysis for the soil samples collected from AOC 619 includes the same parameters, with the exception of organophosphate pesticides and herbicides.

One sediment sample (619M001) was collected from the bottom of a catch basin located at the south-central section of the site. This sample was analyzed for the presence of metals, cyanides, pesticides/PCBs, VOCs, and SVOCs.

EnSafe also advanced three geoprobe soil borings in various areas of the site in 1997, as part of an investigation of utility and railway corridors (designated Zone "L"). Utility/railway corridor geoprobe soil borings relevant to this site are LG37SP001/LG37GP002, LG37SP028, and LG37GP044.

In 1999, EnSafe advanced five additional soil borings (619SB016 through 619SB020) at the north side of Building 1824 to delineate SVOC impacts. Each boring included surface and subsurface sampling. All samples were solely analyzed for SVOCs. EnSafe also performed an SPLP leachate evaluation, which included the installation of new borings at sample locations reviewed during the 1996 investigation.

Concentrations of carcinogenic PAHs in surface and subsurface soil, expressed as benzo(a)pyrene equivalent (BEQ) concentrations, are less than background values calculated by CH2M-Jones (1,304 µg/kg for surface soil and 1,400 µg/kg for subsurface soil). Therefore, no further investigation of BEQs is recommended. No other VOCs or SVOCs in soil samples exceeded comparison criteria.

Metals, pesticides, organopesticides, or herbicides were not identified in soil at concentrations exceeding applicable Zone F background and/or residential RBC values, with the exception of thallium. Thallium was detected at estimated ("J" flagged) values

1 of 0.57 mg/kg at 619SB007 (0-1 foot), and 1.4 mg/kg at 619SB009 (3-5 feet), exceeding
2 the Residential RBC value of 0.55 mg/kg and SSL of 1 mg/kg, respectively. The
3 industrial RBC value is 14.3 mg/kg; the concentrations at this industrial site are within
4 this value. The Zone F subsurface soil background concentration for thallium is
5 1.24 mg/kg. Both borings are located near the center of the site, immediately west of
6 Building 1824. Thallium is delineated on all sides by soil samples containing non-
7 detectable or estimated thallium concentrations less than the residential RBC or SSL (as
8 applicable). Therefore, no further investigation is required.

9 TCE was detected in the sediment sample (619M0001) collected by EnSafe in 1996 at an
10 estimated concentration of 4 µg/kg. TCE was also detected ("J" flagged values only) in
11 surface soils at sporadic locations. All estimated TCE concentrations in these soil
12 samples were less than 10 µg/kg (the residential RBC is 58 µg/kg). The random
13 distribution and low concentration of TCE does not indicate a significant surface release.
14 No further investigation of TCE in soil or sediment is required.

15 **Results of Groundwater Sampling**

16 Four monitoring wells (619GW001, 619GW002, 619GW003, and 620GW001) were
17 installed in 1996 during EnSafe's RFI for AOC 619. Figure 2.7-1 depicts the locations of
18 these groundwater wells. Groundwater samples collected from these wells were
19 analyzed for metals, pesticides/PCBs, organophosphate pesticides, VOCs, and SVOCs
20 during the first sampling event in 1996. (Well 620GW001 was not sampled for pesticides
21 or PCBs.) Each well was also sampled three times in 1997. During the 1997 sampling
22 events, organophosphate pesticides were eliminated from the target parameter list.

23 Groundwater samples were also collected by direct-push methods from two locations
24 (LG37GP002 and LG37GP044) during EnSafe's investigation of utility corridors. These
25 samples were analyzed for metals, VOCs, and cyanide. No VOCs or cyanide were
26 detected. In general, Geoprobe inorganic data is not considered representative of
27 dissolved constituents in groundwater because of the high potential for solids formation
28 in the sample, and therefore was not evaluated.

29 No pesticides, VOCs, or SVOCs were detected above screening criteria in any of the
30 groundwater samples, with the exception of a single "J" flag detection of chloromethane
31 at 8.0 µg/L in 619GW003. This result was not reproducible in successive groundwater
32 sampling events; therefore, no further investigation with regard to chloromethane is
33 necessary.

1 Thallium was detected in groundwater samples collected from monitoring wells
2 619GW001 and 619GW003 during the first sampling round at concentrations slightly
3 exceeding the drinking water RBC of 5.58 µg/L. These results were not reproducible
4 during successive sampling events; therefore, no further investigation is required.

5 Naphthalene was detected at estimated (“J”) values below the detection limit of 10 µg/L
6 in 619GW003 during the first three sampling events; however, naphthalene was not
7 detected during the final event. Naphthalene was not detected in groundwater samples
8 collected from surrounding wells. The presence of low-level naphthalene in 619GW003
9 appears to be a localized condition that does not warrant further investigation.

10 **2.7.3 Data Gaps**

11 No data gaps were identified in soil, sediment, or groundwater.

12 **2.8 AOC 620/SWMU 36 – Building 68 Battery Shop**

13 **2.8.1 General Description and Historical Usage**

14 AOC 620/SWMU 36 consists of Building 68 and the immediately surrounding property
15 on all sides of the building. Building 68 comprises 48,000 ft² of elevated, concrete floor
16 space, supported by piles and underlain by unpaved earth. The interior space includes a
17 central generator and transformer room, acid storage tank room, and a rinse basin area.
18 A loading dock surrounds the eastern, western, and half of the northern sides of the
19 building. Prominent features of Building 68, as they relate to the subject investigation,
20 are depicted on Figure 2.8-1.

21 SWMU 36 is the site of two historical sulfuric acid releases, where acid was discharged
22 within the acid tank room to floor drains in which the piping had separated. The
23 separated piping allowed acid to leak onto the underlying unpaved ground surface.

24 Building 68 is located in the industrial area of Zone F, east of Hobson Avenue. The
25 Zone E borderline is approximately 65 feet east of the building, and the Zone G
26 borderline is approximately 40 feet south of the building. The area surrounding
27 Building 68 is expected to remain for industrial use in the future.

28 Approximately 95 percent of AOC 620/SWMU 36 is paved or under roof. A grass-
29 covered strip located at the south side of Building 68 and a railroad track area west of
30 the west loading dock are not paved.

1 From 1942 to 1952, Building 68 was used as a paint and oil storage facility. Beginning in
2 1952, it was used for the destruction, assembly, and rebuilding of large submarine
3 batteries. Most recently, Building 68 was used for storage and charging of lead acid
4 batteries. Materials released, stored, or disposed of at AOC 620/SWMU 36 include
5 sulfuric acid, lead, paint, solvents, and petroleum products.

6 **2.8.2 Historical Site Investigation Summary**

7 **Results of Soil Sampling**

8 Twelve soil borings were advanced in two phases during EnSafe's 1996-1997 RFI.
9 Figure 2.8-1 depicts soil boring locations for these and subsequent phases of work. Nine
10 borings (036SB001 through 036SB003 and 620 SB001 through 620SB006) were advanced
11 during the first (1996) phase of the investigation. Surface (0-1 foot bgs) and subsurface
12 (3-5 feet bgs) samples were collected from three of these borings (036SB001, 620SB005,
13 and 620SB006). Only surface samples were collected from the remaining six borings
14 because of the shallow depth of the water table and/or subsurface obstructions.
15 Laboratory analysis included metals (all samples), VOCs (all samples), SVOCs (all
16 samples), pesticides (four surface samples), PCBs (four surface samples), and cyanide
17 (one surface sample). Three borings (620SB007 through 620SB009) were advanced
18 during the second (1997) phase of the investigation in an attempt to delineate lead and
19 PCB impacts. Both surface and subsurface samples were collected from each of the three
20 borings; they were analyzed for metals, SVOCs, pesticides, and PCBs.

21 In 1997, EnSafe also collected a series of direct-push soil samples along the south side of
22 Building 68, as part of an investigation of utility and railway corridors (designated
23 Zone L). Utility/railway corridor Geoprobe locations relevant to this addendum are
24 LF699SP001, LF699SP002, and LG037SP002

25 In 1999, EnSafe advanced five additional soil borings (620SB010 through 620SB014) at
26 the south side of Building 68 in an attempt to delineate metals impacts. Each boring
27 included surface and subsurface sampling. All samples were analyzed for metals and
28 SVOCs.

29 Concentrations of PAHs in soil (BEQ concentrations) are less than Zone F background
30 values calculated by CH2M-Jones; therefore, no further action is recommended with
31 regard to BEQs.

32 The following metals were identified in soil at concentrations exceeding applicable
33 Zone F background and/or residential RBC values: aluminum, arsenic, chromium, iron,

1 and lead. With the exception of arsenic, all of these metals were delineated to respective
2 background and/or residential RBC values within Zone F, and no further investigation
3 is required.

4 Arsenic was detected in surface (0-1 foot) soil samples at concentrations exceeding
5 background (19.9 mg/kg) in three soil borings located southeast of Building 68:
6 620SB007 (31.5 mg/kg), 620SB008 (22.6 mg/kg), and 620SB012 (27.3 mg/kg). Additional
7 soil samples are necessary to delineate these impacts. Delineation of arsenic to
8 residential or industrial RBC values is not practical, since these values are significantly
9 less than background. The calculated SSL for arsenic (based on a DAF of 23.7) is 1900
10 mg/kg. Figure 2.8-2 provides a summary of arsenic concentrations detected in shallow
11 soil samples. Note that 620SB008 was sampled twice for arsenic (the result was 15.1
12 mg/kg the second time); the additional sampling event was performed in conjunction
13 with EnSafe's SPLP evaluation.

14 Arsenic was detected in one subsurface (3-5 feet) soil sample, collected from 620SB008,
15 at a concentration of 18.9 mg/kg (Zone F background concentration for subsurface soil
16 is 18.2 mg/kg). This difference between the 620SB008 result and background is
17 statistically insignificant; therefore, delineation of subsurface arsenic impacts is not
18 required.

19 Aroclor-1260 was identified in soil at concentrations exceeding the residential RBC
20 (319 µg/kg) at a single location, 620SB004 (0-1 foot), at a concentration of 510 µg/kg. It
21 was not detected above the RBC in any of the other soil samples in which it was
22 analyzed. Aroclor-1260 concentrations detected in surface soil are summarized on
23 Figure 2.8-3 (no PCBs were detected in subsurface samples). Aroclor-1254 was detected
24 only at location 620SB004, at a concentration greater than the RBC. This compound was
25 not detected in any of the other site samples. PCB concentrations above screening
26 criteria have not been delineated north of 620SB004.

27 **Results of Groundwater Sampling**

28 Four monitoring wells were installed in two phases during EnSafe's 1996-1997 RFI.
29 Figure 2.8-1 depicts locations of these groundwater wells. Two wells, 620GW001 and
30 620GW002, were installed during the first phase (1996) of the investigation.
31 Groundwater samples collected from these wells were analyzed for the presence of
32 VOCs, SVOCs, and metals. The remaining two wells, 620GW003 and 620GW004, were
33 installed during the second phase of investigation (1997). Samples collected from these

1 two wells were solely analyzed for metals. All four wells were sampled a total of five
2 times from 1996/1997 to 1998.

3 Several groundwater samples were also collected from direct-push locations during the
4 course of EnSafe's RFI. Analytical data from inorganic constituents generated from these
5 samples are generally not considered valid for the purpose of source characterization or
6 delineation. The data are invalid because of the absence of a sand pack or well screen,
7 which is necessary to filter high turbidity caused by the silt and clay material which
8 predominates in the shallow subsurface.

9 No VOCs or SVOCs were detected above MCLs in any of the groundwater samples
10 collected from the monitoring wells, and pH levels measured during well purging
11 activity ranged from 6.6 to 7.6 (after stabilization). Two metals, lead and thallium,
12 exceeded MCLs and background values in one or more groundwater samples.

13 In 20 samples obtained from the five wells surrounding AOC 620, lead was detected at
14 concentrations less than the MCL except for one sample from 620GW004. The 30.7 µg/L
15 concentration measured in the second sampling event (1997) was not reproducible at the
16 site and is not considered characteristic of site conditions. Further investigation of lead
17 in groundwater at AOC 620/SWMU 36 is not required.

18 In 20 samples from the five wells surrounding AOC 620, one qualified detection of
19 thallium was noted at 620GW001 during one sampling event. All other samples
20 contained either non-detectable concentrations or estimated concentrations similar to
21 the reporting limit, near 5 µg/L, and similar to the background concentration of
22 5.58 µg/L. The 11 µg/L concentration measured in the first sampling event (1996) was
23 not reproducible at the site and is not considered characteristic of site conditions.
24 Therefore, further investigation of thallium in groundwater at AOC 620/SWMU 36 is
25 not warranted.

26 During October 2000, monitoring well 620GW003, located immediately southeast of
27 Building 68, was destroyed during repair of a utility line. Except for iron and
28 manganese, which are common groundwater minerals, groundwater samples from this
29 area did not contain constituents exceeding screening criteria, and further groundwater
30 sampling is not needed. For this reason, CH2M-Jones does not recommend replacement
31 or relocation of 620GW003.

1 2.8.3 Data Gaps

2 Soil

3 The text that follows discusses the data gaps that were identified with regard to the
4 EnSafe RFI.

5 Arsenic was detected in surface (0-1 foot) soil samples at concentrations exceeding
6 background (19.9 µg/kg) in three soil borings located southeast of Building 68:
7 620SB007 (31.5 µg/kg), 620SB008 (22.6 µg/kg), and 620SB012 (27.3 µg/kg). The
8 apparently ubiquitous occurrence of arsenic of soils and groundwater in the Charleston
9 area is believed to be naturally occurring. The provenance of arsenic in the South
10 Carolina Coastal Plain and in the Charleston area is currently being evaluated.
11 However, additional soil samples are necessary to delineate the area of elevated arsenic
12 concentrations.

13 Aroclor-1260 and Aroclor-1254 were identified in soil at concentrations exceeding the
14 residential RBC (319 µg/kg) at a single location, 620SB004 (0-1 foot), at respective
15 concentrations of 510 and 350 µg/kg. These compounds were not detected above the
16 RBC in any of the remaining nine surface samples or five subsurface samples.
17 Delineation of soil impacts to the north of 620SB004 is required.

18 Several areas of potential concern associated with historical operations inside
19 Building 68 were not previously investigated. These areas include the central generator
20 and transformer room, and the rinse basin area located at the northeast corner of the
21 building. Of particular concern is the presence of oil staining, observed on the concrete
22 floor in the immediate vicinity of the transformers. Although the floor appeared to be in
23 good condition, an expansion joint was observed immediately north of the transformers,
24 which may have provided a conduit for potential contaminant migration. Evaluation of
25 potential PCB releases to the soil beneath the transformer room, and potential releases
26 of solvents and metals from the rinse basin drain area, are needed.

27 Groundwater

28 No data gaps were identified with regard to groundwater impacts at AOC
29 620/SWMU 36.

30 2.8.4 Proposed Sampling and Analysis

31 Two soil borings (620SB015 and 620SB016) will be advanced immediately north of
32 Building 68 to delineate the extent of PCBs to the north of the transformers and

1 620SB004 (Figure 2.8-4 shows boring locations). Surface (0-1 foot) samples will be
2 collected and analyzed for the presence of PCBs. Because of the immobile nature of
3 PCBs, subsurface samples will not be collected.

4 Two soil borings (620SB017 and 620SB018) will be advanced immediately east of
5 Building 68, beneath the loading dock near the drain lines leading from the interior
6 rinse basins. The purpose of these borings will be to investigate potential impacts
7 associated with historical use of the basins (refer to Figure 2.8-4 for boring locations).
8 Surface (0-1 foot) and subsurface (2-3 foot) samples will be collected and analyzed for
9 the presence of VOCs, SVOCs, and metals. Subsurface soil samples are to be collected at
10 shallower depths than normally specified to remain above the anticipated shallow
11 groundwater table. Surface soil will also be sampled for PCBs. If the soil is visibly
12 stained, the subsurface samples also will be analyzed for PCBs.

13 Three soil borings (620SB019, 620SB020, and 620SB021) will be advanced inside
14 Building 68 to investigate potential source areas associated with the electrical
15 transformers (refer to Figure 2.8-4 for these locations). Two borings will be advanced
16 adjacent to the transformers, near the two areas of oil staining. A third boring will be
17 located at the expansion joint in the concrete floor. Because of the immobile nature of
18 PCBs, only surface (0-1 foot) samples will be collected. If the samples are visibly stained,
19 contingency samples will be collected at 2-3 foot depth. All samples will be analyzed for
20 the presence of PCBs.

21 Finally, three soil borings (620SB022, 620SB023, and 620SB024) will be advanced to
22 delineate shallow arsenic concentrations southeast of Building 68 (refer to Figure 2.8-4
23 for proposed soil boring locations). Because this area is unpaved, both surface (0-1 foot)
24 and subsurface (2-3 feet) samples will be collected to confirm the vertical extent of
25 arsenic.

26 Sample collection and analysis details are presented in Section 3.0 of this Work Plan
27 Addendum.

28 **2.9 AOC 709(F) – Former Fuels Distribution System**

29 **2.9.1 General Description and Historical Usage**

30 AOC 709(F) consists of a small (approximately 0.7 acres) section of the CNC property,
31 located immediately west of Hobson Avenue, east of AOC 609, along Beatty Street in
32 Zone F, shown on Figure 2.9-1. This area is not the AOC 709 identified in Zone H in the

1 RCRA permit. The area near AOC 709(F) contains a series of utility corridors, including
2 fuel distribution (FD) system conveyance piping. During investigation of the base-wide
3 FD system, elevated concentrations of arsenic were detected in shallow groundwater at
4 this location.

5 There is no record of a release at this site, which is currently occupied by the Hobson
6 Avenue right-of-way and an athletic field. Based on review of historical maps and aerial
7 photographs, there is no apparent historical source of arsenic (i.e., there are no known
8 historical activities in the area associated with arsenic use). The buried FD system
9 pipeline, which extends through AOC 709(F), was used exclusively for the conveyance
10 of petroleum fuels (no waste oil products or other fluids were transferred).

11 **2.9.2 Historical Site Investigation Summary**

12 **Results of Soil Sampling**

13 Three soil borings (FDSSC097, GFDSSC098, and FGDFSB005) were advanced at
14 AOC 709(F) as part of the CNC FD system investigation. Figure 2.9-1 depicts the
15 locations of these borings. Surface (0-1 foot below ground surface [bgs]) and subsurface
16 samples were collected from borings FDSSC097 and GDFSB005 in 1996. Subsurface
17 samples were collected at depths of 8 - 10 feet bgs for FDSSC097 and 3-5 feet bgs for
18 GDFSB005. Only a surface sample was collected from FDSSC098 in 1996. Laboratory
19 analysis for the soil samples collected from FDSSC097 and GDFSB005 included cyanide,
20 metals, pesticides/PCBs, VOCs, and SVOCs. Laboratory analysis for the soil sample
21 collected from FDSSC098 included total petroleum hydrocarbon (TPH-gasoline range
22 organics [GRO]), TPH-diesel range organics [DRO], and other fuel-related TPH analysis.
23 EnSafe resampled FDSSC097 in 1999 as part of its synthetic precipitation leaching
24 procedure (SPLP) evaluation. The depth at which these latter samples were collected is
25 not known.

26 No COPCs were detected in these soil samples at concentrations exceeding applicable
27 SSLs, RBCs, or background screening criteria, with the exception of BEQs. A BEQ
28 concentration of 2,687 µg/kg was reported for the 1999 FDSSC097 sample. Individual
29 PAH concentrations were compared to Zone F SSLs calculated by CH2M HILL-Jones for
30 a DAF of 8.8. No SSL exceedences were identified; therefore, no further investigation of
31 BEQ issues at this site is necessary.

1 **Results of Groundwater Sampling**

2 Shallow monitoring wells GFDSGW16A, GFDSGW16B, AND GFDSGW16C were
3 installed in 1996 during EnSafe's RFI. Figure 2.9-1 depicts well locations. All three wells
4 were sampled semiannually in 1997 and 1998 (four sampling events total). Groundwater
5 samples were analyzed for cyanide, metals, pesticides/PCBs, VOCs, and SVOCs during
6 the first sampling event conducted in 1997. The list of analytes was progressively
7 shortened during successive sampling events in order to target specific parameters.
8 GFDSGW16B was resampled a fifth time in 1999, using both field-filtering and
9 conventional sampling techniques. Sample parameters for the 1999 event were limited
10 to select target metals antimony, arsenic, beryllium, chromium, lead, mercury, and
11 thallium.

12 With the exception of arsenic, no COPCs were detected above MCLs and/or applicable
13 screening criteria in any of the groundwater samples. Arsenic was detected at variable
14 low to moderate levels in all three wells, especially FDSGW16B, which exhibited a
15 sample concentration as high as 254 µg/L during the third sampling event conducted in
16 1997. The arithmetic average concentration for all three wells was 76 µg/L in 1997 and
17 35 µg/L in 1998 (the MCL for arsenic has been recently changed to 10 µg/L).

18 Figure 2.9-2 depicts arsenic concentrations in groundwater for AOC 709(F) and
19 surrounding wells. Concentrations exceeding the screening criteria have been observed
20 upgradient (west of the site) at SMEGW001, SMEGW002, and SMEGW008, and
21 crossgradient (northeast of the site) at EGDEGW008D and EGDEGW008. Arsenic in
22 soils and groundwater in the Charleston area is believed to be naturally occurring.
23 There is no known historical source for these impacts in this area, aside from the
24 distribution of dredge material. Accordingly, arsenic contamination will be addressed
25 base-wide, and no further investigation with regard to AOC 709(F) arsenic in
26 groundwater is necessary.

27 **2.9.3 Data Gaps**

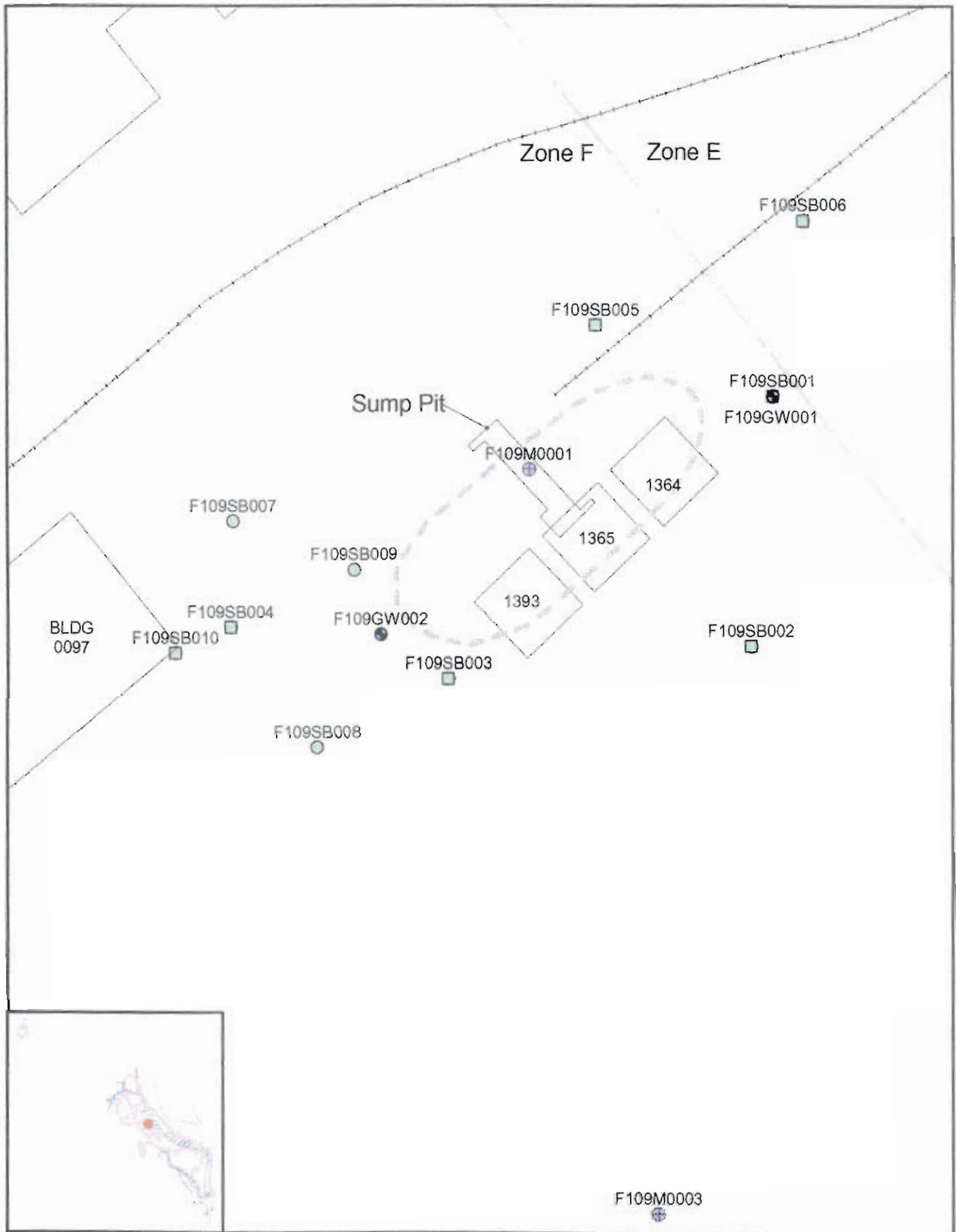
28 No data gaps were identified in soil or groundwater. Additional sampling of arsenic in
29 groundwater may be conducted upon review of base-wide arsenic conditions, if
30 warranted.



-  Aoc109outline.shp
-  Railroads
-  Zone Boundary
-  Original Location of Structures as Shown in RFI Documentation



Figure 2.1-1
 SWMU 109
 Aerial Photo
 Charleston Naval Complex

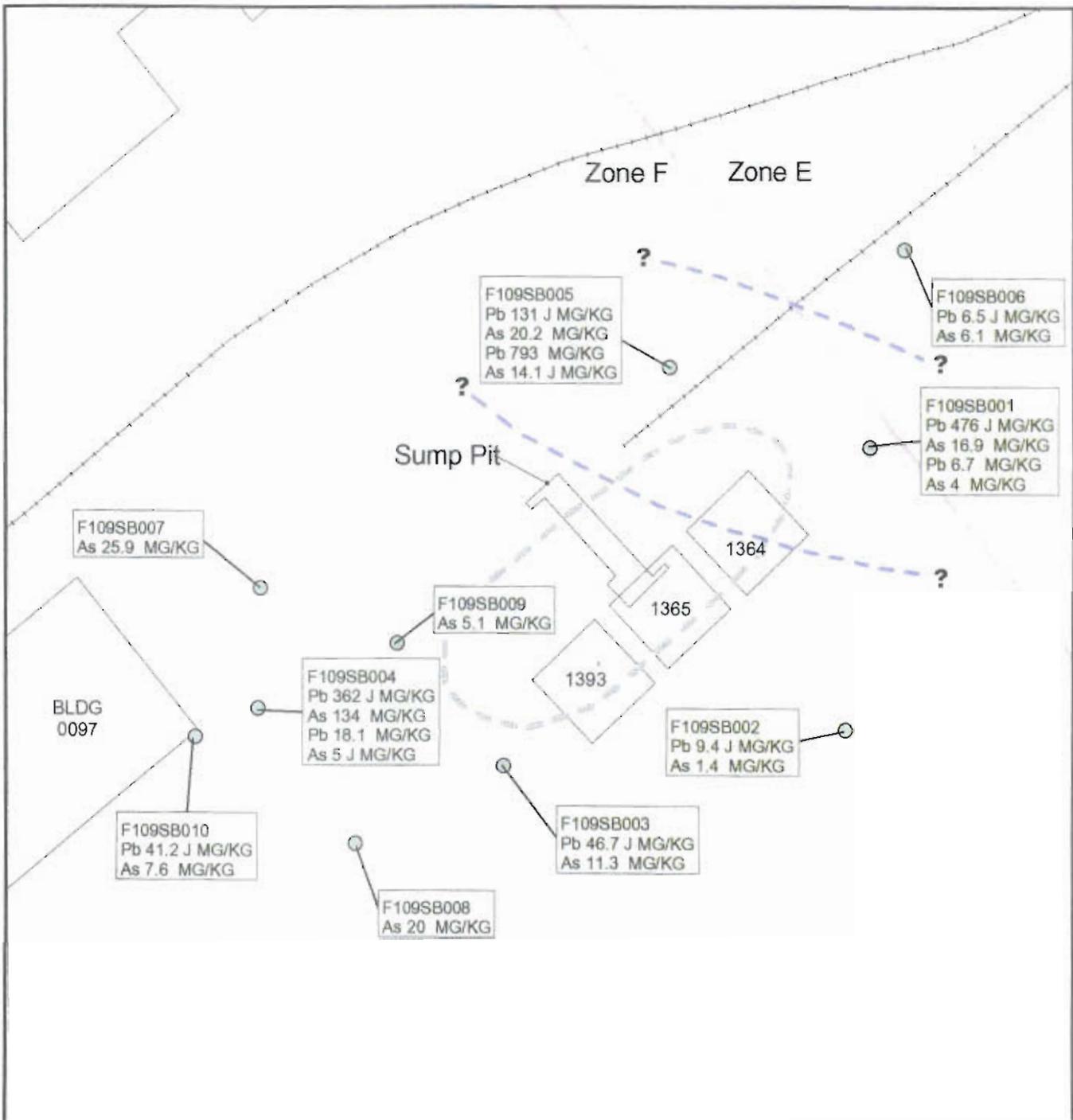


- AOC/SWMU Boundary
- ⊕ Sediment
- Soil Boring
- Groundwater Well
- Zone Boundary
- Surface Soil

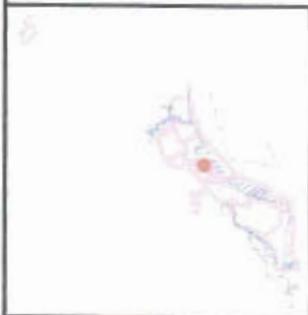
--- Railroads



Figure 2.1-2
 SWMU 109
 Sample Locations
 Charleston Naval Complex



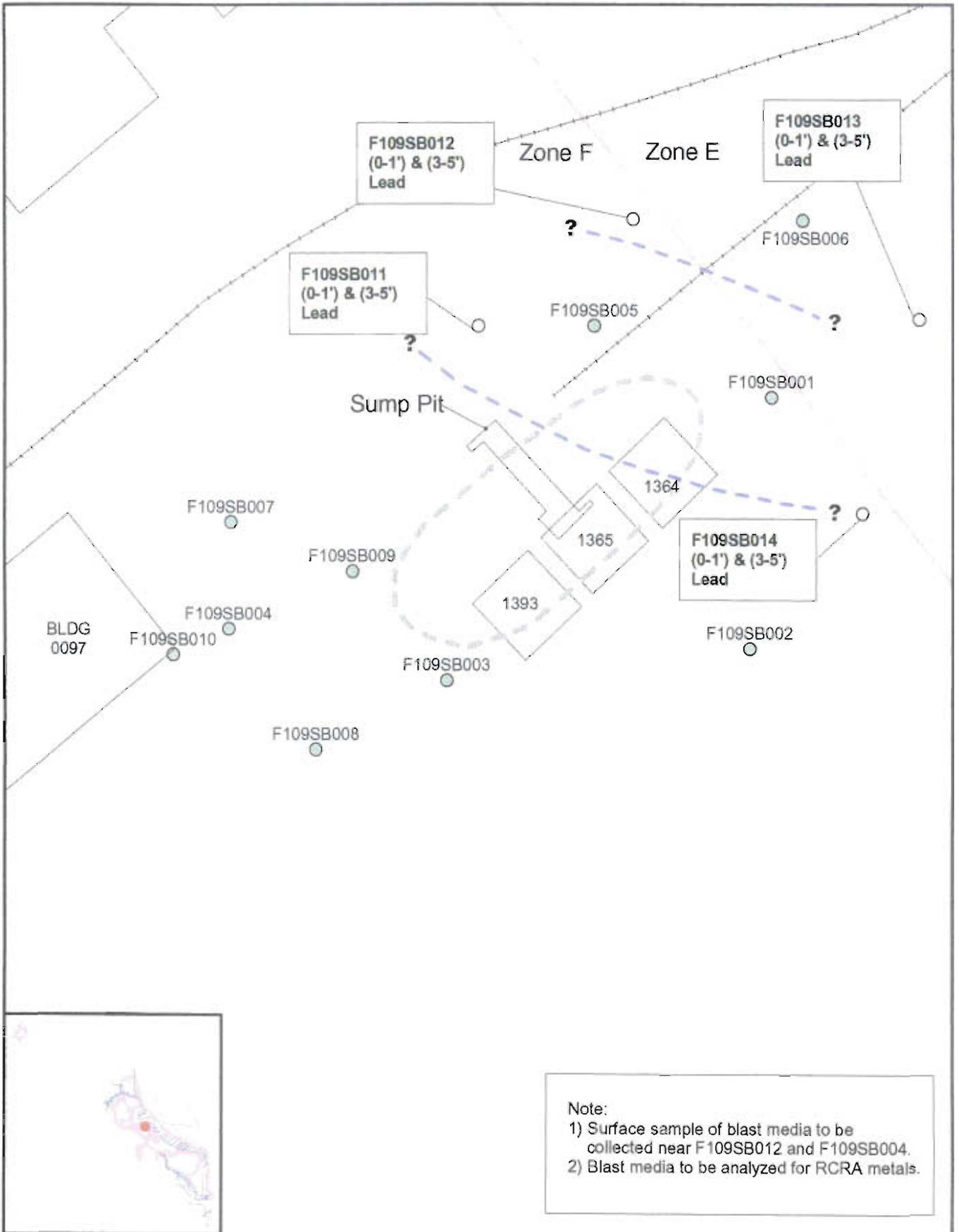
- Notes:
- 1) F109SB001, F109SB004, and F109SB005 sampled twice, in conjunction with SPLP assessment.
 - 2) Arsenic Zone F background = 19.9 mg/kg
Arsenic Zone E background = 23.9 mg/kg
 - 3) Lead Zone F background = 180 mg/kg
Lead Zone E background = 265 mg/kg
Lead Residential RBC = 400 mg/kg
Lead Industrial RBC = 1000 mg/kg
 - 4) J = estimated value



- Surface Soil
- - - AOC/SWMU Boundary
- - - Zone Boundary
- - - Area of Lead Concentrations Greater Than RBC



Figure 2.1-3
SMWU 109
Lead and Arsenic in Surface Soils Samples
Charleston Naval Complex



Note:
 1) Surface sample of blast media to be collected near F109SB012 and F109SB004.
 2) Blast media to be analyzed for RCRA metals.

- Proposed Soil Samples
- AOC/SWMU Boundary
- Surface Soil
- Zone Boundary

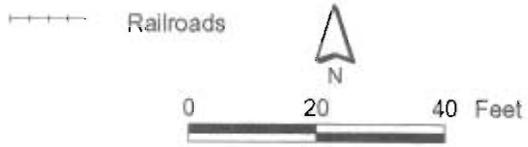


Figure 2.1-4
 SWMU 109
 Proposed Sample Locations
 Charleston Naval Complex

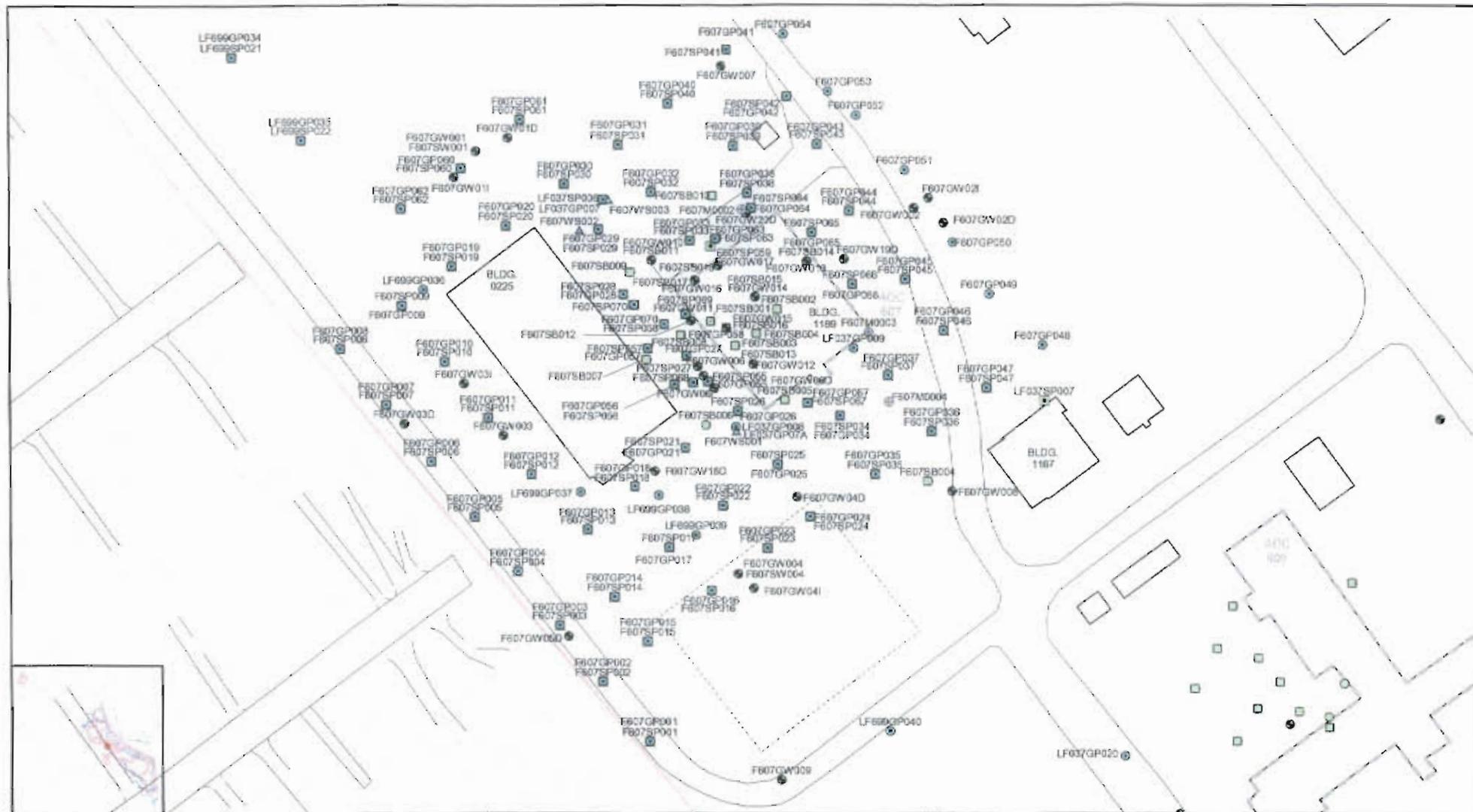


- Groundwater Well
- Proposed Shallow Well Locations
- Stair Well
- ▭ AOC Boundary
- ▭ Buildings



0 90 180 Feet

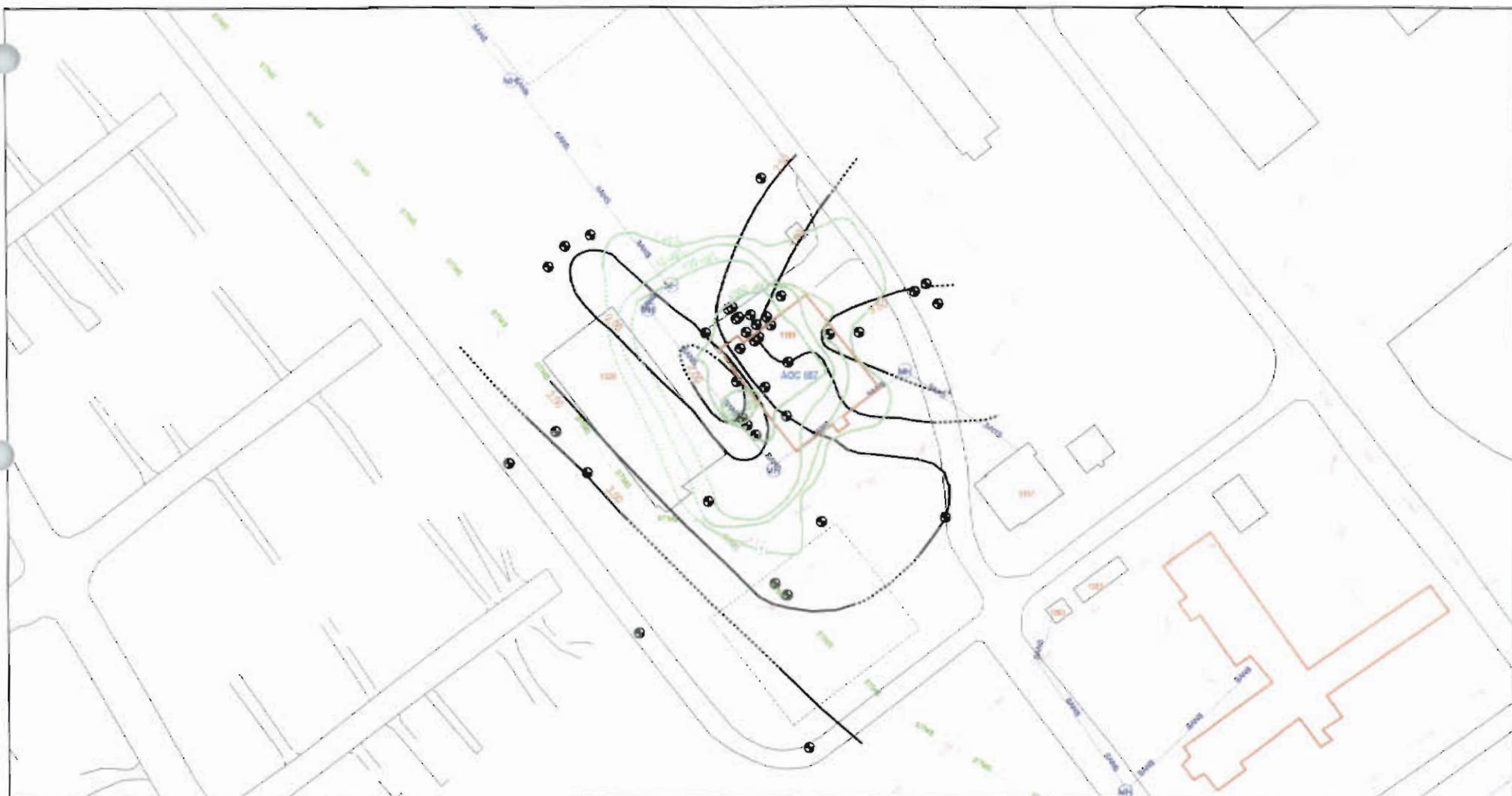
Figure 2.2-2
 AOC 607
 Additional Wells Installed December 2000
 Charleston Naval Complex
 CH2M HILL



- Sediment
- Groundwater Well
- Soil Boring
- ▲ Surface Water
- ⊙ Groundwater Probe
- Surface Soil
- ⊞ Soil Probe
- - - AOC/SWMU Boundary
- ▬ Pavement
- ▬ Zone Boundary



Figure 2.2-1
AOC 607
Sample Locations
Charleston Naval Complex



- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings
- Groundwater Contours
- - - Inferred
- Known
- Zone F Wells
- Sanitary Sewer Lines (SANS)
- Storm Sewer Line (STMS)
- Sanitary Sewer Lines (SANS) - NS
- Storm Sewer Line (STMS) - NS
- Total VOC Isoconcentration Lines (dashed where inferred)



Figure 2.2-3
 AOC 607
 Total VOCs in Groundwater
 Charleston Naval Complex

CH2MHILL

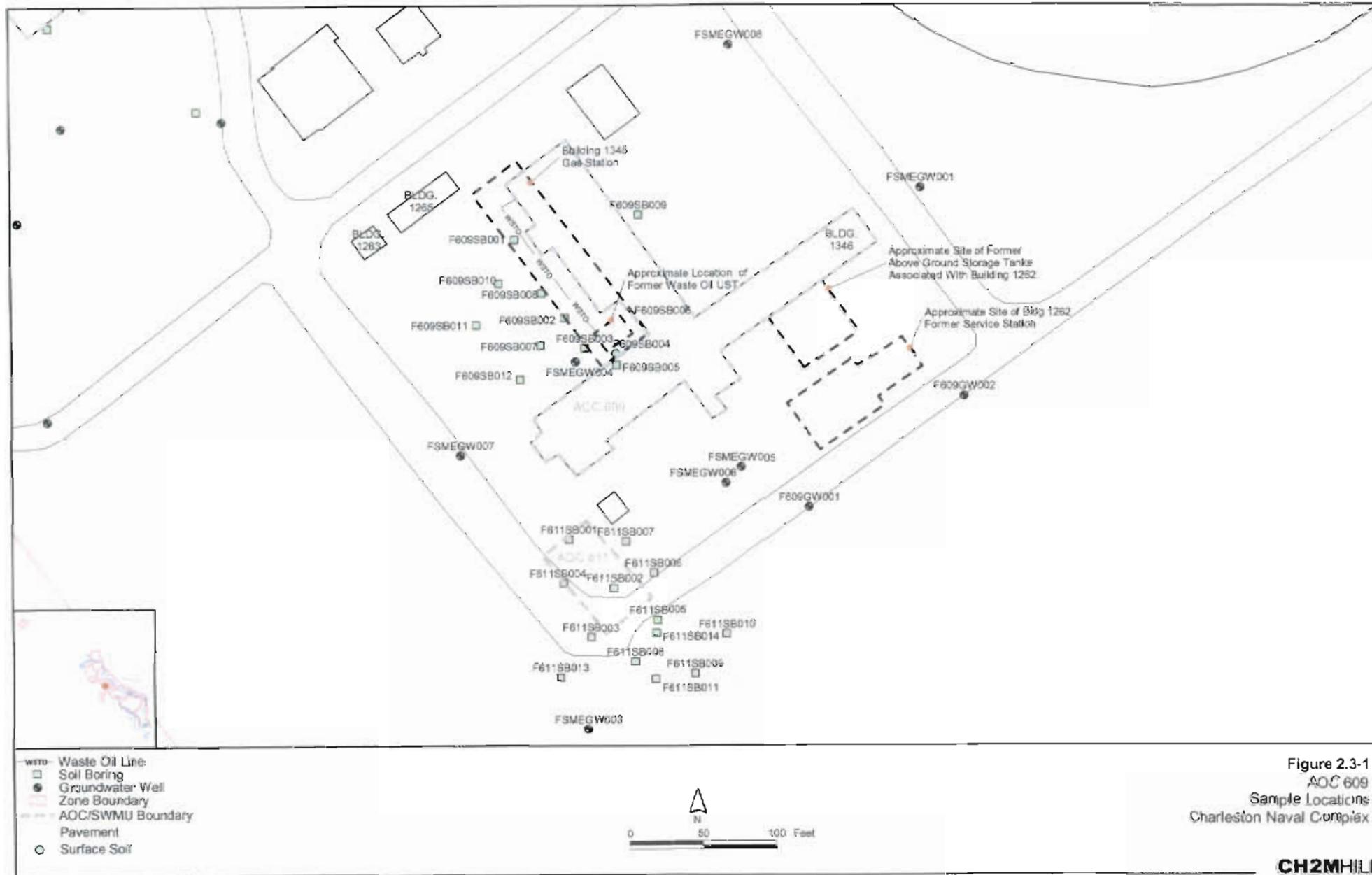
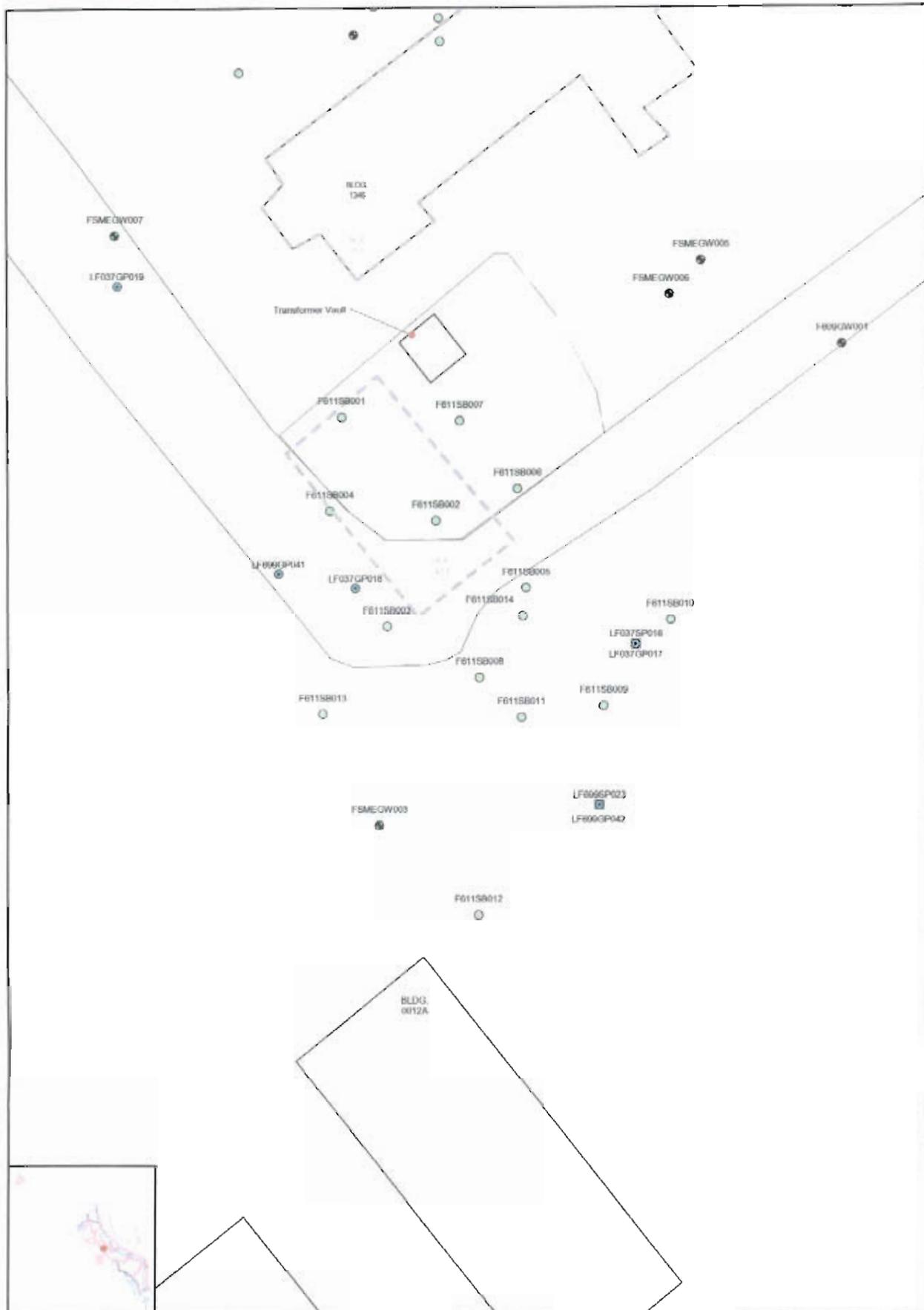


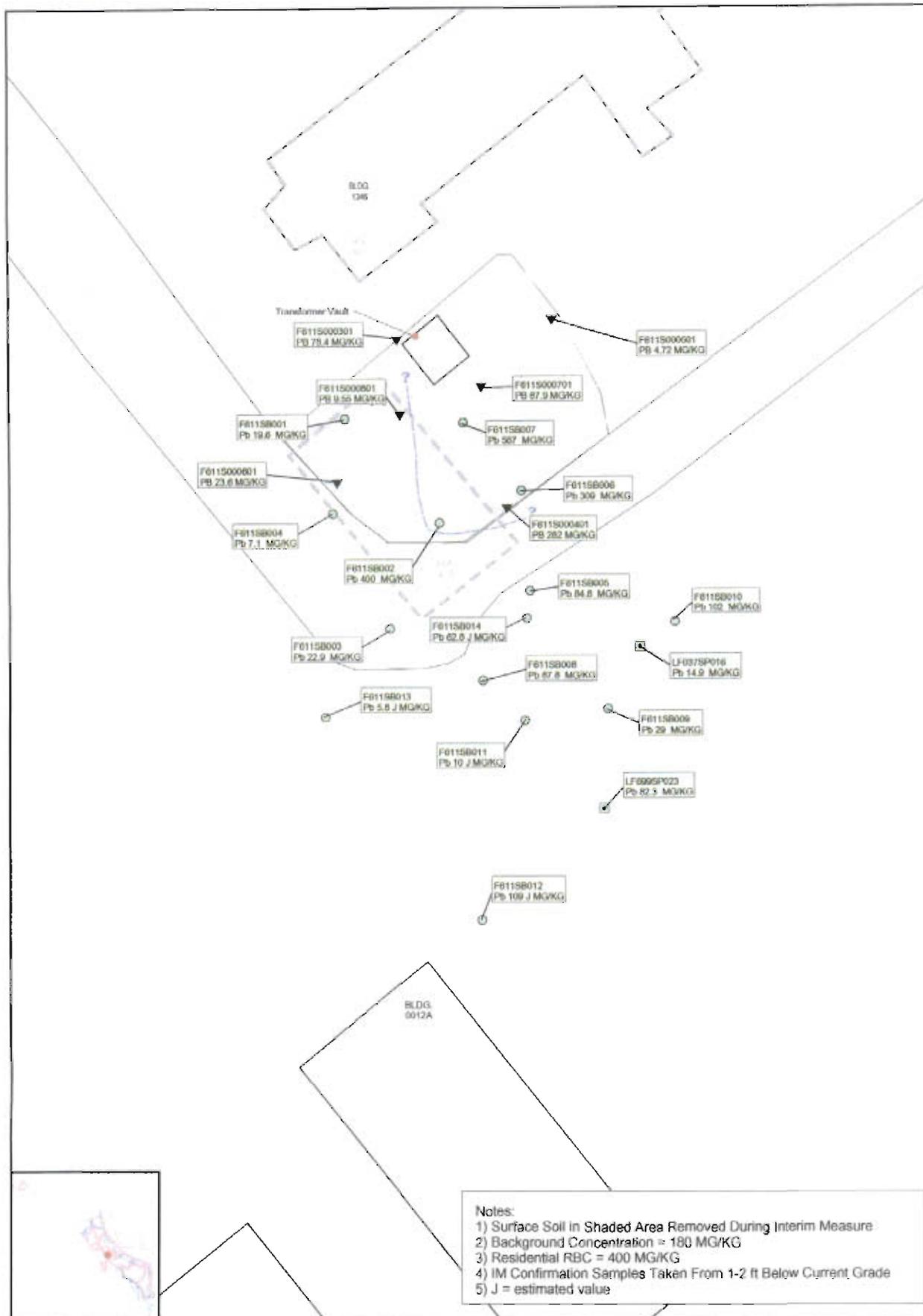
Figure 2.3-1
 AOC 609
 Sample Locations
 Charleston Naval Complex



- AOC/SWMU Boundary
- Soil Boring
- Groundwater Well
- Interim Measure Area of Removal
- ▭ Pavement
- ▣ Soil Probe
- ⊙ Groundwater Probe



Figure 2.4-1
AOC 611
Sample Locations
Charleston Naval Complex



- Surface Soil
- ◻ Soil Probe
- ▼ IM Confirmation Samples
- - - AOC/SWMU Boundary
- ▭ IM Area of Removal
- Area of Lead Concentrations Greater Than Zone F Background Pavement



Figure 2.4-2
AOC 611
Lead in Surface Soil and Base of IM Excavation
Charleston Naval Complex

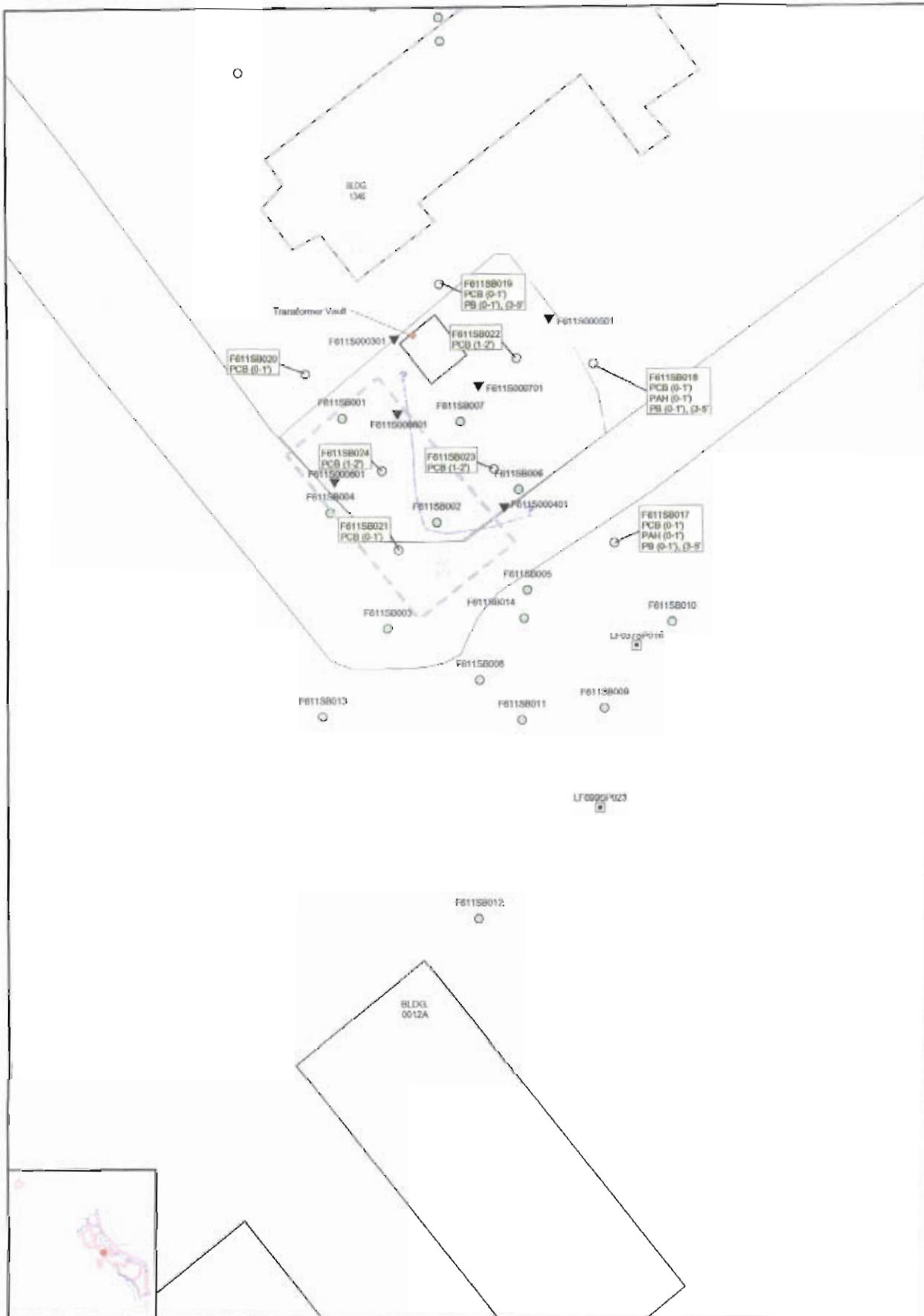
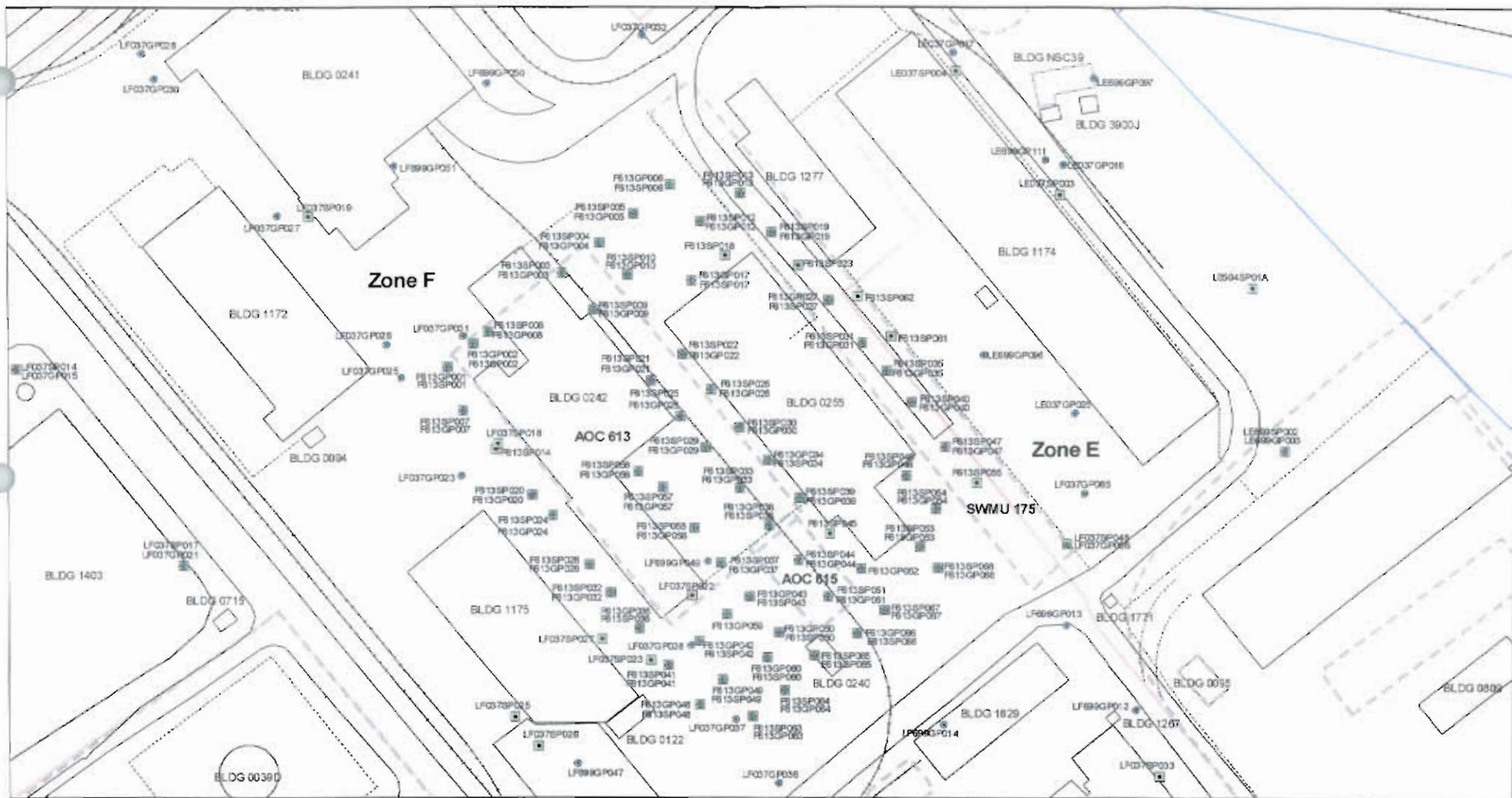


Figure 2-4-3
AOC 611

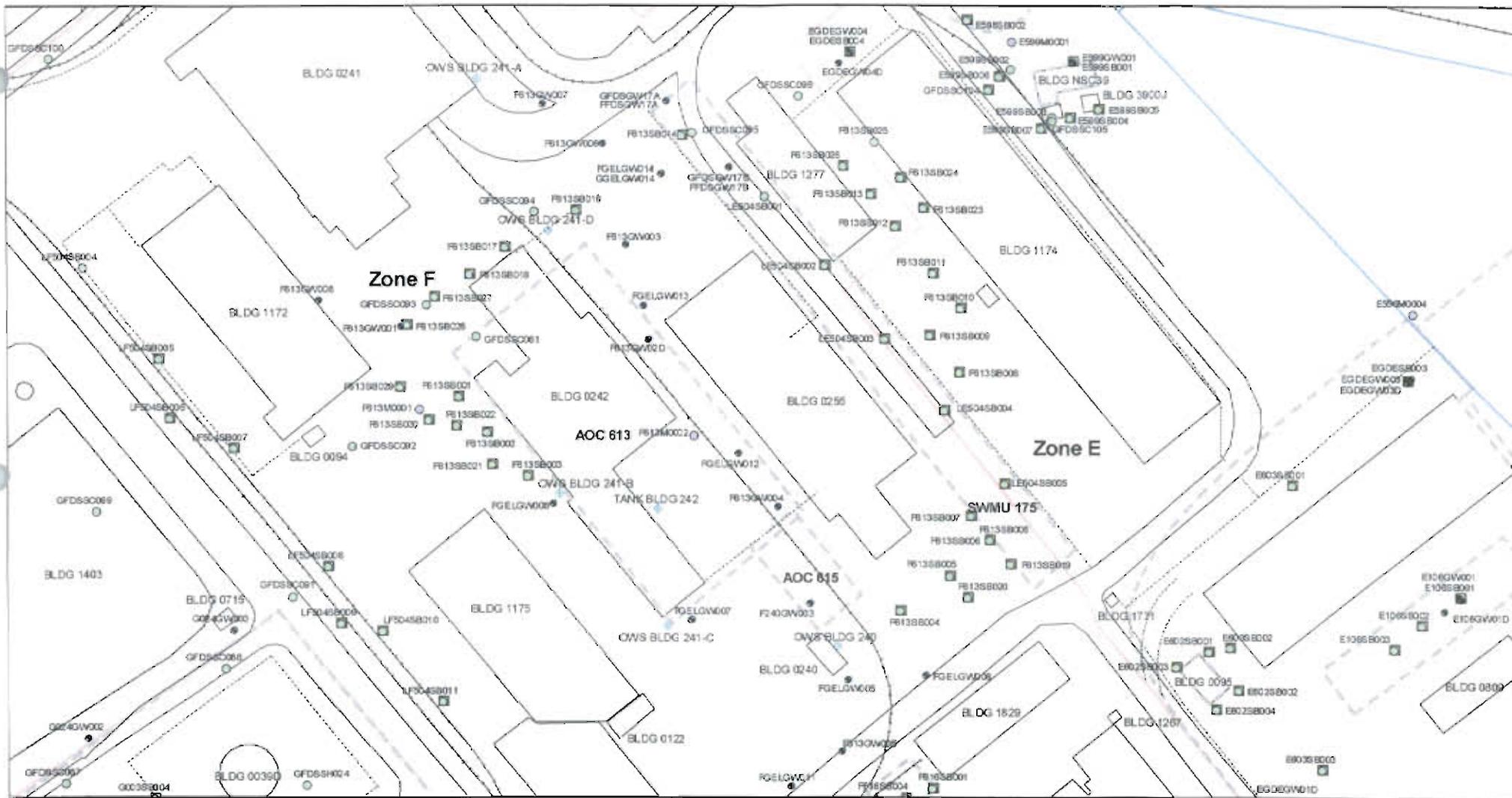
Proposed Sample Locations
Charleston Naval Complex



- Groundwater Probe
- Soil Probe
- Fence
- Railroads
- Roads - Lines
- Shoreline
- SWMU / AOC
- ▭ Buildings
- Zone Boundary



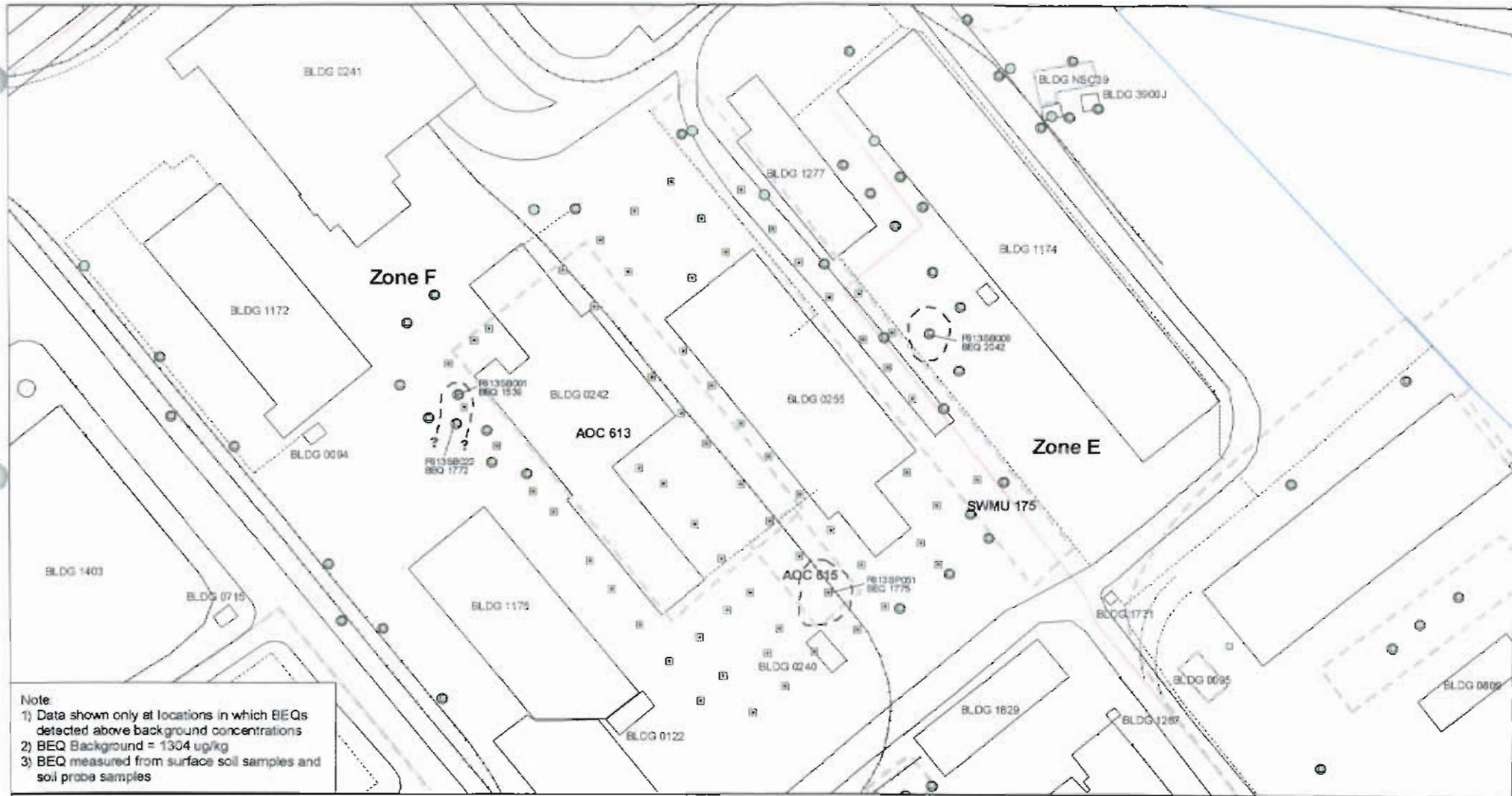
Figure 2.5-2
AOC 613/615/SWMU 175
 Soil Probe and Groundwater Probe Sample Locations
 Charleston Naval Complex



- Groundwater Well
- Sediment
- Surface Soil
- Soil Boring
- ◆ OWS
- Fence
- Railroads
- Roads - Lines
- Shoreline
- SWMU / AOC
- Buildings
- Zone Boundary



Figure 2.5-3
AOC 613/615/SWMU 175
 Soil Boring, Groundwater Well, and Sediment Sample Locations
 Charleston Naval Complex.



Note
 1) Data shown only at locations in which BEQs detected above background concentrations
 2) BEQ Background = 1304 ug/kg
 3) BEQ measured from surface soil samples and soil probe samples

- Surface Soil
- Soil Boring
- Soil Probe
- Concentration Line
- Fence
- Railroads
- Roads - Lines
- Shoreline
- SWMU / AOC
- Buildings
- Zone Boundary

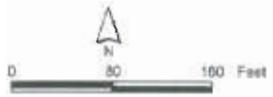


Figure 2.5-4
 AOC 613/615/ SWMU 175
 BEQ Concentrations in Surface Soil
 Charleston Naval Complex

File Path: G:\58514\Drawings\Map\02_515_15_15a.dwg Date: 03 Feb 2007 21:28 User: NPG2472

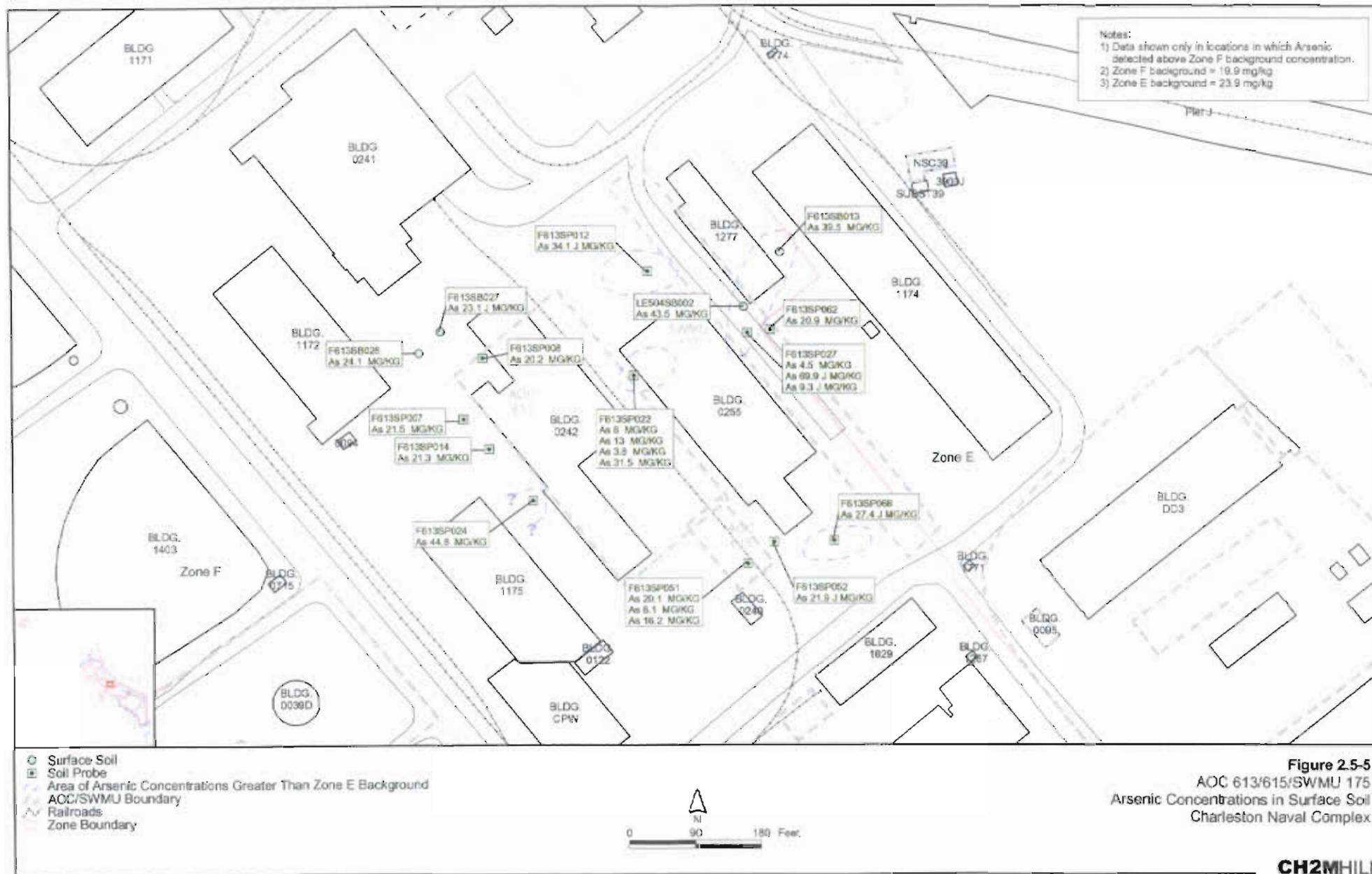
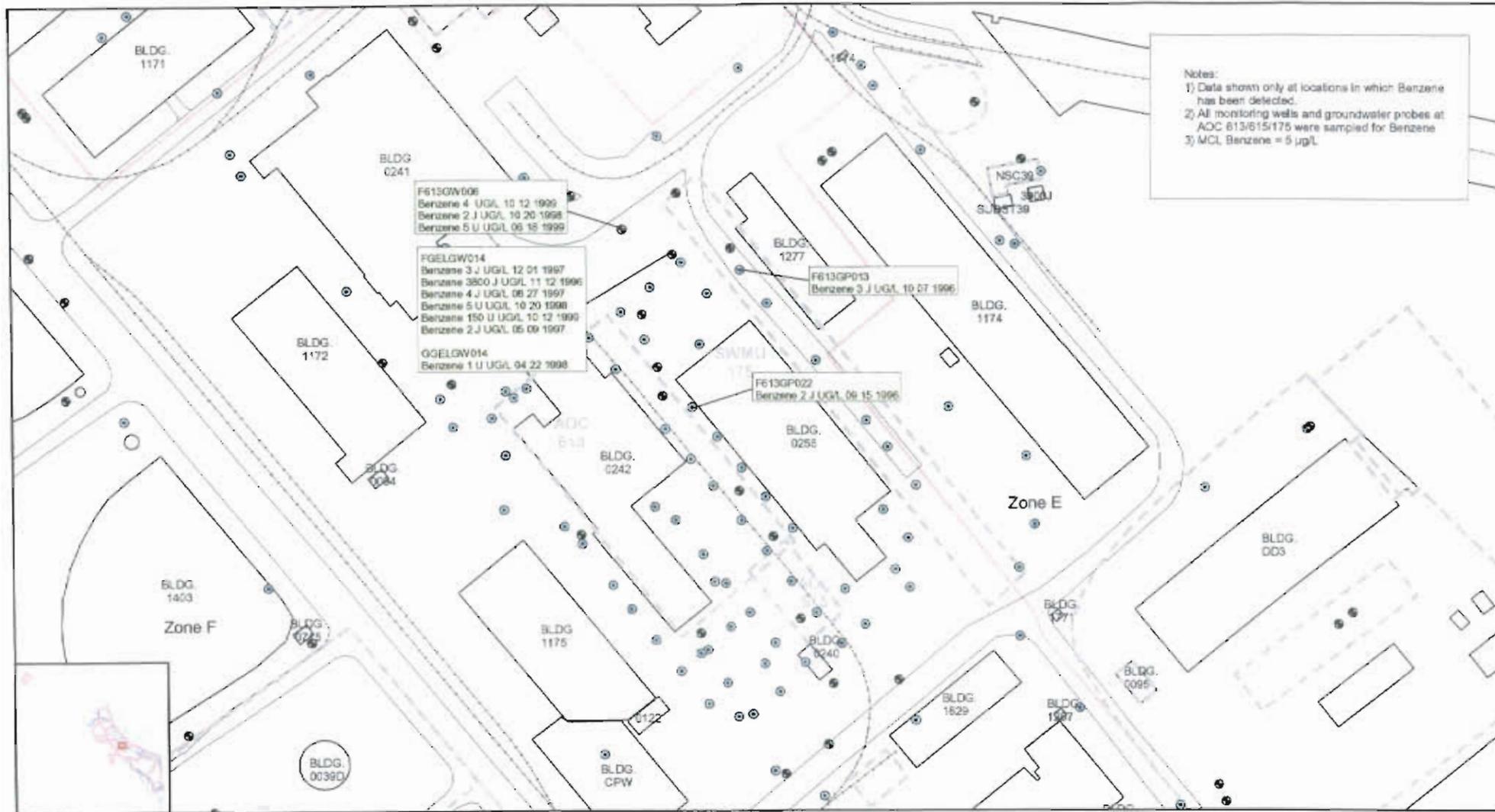


Figure 2.5-5
 AOC 613/615/SWMU 175
 Arsenic Concentrations in Surface Soil
 Charleston Naval Complex



Notes:
 1) Data shown only at locations in which Benzene has been detected.
 2) All monitoring wells and groundwater probes at AOC 613/615/175 were sampled for Benzene
 3) MCL Benzene = 5 µg/L

F613GW006
 Benzene 4 UGL, 10 12 1999
 Benzene 2 J UGL, 10 20 1998
 Benzene 5 U UGL, 05 15 1999

FGELGW014
 Benzene 3 J UGL, 12 01 1997
 Benzene 3800 J UGL, 11 12 1996
 Benzene 4 J UGL, 08 27 1997
 Benzene 5 U UGL, 10 20 1998
 Benzene 150 U UGL, 10 12 1999
 Benzene 2 J UGL, 05 09 1997

GGELGW014
 Benzene 1 U UGL, 04 22 1998

F613GP013
 Benzene 3 J UGL, 10 07 1996

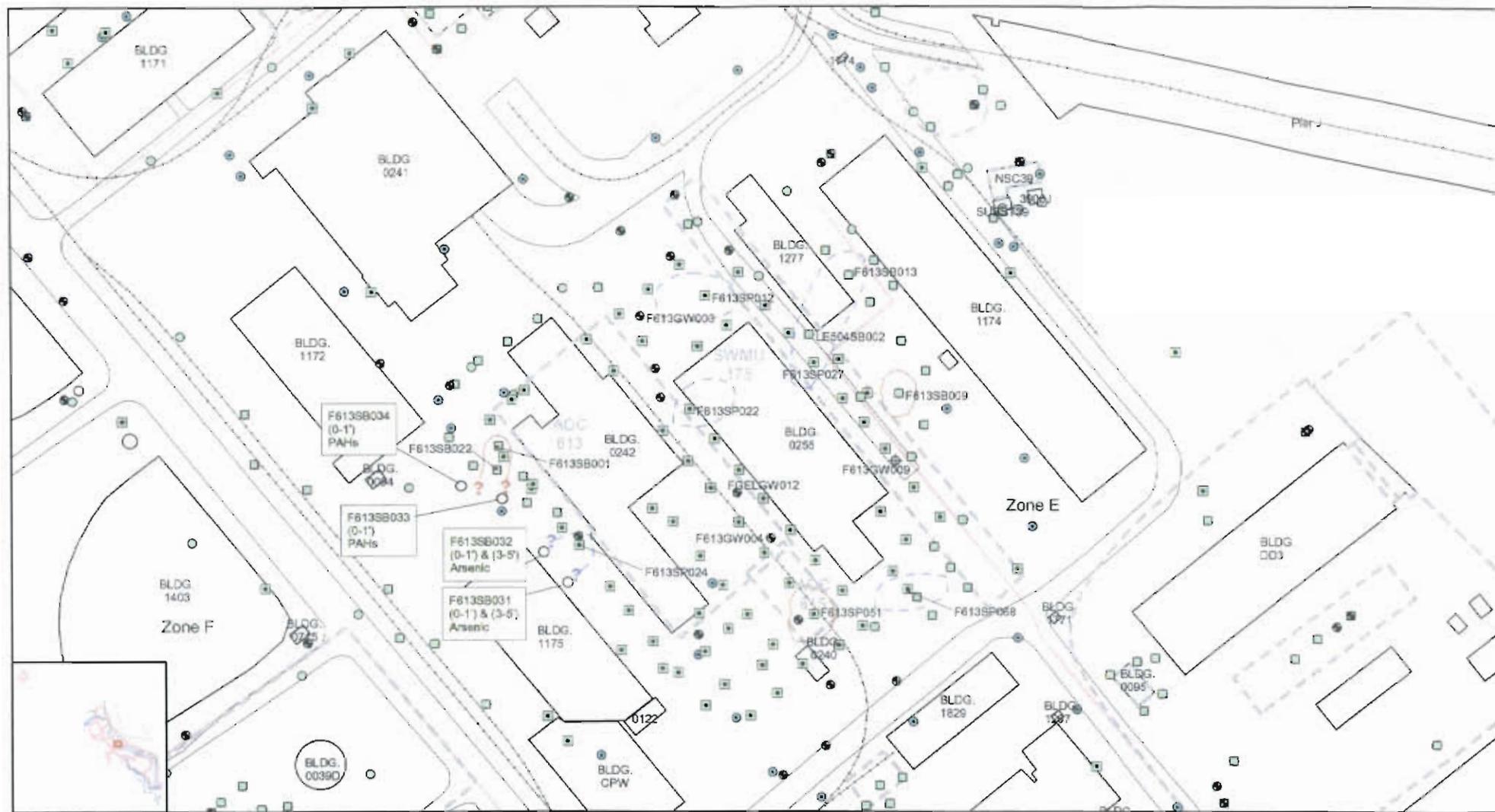
F613GP022
 Benzene 2 J UGL, 06 15 1996

- Groundwater Probe
- Groundwater Well
- AOC/SWMU Boundary
- Railroads
- Zone Boundary



Figure 2.5-7
 AOC 613/615/SWMU 175
 Benzene Concentrations in Groundwater
 Charleston Naval Complex

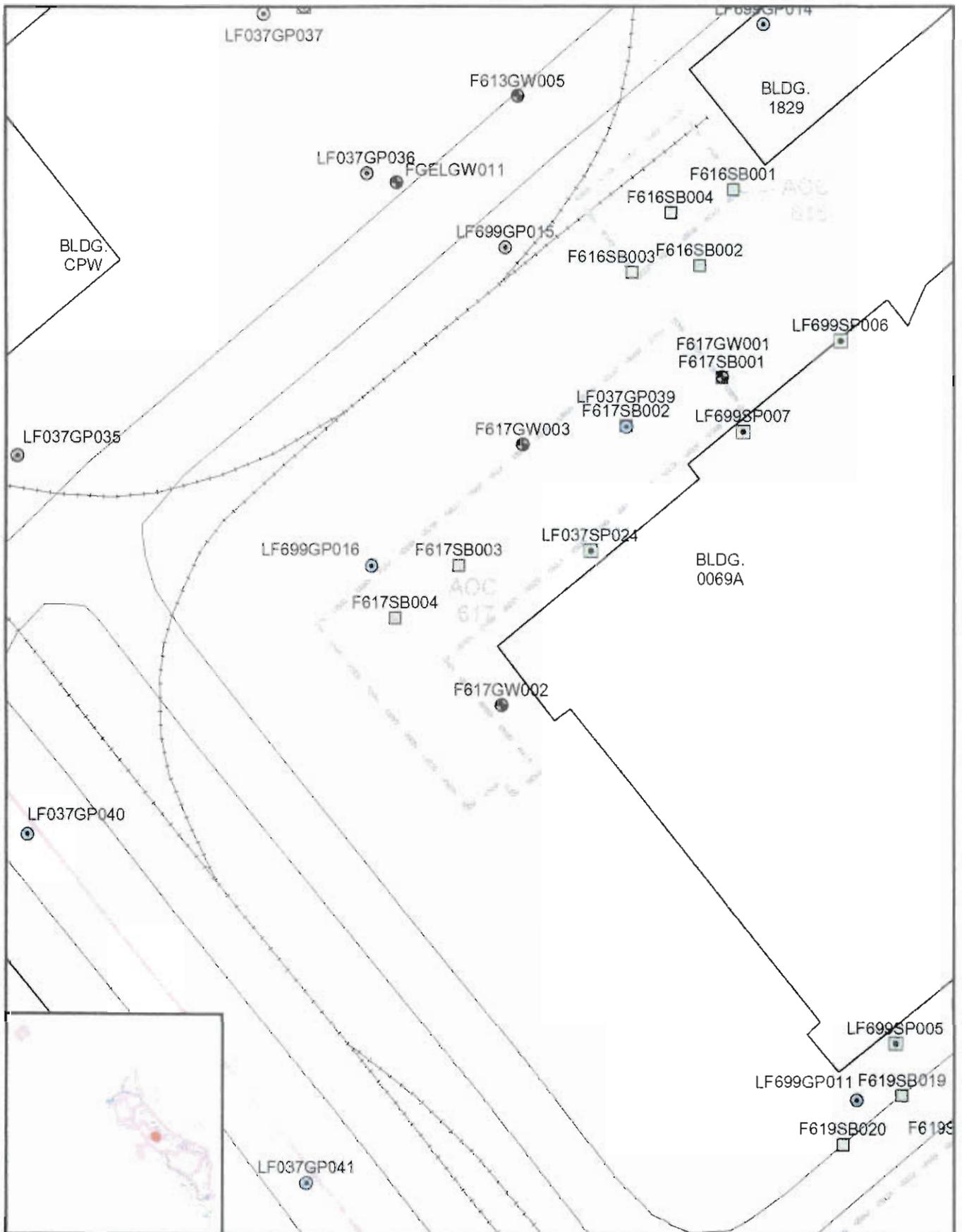
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- ⊕ Proposed Monitoring Well
- Proposed Soil Boring
- ≡ Railroads
- Zone Boundary
- Groundwater Well
- Soil Boring
- ⊞ Soil Probe
- Surface Soil
- ⊙ Groundwater Probe
- AOC/SWMU Boundary
- Area of BEQ Concentrations Greater Than Zone Background
- Area of Arsenic Concentrations Greater Than Zone E Background



Figure 2-5-8
AOC 613/615/SWMU 175
Proposed Soil Boring and Monitoring Well Locations
Charleston Naval Complex



- Soil Boring
- ⊙ Groundwater Probe
- - - AOC/SWMU Boundary
- Groundwater Well
- ◻ Soil Probe
- - - Railroad

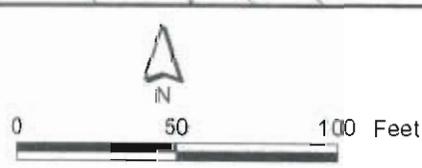
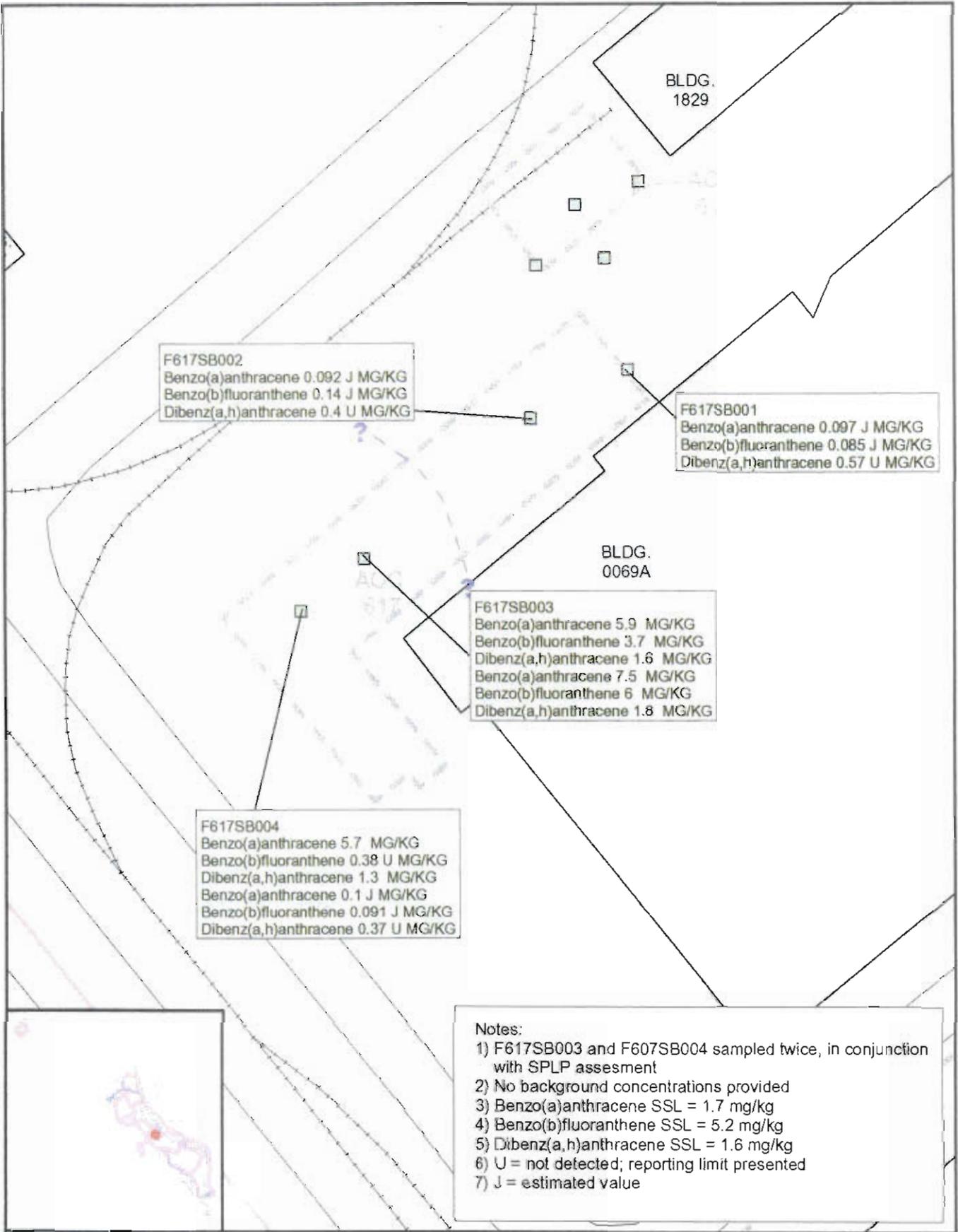


Figure 2.6-1
AOC 617
Sample Locations
Charleston Naval Complex



F617SB002
 Benzo(a)anthracene 0.092 J MG/KG
 Benzo(b)fluoranthene 0.14 J MG/KG
 Dibenz(a,h)anthracene 0.4 U MG/KG

F617SB001
 Benzo(a)anthracene 0.097 J MG/KG
 Benzo(b)fluoranthene 0.085 J MG/KG
 Dibenz(a,h)anthracene 0.57 U MG/KG

F617SB003
 Benzo(a)anthracene 5.9 MG/KG
 Benzo(b)fluoranthene 3.7 MG/KG
 Dibenz(a,h)anthracene 1.6 MG/KG
 Benzo(a)anthracene 7.5 MG/KG
 Benzo(b)fluoranthene 6 MG/KG
 Dibenz(a,h)anthracene 1.8 MG/KG

F617SB004
 Benzo(a)anthracene 5.7 MG/KG
 Benzo(b)fluoranthene 0.38 U MG/KG
 Dibenz(a,h)anthracene 1.3 MG/KG
 Benzo(a)anthracene 0.1 J MG/KG
 Benzo(b)fluoranthene 0.091 J MG/KG
 Dibenz(a,h)anthracene 0.37 U MG/KG

- Notes:
- 1) F617SB003 and F607SB004 sampled twice, in conjunction with SPLP assesment
 - 2) No background concentrations provided
 - 3) Benzo(a)anthracene SSL = 1.7 mg/kg
 - 4) Benzo(b)fluoranthene SSL = 5.2 mg/kg
 - 5) Dibenz(a,h)anthracene SSL = 1.6 mg/kg
 - 6) U = not detected; reporting limit presented
 - 7) J = estimated value

- Soil Boring
- AOC/SWMU Boundary
- Railroads
- Zone Boundary



Figure 2.6-2
 AOC 617

PAH Concentrations in Subsurface Soil Samples
 Charleston Naval Complex

--- Area of Select PAH Concentrations Greater Than SSLs

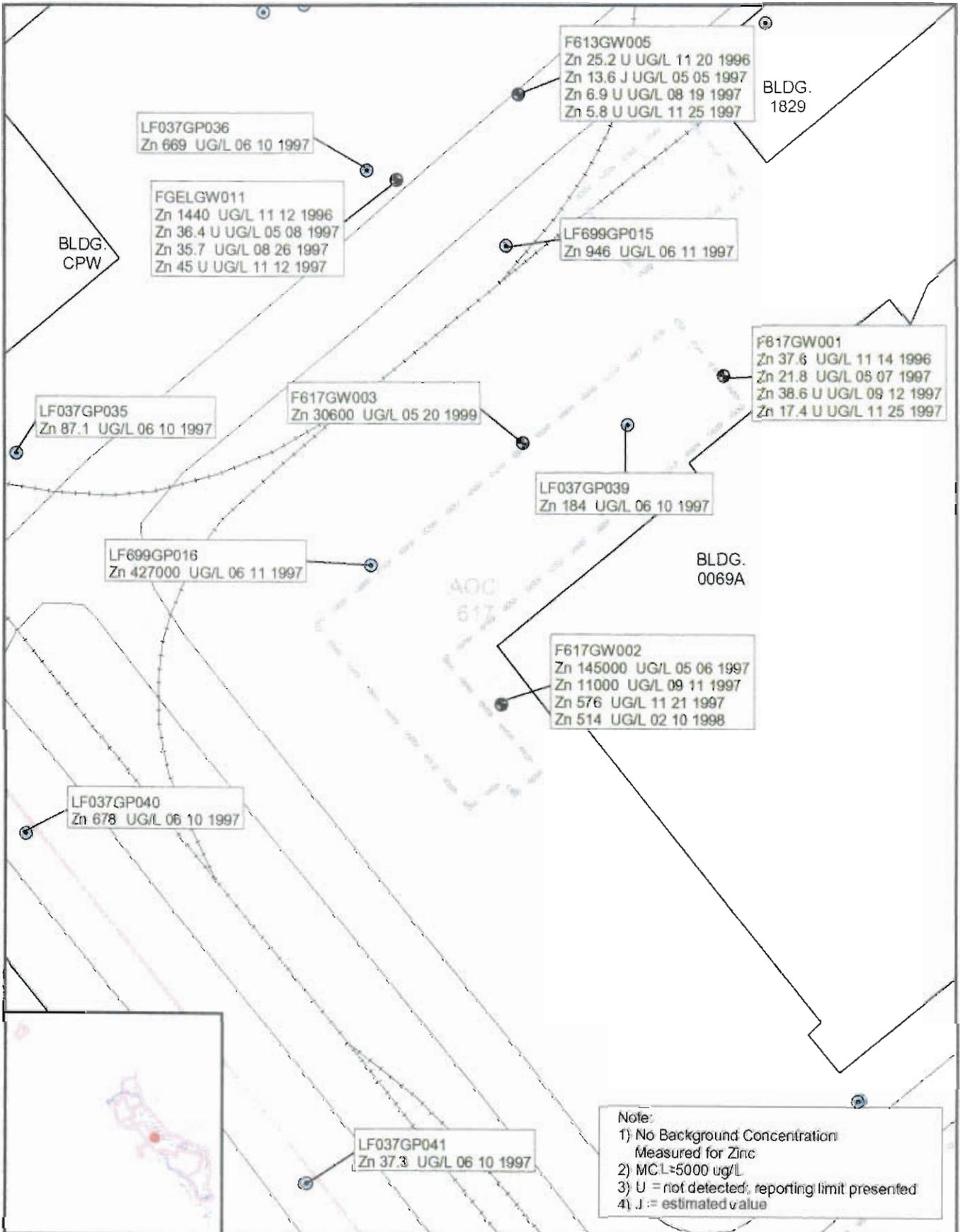


Figure 2.6-3
 Aoc 617
 Zinc Concentrations in Groundwater
 Charleston Naval Complex

● Groundwater Probe
 --- AOC/SWMU Boundary
 ● Groundwater Well
 +---+ Railroads

0 50 100 Feet
 N

CH2M HILL

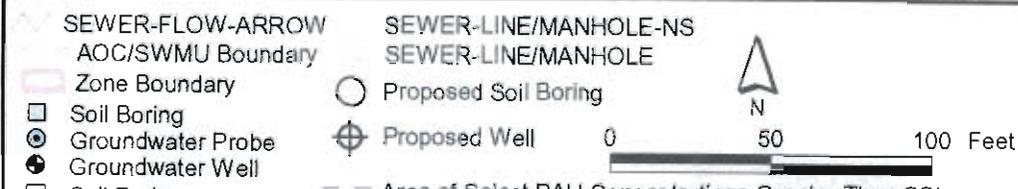
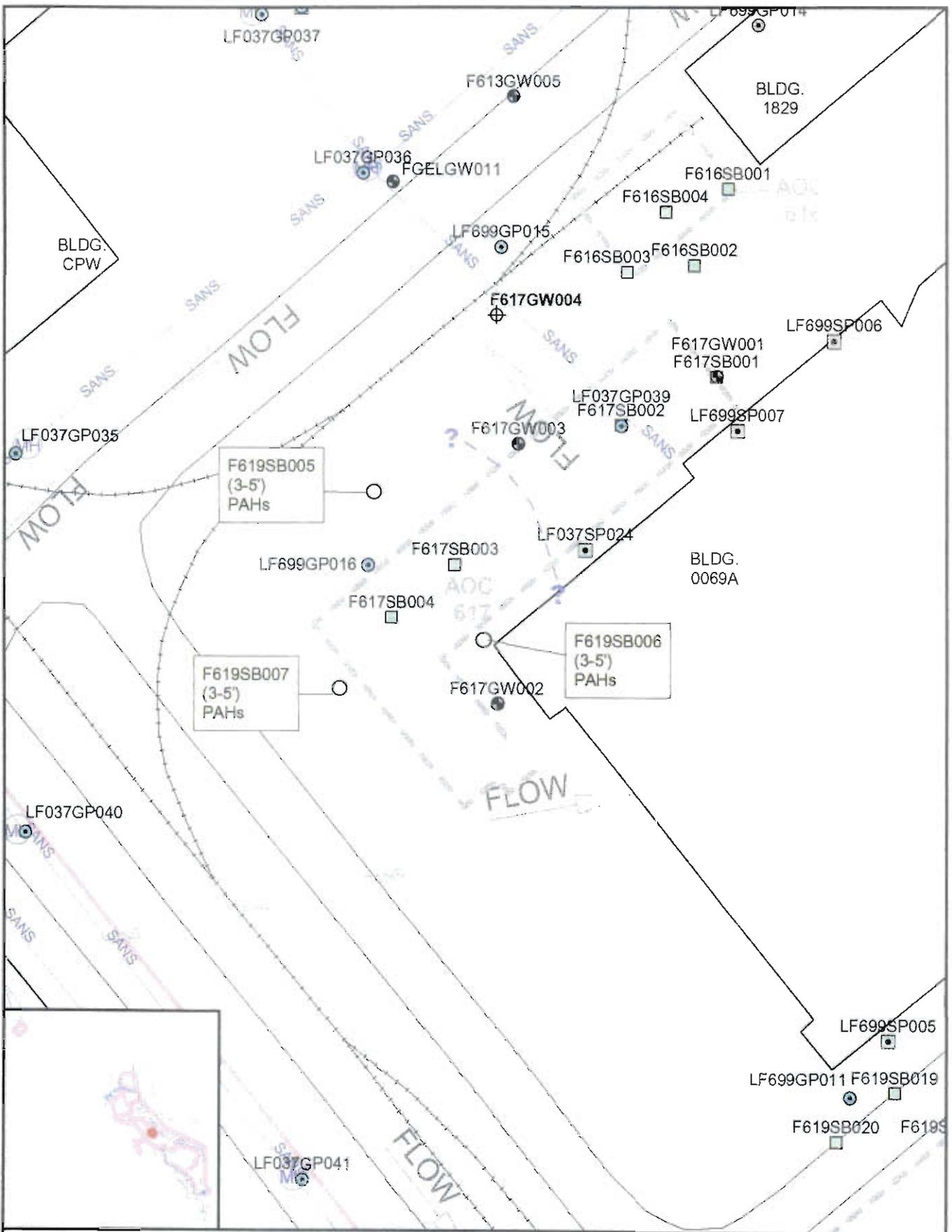
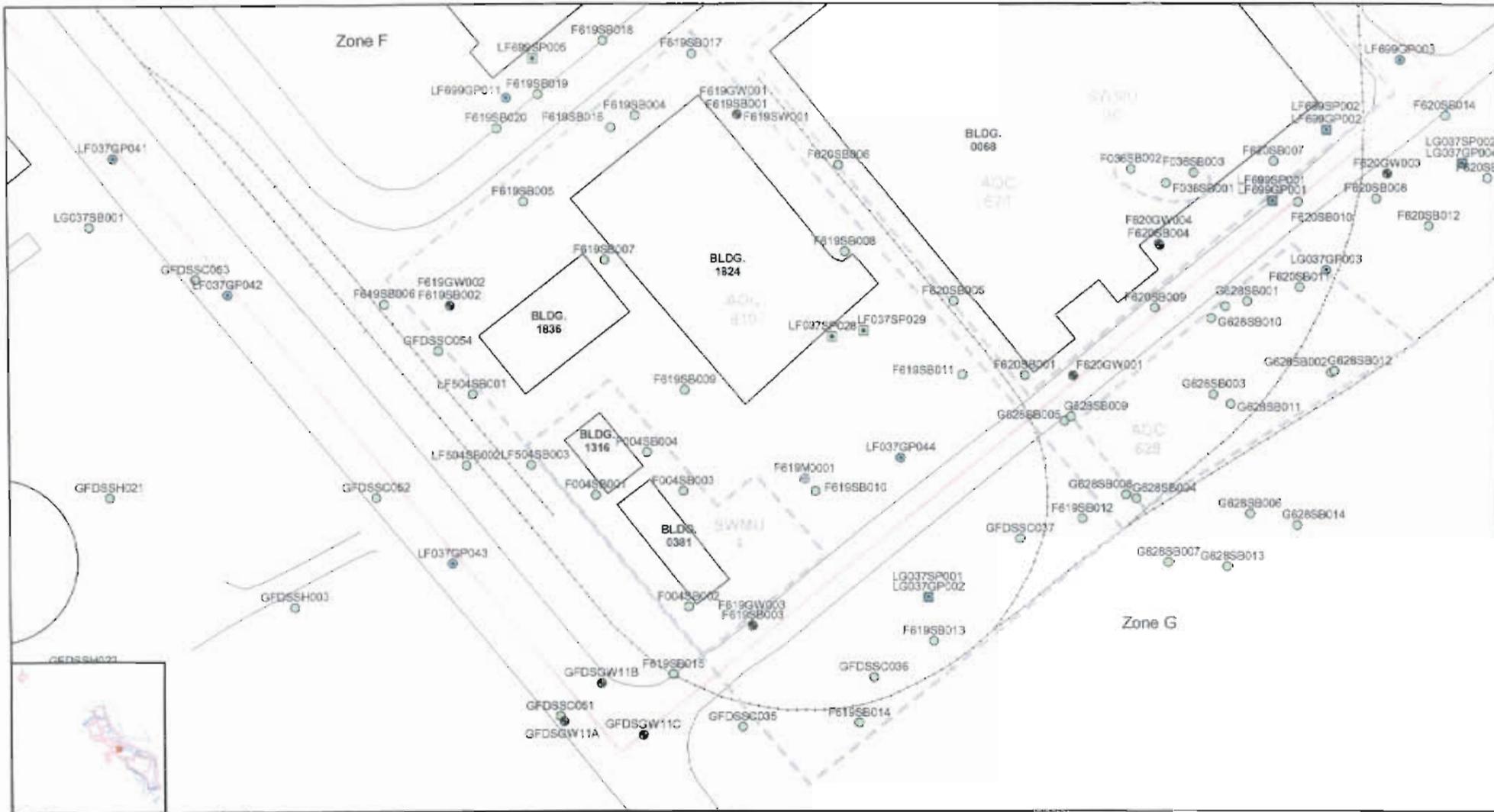


Figure 2.6-4
AOC 617
 Proposed Soil Boring and
 Monitoring Well Locations
 Charleston Naval Complex



- ⊕ Sediment
- ⊙ Groundwater Probe
- Soil Boring
- Groundwater Well
- ⊠ Soil Probe
- - - AOC/SWMU Boundary
- - - Zone Boundary

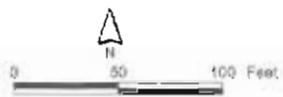
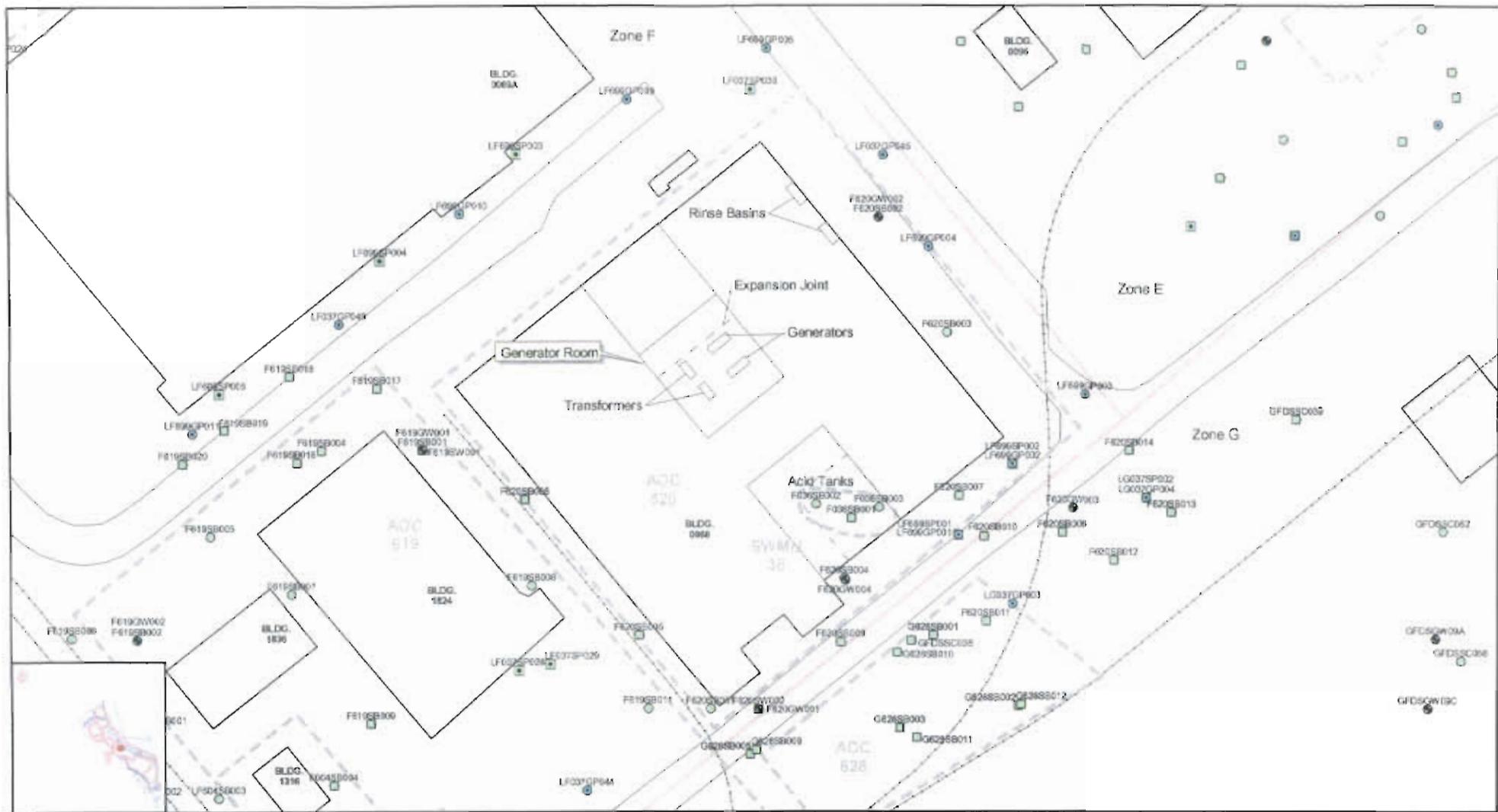


Figure 2.7-1
 AOC 619/SWMU 4
 Sample Locations
 Charleston Naval Complex

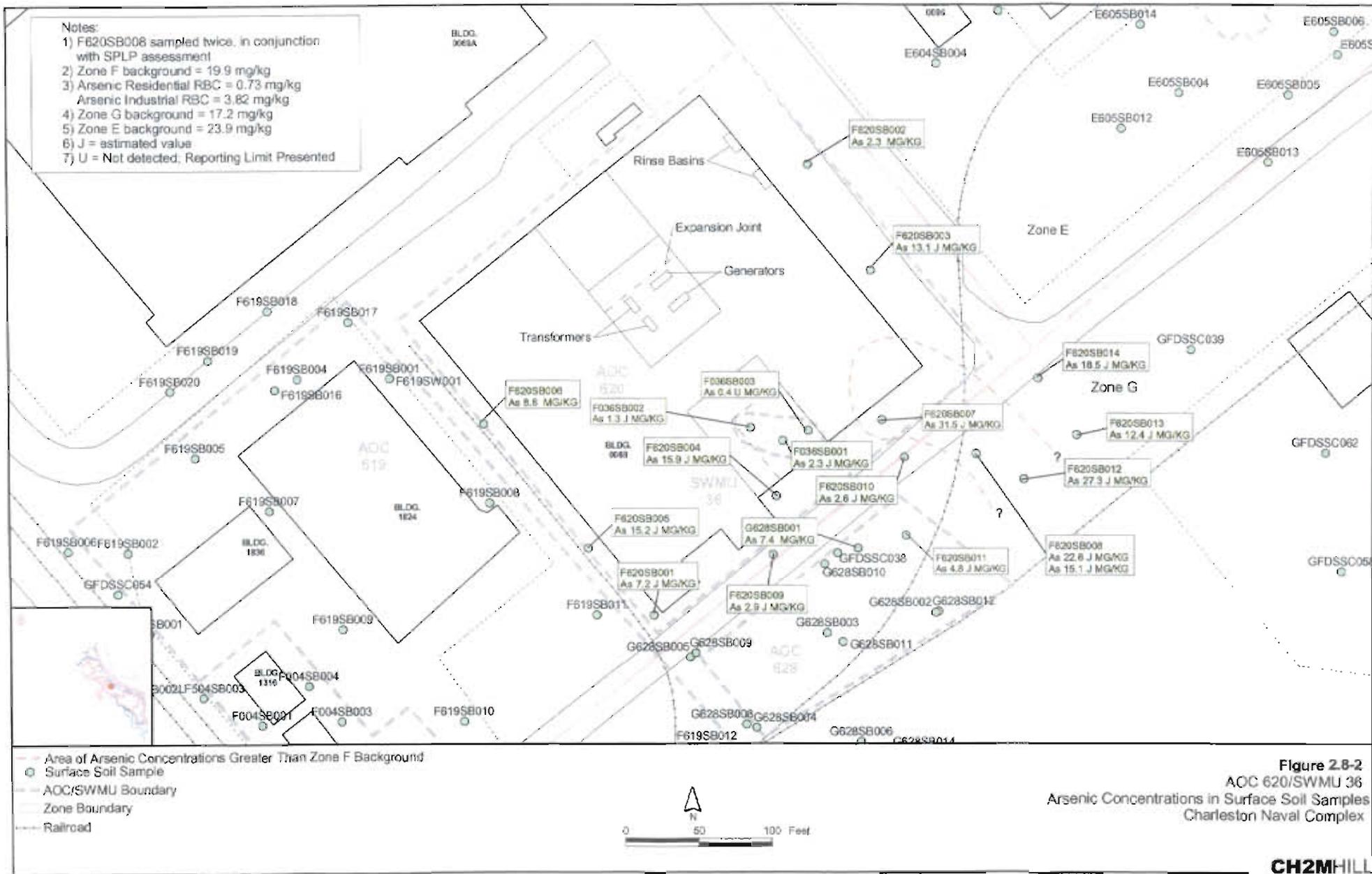


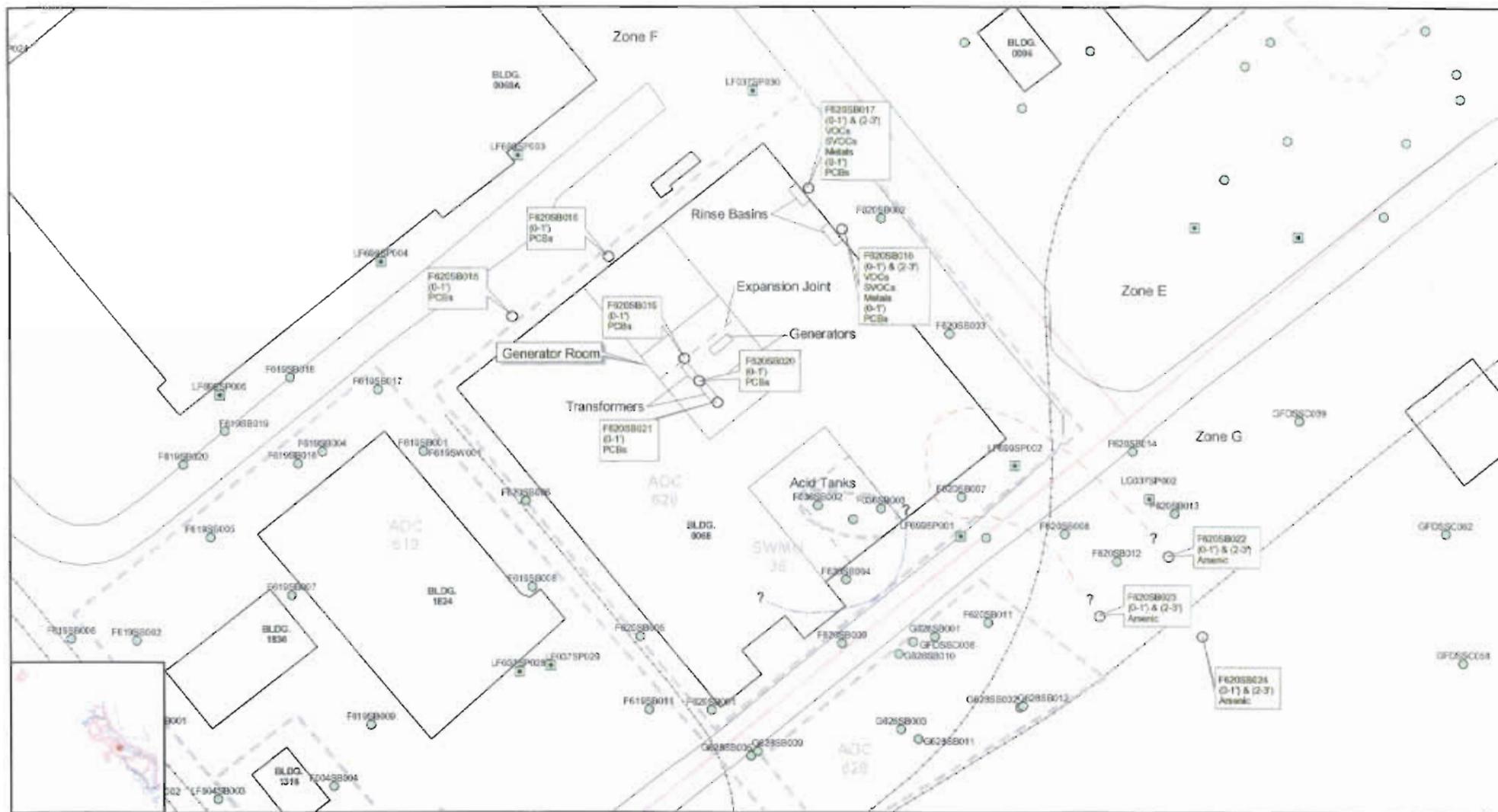
- Soil Boring
- Surface Soil
- Groundwater Well
- ⊙ Groundwater Probe
- ⊞ Soil Probe
- - - AOC/SWMU Boundary
- - - Zone Boundary
- Railroad



Figure 2.8-1
 AOC 620/SWMU 36
 Sample Locations
 Charleston Naval Complex

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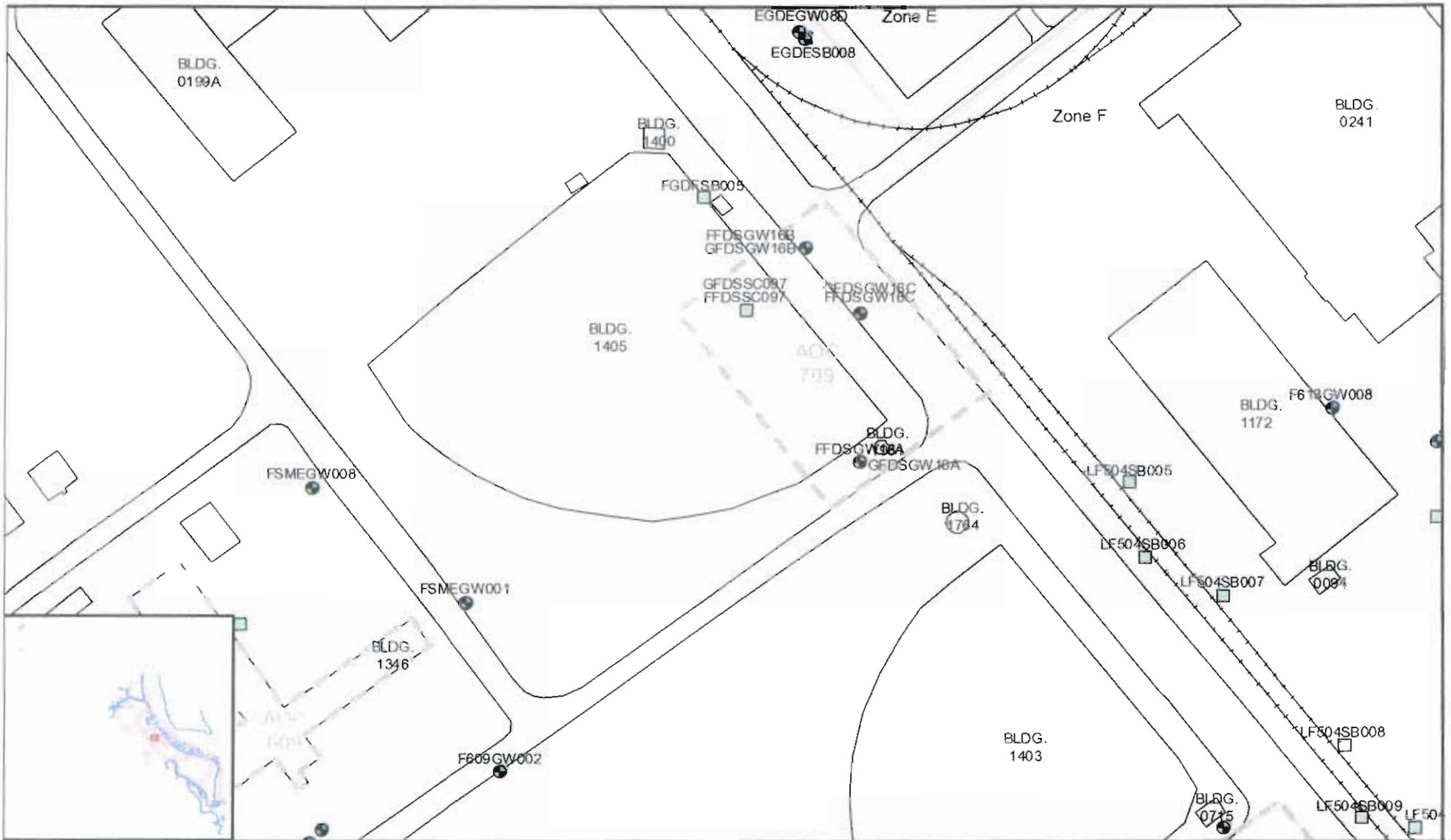


- - Area of Arsenic Concentrations Greater Than Zone F Background
- - Area of PCB Concentrations Greater Than RBC
- - AOC/SWMU Boundary
- Proposed Soil Sample
- Surface Soil Sample
- Railroad



Figure 2.8-4
 AOC 620/SWMU 36
 Proposed Sample Locations
 Charleston Naval Complex

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- Groundwater Well
- Soil Boring
- AOC/SWMU Boundary
- Railroads
- Zone Boundary

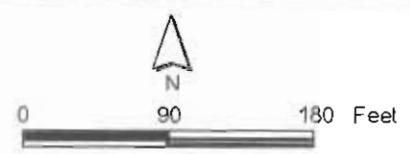
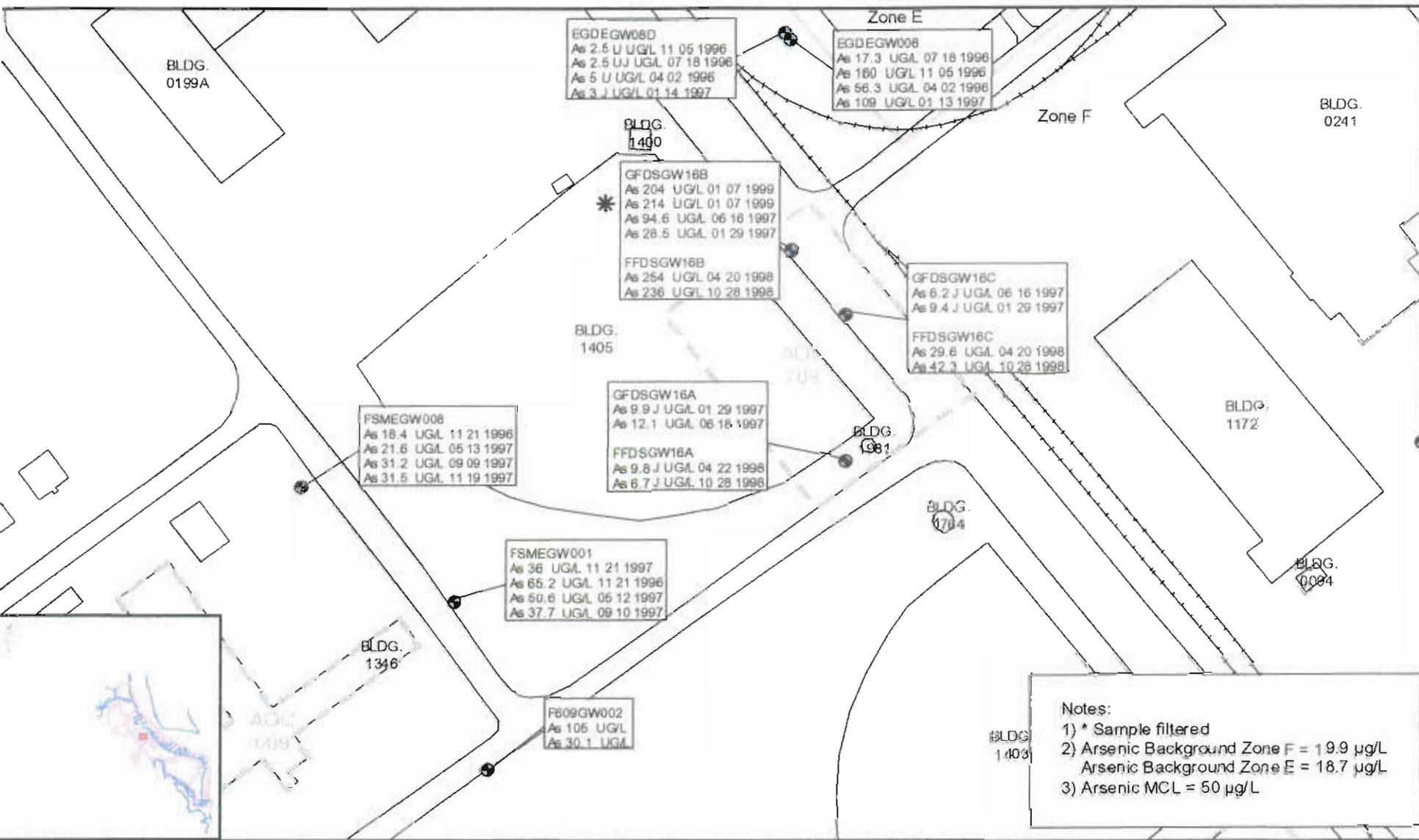


Figure 2.9-1
 AOC 709 (F)
 Sample Locations
 Charleston Naval Complex



- Groundwater Well
- AOC/SWMU Boundary
- ≡ Railroads
- - - Zone Boundary



Figure 2.9-2
AOC 709 (F)
Arsenic in Groundwater
Charleston Naval Complex

SECTION 3.0

Sampling Protocol and Analysis

1 **3.0 Sampling Protocol and Analysis**

2 Soil and groundwater sampling is planned for SWMU 109; AOC 607; AOC 611; AOC
3 613/615/175; AOC 617; and AOC 620/SWMU 4. Table 3-1 summarizes the additional
4 sample collection locations and analysis proposed in Section 2.0 of this RFI Work Plan
5 Addendum.

6 The soil and groundwater sampling and analysis described in this RFI Work Plan
7 Addendum will follow the procedures outlined in the approved Comprehensive
8 Sampling and Analysis Plan (CSAP) portion of the *RFI Work Plan* (E/ A&H, 1994). The
9 CSAP outlines all monitoring procedures to be performed during the investigation to
10 characterize the environmental setting, source, and releases of hazardous constituents.
11 In addition, the CSAP includes the Quality Assurance Plan (QAP) and Data
12 Management Plan (DMP) to verify that all information and data are valid and properly
13 documented. Unless otherwise noted, the sampling strategy and procedures will be
14 performed in accordance with the EPA Environmental Services Division *Standard*
15 *Operating Procedures and Quality Assurance Manual* (ESDSOPQAM, 1996).

16 A copy of the ESDSOPQAM will be kept on site to supplement the CSAP during all
17 field operations. Sample analyses will be conducted in accordance with the guidance in
18 *EPA Test Methods for Evaluating Solid Waste, SW-846, 3rd ed.*, Office of Solid Waste and
19 Emergency Response (SW-846) and in the EPA Environmental Services Division
20 *Laboratory Operations and Quality Control Manual* (ESDLOPQCM, 1996). Sample analysis
21 and data collection efforts will satisfy EPA DQO Level III protocol. A minimum of 5
22 percent of the Zone F samples will be analyzed at EPA DQO Level IV for confirmation
23 purposes.

24 **3.1 Soil Sampling Procedures**

25 Soil will be sampled in accordance with the RFI Work Plan and the EPA guidance
26 referenced above. Subsurface soil samples are intended to be collected above the
27 groundwater table. If groundwater is encountered within the depth interval of the
28 subsurface sample, the sample depth will be decreased sufficiently to obtain the sample.
29 Specific site instructions are outlined below:

1 **SWMU 109**: Boreholes for locations with both surface and subsurface soil samples may
2 be advanced using hollow stem augers. Sample collection, preparation, and equipment
3 decontamination procedures will follow the guidance documents above. Samples of
4 blast media should be collected from the surface within a 3-foot radius of the identified
5 location, using a decontaminated stainless steel trowel.

6 **AOC 611**: Surface soil and near surface soil (1-2 feet below grade) samples in unpaved
7 areas may be collected by hand auger at the specified depths. Samples to be collected at
8 both 0-1 foot and 3-5 feet below grade may be collected using split spoons in a borehole
9 advanced by hollow-stem augers.

10 **AOC 613/615/175**: Boreholes for locations with both surface and subsurface soil samples
11 may be advanced using hollow stem augers. Surface soil samples will be collected
12 beneath pavement.

13 **AOC 620/SWMU 36**: Surface soil samples collected from beneath the floor slab, at the
14 base of the crawl space, will be collected after coring the floor. A decontaminated hand
15 auger, core sampler, or other device may be used to obtain the sample. If any of the
16 surface samples contain visibly stained soil, a subsurface soil sample will be collected
17 from 2-3 feet below grade at that location. Surface and subsurface samples collected near
18 the rinse basins may be obtained after coring the loading dock and extending a hand
19 auger through the core hole. Likewise, if the surface samples in this location are visibly
20 stained, the subsurface samples will be analyzed for PCBs in addition to the other
21 specified parameters. Samples in the unpaved area southeast of AOC 620/SWMU 36
22 will be collected with a hand auger.

23 **3.2 Monitor Well Installation**

24 Permanent monitoring wells will be installed at AOC 617 and AOC 613/615/SWMU
25 175, both screened in the shallow water-bearing zone. The location and construction
26 details of the proposed monitoring wells will be presented in the request for installation,
27 which will follow the content requirements as outlined in R.61-79.265 Subpart F of the
28 South Carolina Hazardous Waste Management Regulations and R.61-71 of the South
29 Carolina Well Standards and Regulations. The request will be submitted to SCDHEC for
30 approval at least two weeks prior to the scheduled well installation activities. This
31 written request provides the purpose of the monitoring well activities and consists of
32 well construction details and a map depicting the proposed well locations.

1 **3.2 Investigation-Derived Waste**

2 Investigative-derived waste (IDW) generated during the sample collection associated
3 with this Work Plan Addendum will include pavement or concrete slab cores, drill
4 cuttings, well development water, and purge water monitoring well sampling. IDW will
5 be collected in labeled 55-gallon drums, sealed, and left on site. Soil waste will be
6 segregated from liquid waste. After the analytical results have been reviewed, the 55-
7 gallon drums and their contents will be removed by the U.S. Naval Detachment
8 (Detachment) for off site treatment or disposal. If arrangements cannot be made with
9 the Detachment, CH2M-Jones will haul the drums to a permitted and licensed facility
10 for treatment or disposal.

TABLE 3-1
 Proposed Sampling and Analysis Plan—Zone F
 Charleston Naval Complex, North Charleston, South Carolina

Site	Proposed Sample Collection Location(s)	Matrix/Interval	Quantity	Analysis	Rationale
109	F109SB011 F109SB012 F109SB013 F109SB014	Surface (0-1') and Subsurface (3-5') soil Blast media surface	One soil sample from each depth interval at each location (8 samples total)	Lead in Soil Eight RCRA Metals in Blast Media	Delineate lead impacts in soil northeast of AOC 109 Determine possible source of metals impacts in catch basin sediment sample F109M0002.
	Two blast media surface samples				
607	Two new monitoring wells along Avenue D, west of Building 225	Groundwater	Two quarterly sampling events for Avenue D wells (4 samples total)	VOC – Avenue D Wells	Delineate PCE impacts in groundwater west of Building 225
	F607GW002		One sample from F607GW002	Lead – F607GW002	Evaluate elevated lead in groundwater at the eastern periphery of AOC 607.
611	F611SB017 F611SB018 F611SB019 F611SB020 F611SB021 F611SB022 F611SB023 F611SB024	Surface (0-1') and Subsurface (3-5') soil for F611SB017, F611SB018, and F611SB019	One soil sample from each depth interval at each location (11 samples total)	Lead - Surface (0-1') and Subsurface (3-5') soil for F611SB017, F611SB018, and F611SB019 PAHs - Surface (0-1') soil only for F611SB020 and F611SB021	Delineate Lead, PAH, and PCB impacts within and outside of the IM area.
		Surface (0-1') only for F611SB020 and F611SB021		PCBs – Shallow Subsurface (1-2') soil for F611SB022, F611SB023, and F611SB024; Surface (0- 1') soil for F611SB017, F611SB018, F61SB019, F611SB020, and F611SB021	
		Shallow Subsurface (1- 2') only for F611SB022, F611SB023, and F611SB024			

TABLE 3-1
 Proposed Sampling and Analysis Plan—Zone F
 Charleston Naval Complex, North Charleston, South Carolina

Site	Proposed Sample Collection Location(s)	Matrix/Interval	Quantity	Analysis	Rationale
613/615/175	F613SB031 F613SB032 F613SB033 F613SB034	Surface Soil (0-1') for F613SB033 and F613SB034		PAHs - Surface (0-1') soil for F613SB033 and F613SB034	.Delineate BEQs above background
	F613GW009 installed and sampled F613GW003 F613GW004 FGELGW012 F619SB005 F619SB006 F619SB007	Surface (0-1') and Subsurface (3-5') soil for F613SB031 and F613SB032	One soil sample from each depth interval at each location (6 samples total)	Arsenic – Surface (0-1') and subsurface (3-5') soil for F613SB031 and F613SB032	Delineate Arsenic
		Groundwater, shallow water-bearing zone	4 groundwater samples	VOCs - groundwater	Evaluate groundwater CVOCs east of AOC 613 and in south half of SWMU 175
		Subsurface (3-5') soil	One soil sample from each location (3 samples total)	PAH – Soil	
		Groundwater, shallow water-bearing zone	Two quarterly sampling events for groundwater (8 samples total)	Metals (As, Cd, Cr, Ni, Sb, and Zn) – Groundwater	Delineate PAH impacts in soil and zinc impacts in groundwater
		Surface (0-1') soil for F620SB015 and F620SB016	One soil sample from each depth interval at each location (15 samples total)	PCBs – Surface (0-1') soil for F620SB015, F620SB016, F620SB017, F620SB018, F620SB019	Investigate generator/transformer area inside Building 68
		Surface (0-1') and Shallow Subsurface (2-3') soil for F620SB017 and F620SB018	Contingency samples as needed	F620SB020, and F620SB021 Contingency samples in Shallow Subsurface (2-3') soil 620SB017, F620SB018, F620SB019, F620SB020, and F620SB021	Investigate rinse basins drain located outside Building 68
617 620	F617GW001 F617GW002 F617GW003 F617GW004 installed and sampled F620SB015 F620SB016 F620SB017 F620SB018 F620SB019 F620SB020 F620SB021 F620SB022 F620SB023 F620SB024	Surface (0-1') soil for F620SB019, F620SB020, and F620SB021; Contingency subsurface		F620SB021	Delineate PCB impacts to the north of Building 68 Delineate Arsenic impacts to the southeast of Building 68.

TABLE 3-1
 Proposed Sampling and Analysis Plan—Zone F
 Charleston Naval Complex, North Charleston, South Carolina

Site	Proposed Sample Collection Location(s)	Matrix/Interval	Quantity	Analysis	Rationale
		soil (2-3') at F620SB019, F620SB020, and F620SB021		VOCs, SVOCs, and Metals - Surface (0-1') and Shallow Subsurface (2-3') soil for F620SB017 and F620SB018	
		Surface (0-1') and Shallow Subsurface (2-3') soil for F620SB022, F620SB023, and F620SB024		Arsenic – Surface (0-1') and Shallow Subsurface (2-3') soil for F620SB022, F620SB023, and F620SB024	

SECTION 4.0

References

4.0 References

- 2 CH2M-Jones. *AOC 607 Interim Measure Work Plan, Building 225 Indoor Air Pathway*
- 3 *Assessment*. December 2000.
- 4 CH2M-Jones. *Sampling and Analysis Plan for Zone F/Site 22 – Building 242*. August 2000.
- 5 EnSafe Inc. *Final Zone F Work Plan Addendum, Revision 0*. November 3, 1999.
- 6 EnSafe Inc. *Zone F RFI Work Plan*. December 31, 1997.
- 7 EnSafe Inc. *Zone F RCRA Facility Investigation Report, Revision 0*. March 31, 1999.
- 8 SPORTENVDETHASN *Completion Report, Interim Measure for AOC 61*. January 29,
- 9 1998.
- 10 EnSafe Inc./Allen & Hoshall. *RFI Work Plan*. 1994.
- 11 Tetra-Tech NUS. *Rapid Assessment Report for Site 25, Building 1346*. January 2000.
- 12 SPORTENVDETHASN. *UST Assessment Report*. September 1996.
- 13 Tetra Tech NUS (TTNUS). *Final Assessment Report*. February 2000.
- 14 *Final RCRA Facility Assessment for Naval Base Charleston. E/A&H, June 6, 1995 and earlier*
- 15 *RFI documents 1) Final Zones D, F, and G RFI Work Plan. E/A&H, June 1996, 2) Final*
- 16 *Comprehensive SAP for RFI (Rev 2). E/A&H, July 1996, 3) Final Comprehensive RFI Work*
- 17 *Plan. E/A&H, July 1996.*
- 18 *Excerpts From The Rough Draft of The AOC 607 Corrective Measures Study Report: Dual*
- 19 *Phase Extraction With Air Sparging Pilot Study Results. E/A&H, June 2000.*
- 20 *Completion Report, Interim Measure for AOC 611, SPORTENVDETHASN, January 29,*
- 21 *1998.*
- 22 *Draft Zone F RCRA Facility Investigation Report. E/A&H, December, 1997.*

APPENDIX A

Site-Specific Soil Screening Levels

APPENDIX A

Soil-Screening Level Tables

SSLs were prepared as described in the attached Technical Memorandum: Application of Soil-Screening Levels (SSLs) at Charleston Naval Complex (CNC), dated January 9, 2001. Infiltration rates were subsequently adjusted to account for the full infiltration value provided by U.S. Geological Survey (USGS). The SSL tables provided in this appendix present values for dilution attenuation factor (DAF), and corresponding SSLs, both of which were calculated using the partial infiltration and the full infiltration rates.

Appendix A

Table A1. Hydraulic Conductivity

Wells	Hydraulic Conductivity (ft/day)	
	Falling Head	Rising Head
GDF001	6	8.4
607001	1.74	2
607002	0.42	0.62
607004	0.191	0.197
613001	0.83	1.3
613004	0.38	0.27
619002	0.11	0.11
619003	0.28	0.32
620002	0.42	0.41
GEL005	0.42	0.41
GEL007	0.31	0.21
SME004	8.70E-02	9.20E-02
Shallow		
607011	1.3	1.2
607021	0.37	0.55
607041	0.7	0.66
Intermediate		
GDF01D	2.7	1.7
60701D	2.70E-02	NM
60702D	2.30E-02	NM
60704D	8.10E-03	NM
61302D	0.12	0.12
Deep		
Average =	0.82	1.09
Average for all values =		0.95

NM Not measured

0.95 ft/day =

346.75 ft/yr
105.7 m/yr

Table A2. DAF Calculations

Assuming 25% of USGS Infiltration Rate for potentially non-paved areas (west of Hobson Ave.) and 100% of Infiltration Rate for fully paved, industrial areas (east of Hobson Ave.)

Site(s)	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient I (m/m)	Aquifer Thickness da (m)	Source Length Sw (m)	Infiltration Rate I' (m/yr)	Mixing Zone d (m)	DAF
004/619, 036/620	105.7	0.02	9.8	120	0.00762	9.8	23.7
616,617	105.7	0.018	9.8	21	0.00762	2.3	28.4
607	105.7	0.0079	8.2	46	0.0305	6.4	4.8
609, 611	105.7	0.0043	8.5	38	0.0305	6.2	3.4
109	105.7	0.0058	7.6	30	0.00762	3.5	10.5
613/615/175	105.7	0.0227	9.1	150	0.00762	9.1	20.1
709	105.7	0.025	10.8	120	0.0305	10.8	8.8

Table A3. DAF Calculations

Assuming 100% of USGS Infiltration Rate for all sites

Site(s)	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient I (m/m)	Aquifer Thickness da (m)	Source Length Sw (m)	Infiltration Rate I' (m/yr)	Mixing Zone d (m)	DAF
004/619, 036/620	105.7	0.02	9.8	120	0.0305	9.8	6.7
616,617	105.7	0.018	9.8	21	0.0305	2.6	8.6
607	105.7	0.0079	8.2	46	0.0305	6.4	4.8
609, 611	105.7	0.0043	8.5	38	0.0305	6.2	3.4
109	105.7	0.0058	7.6	30	0.0305	4.5	4.0
613/615/175	105.7	0.0227	9.1	150	0.0305	9.1	5.8
709	105.7	0.025	10.8	120	0.0305	10.8	8.8

Appendix A
 ZONE F SSL Calculations -- AOC 607

Site No.	AOC 607	I' = .00762	I' = .0305	Residential	Industrial	Surface	Subsurface
Site-Specific DAF		13.6	4.8				
Constituent	SSL for DAF=1	Adjusted SSL	Adjusted SSL	RBC	RBC	Background	Background
Inorganics							
Ag	MG/KG	5.8E+01	7.8E+02	2.8E+02	39	1000	1.85
Al	MG/KG	4.2E+04	5.6E+05	2.0E+05	7800	200000	18500
As	MG/KG	2.0E+01	2.7E+02	9.6E+01	0.43	3.8	19.9
Ba	MG/KG	1.0E+02	1.4E+03	4.8E+02	550	14000	61.5
Be	MG/KG	5.8E-01	8.0E+00	2.8E+00	16	410	1.05
Cd	MG/KG	4.6E+00	6.3E+01	2.2E+01	7.8	100	0.26
Co	MG/KG	1.5E+03	2.0E+04	7.0E+03	470	12000	15.1
Cr	MG/KG	5.1E+01	6.9E+02	2.4E+02	210	450	34.8
Cu	MG/KG	9.2E+02	1.3E+04	4.4E+03	310	8200	48.2
Fe	MG/KG	1.6E+04	2.2E+05	7.8E+04	2300	61000	
Hg	MG/KG	2.9E+00	4.0E+01	1.4E+01	2.3	61	0.62
Mn	MG/KG	5.4E+03	7.3E+04	2.6E+04	1100	4100	307
Ni	mg/kg	5.5E+01	7.5E+02	2.7E+02	160	4100	12.6
Pb	mg/kg	3.1E+01	4.2E+02	4.0E+02	400	100	180
Sb	mg/kg	9.2E-01	1.3E+01	4.4E+00	3.1	82	0.79
Se	mg/kg	1.2E+01	1.6E+02	5.5E+01	39	1022	1.15
V	mg/kg	2.2E+02	2.9E+03	1.0E+03	55	1400	48.9
Zn	mg/kg	1.6E+03	2.2E+04	7.8E+03	2300	61000	198
VOCs							
2-Butanone (MEK)	µg/kg	4.6E+03	6.3E+04	2.2E+04	4.70E+06		
cis-1,2-DCE	µg/kg	2.8E+01	3.8E+02	1.3E+02			
trans-1,2-DCE	µg/kg	3.5E+01	4.8E+02	1.7E+02			
1,2-DCE (total)	µg/kg	7.1E+01	9.6E+02	3.4E+02	7.00E+04	1.80E+06	
1,1-DCE	µg/kg	4.2E+00	5.6E+01	2.0E+01			
4-Methyl-2-Pentanone	µg/kg	7.7E+02	1.0E+04	3.7E+03	6.30E+05		
Acetone	µg/kg	7.5E+02	1.0E+04	3.6E+03	7.80E+05		
Carbon disulfide	µg/kg	2.0E+03	2.7E+04	9.6E+03	7.80E+05		
Methylene chloride	µg/kg	1.3E+00	1.8E+01	6.3E+00	8.50E+04		
Toluene	µg/kg	1.2E+03	1.6E+04	5.5E+03	1.60E+06	4.10E+07	
PCE	µg/kg	5.3E+00	7.2E+01	2.5E+01	1.20E+04	1.10E+05	
TCE	µg/kg	5.4E+00	7.3E+01	2.6E+01	5.80E+04	5.20E+05	
Vinyl chloride	µg/kg	7.82E-01	1.1E+01	3.8E+00			
Xylenes	µg/kg	8.5E+03	1.2E+05	4.1E+04			
SVOCs							
1,2,4-trichlorobenzene	µg/kg	6.50E+02	8.8E+03	3.1E+03			
Butylbenzophthalate	µg/kg	6.7E+04	9.1E+05	3.2E+05	1.60E+06		
Indeno(1,2,3-cd)pyrene	µg/kg	7.08E+03	9.6E+04	3.4E+04	8.75E-01	7.84E+00	
Benzo(a)anthracene	µg/kg	2.03E+02	2.8E+03	9.7E+02	8.75E-01	7.84E+00	
Benzo(b)fluoranthene	µg/kg	1.25E+03	1.7E+04	6.0E+03	8.75E-01	7.84E+00	
Benzo(a)pyrene	µg/kg	1.04E+03	1.4E+04	5.0E+03	8.75E-02	7.84E-01	
Benzo(k)fluoranthene	µg/kg	1.25E+03	1.7E+04	6.0E+03	8.75E+00	7.84E+01	
Anthracene	µg/kg	2.71E+04	3.7E+05	1.3E+05	2.35E+03	6.13E+04	
Dibenz(a,h)anthracene	µg/kg	5.81E+03	7.9E+04	2.8E+04	8.75E-02	7.84E-01	
Chrysene	µg/kg	4.08E+02	5.5E+03	1.9E+03	8.75E+01	7.84E+02	
Naphthalene	µg/kg	6.76E+00	9.2E+01	3.2E+01	1.60E+05	4.10E+06	
Pyrene	UG/KG	9.64E+03	1.3E+05	4.6E+04	2.35E+02	6.13E+03	

Appendix A

ZONE F SSL Calculations -- SWMU 109

Site No.		109	I' = .00762	I' = .0305				
Site-Specific DAF			10.5	4	Residential	Industrial	Surface	Subsurface
Constituent		SSL for DAF=1	Adjusted SSL	Adjusted SSL	RBC	RBC	Background	Background
Inorganics								
Ag	mg/kg	5.7E+01	598	228	39	1000	1.85	
Al	mg/kg	7.4E+04	777778	296296	7800	200000	18500	17100
As	mg/kg	4.6E+01	479	182	0.43	3.8	19.9	18.2
Ba	mg/kg	8.3E+01	868	330	550	14000	61.5	51.8
Be	mg/kg	7.7E-01	8	3	16	410	1.05	1.2
Cd	mg/kg	4.6E+00	48	18	7.8	100	0.26	0.09
Co	mg/kg	1.3E+04	134615	51282	470	12000	15.1	6.85
Cr	mg/kg	1.4E+02	1436	547	210	450	34.8	32.2
Cu	mg/kg	3.1E+03	32906	12536	310	8200	48.2	30.4
Fe	mg/kg	2.8E+04	293162	111681	2300	61000		
Hg	mg/kg	5.4E+00	57	22	2.3	61	0.62	0.23
Mn	mg/kg	1.3E+04	134615	51282	1100	4100	307	469
Ni	mg/kg	1.9E+02	1944	741	160	4100	12.6	8.85
Pb	mg/kg	1.1E+01	120	400	400	100	180	51.7
Sb	mg/kg	1.1E+00	11	4	3.1	82	0.79	
Se	mg/kg	1.8E+01	191	73	39	1022	1.15	1.24
V	mg/kg	2.6E+02	2782	1060	55	1400	48.9	49.4
Zn	mg/kg	4.8E+03	50855	19373	2300	61000	198	84.2
VOCs								
Acetone	µg/kg	1.3E+01	1.3E+02	51	7.80E+05			
Carbon disulfide	µg/kg	7.6E+01	8.0E+02	306	7.80E+05			
SVOCs								
Benzo(a)anthracene	µg/kg	4.8E+02	5.1E+03	1937	870	7800		
Benzo(a)pyrene	µg/kg	2.0E+03	2.1E+04	8091	87	780		
Benzo(b)fluoranthene	µg/kg	2.5E+03	2.6E+04	9840	870	7800		
Benzo(k)fluoranthene	µg/kg	1.5E+04	1.6E+05	59259	8700	78000		
Chrysene	µg/kg	4.8E+04	5.1E+05	193732	87000	7.80E+05		
Dibenz(a,h)anthracene	µg/kg	4.6E+02	4.8E+03	1823	87	780		
Indeno(1,2,3-cd)pyrene	µg/kg	4.3E+02	4.5E+03	1709	870	7800		
Anthracene	µg/kg	3.1E+06	3.3E+07	12535613	2.30E+06	6.10E+07		
Benzo(g,h,i)perylene	µg/kg	2.8E+07	3.0E+08	113960114	1.60E+05			
Benzoic acid	µg/kg	3.1E+04	3.3E+05	125356	3.10E+07			
bis(2-Ethylhexyl)phthalate	µg/kg	9.1E+05	9.5E+06	3624005	46000			
Fluoranthene	µg/kg	1.6E+06	1.7E+07	6381766	3.10E+05	8.20E+06		
Naphthalene	µg/kg	1.5E+04	1.6E+05	59259	1.60E+05	4.10E+06		
Phenanthrene	µg/kg	3.4E+05	3.6E+06	1367521	2.30E+05			
Pyrene	µg/kg	1.1E+06	1.2E+07	4558405	2.30E+05	6.10E+06		
Pesticides & PCBs								
4,4'-DDD	µg/kg	5.6E+02	5.9E+03	2240.00	2700	24000		
4,4'-DDE	µg/kg	1.1E+04	1.2E+05	44444	1900	17000		
4,4'-DDT	µg/kg	5.8E+01	6.1E+02	232.00	1900	17000		
Aroclor-1260	µg/kg	2.8E+01	1.0E+03	1000	320	2900		
Methoxychlor	µg/kg	3.9E+04	4.1E+05	156352	39000	1000000		
gamma-Chlordane	µg/kg	1.5E+01	1.6E+02	60.00	1800	16000		

Appendix A

ZONE F SSL Calculations -- AOC 609 & AOC 611

Site No. Site-Specific DAF Constituent	AOC 609 & AOC 611		I' = .00762	I' = .0305	Residential RBC	Industrial RBC	Surface Background	Subsurface Background
	SSL for DAF=1	Adjusted SSL	8.3	3.4				
Inorganics								
Ag	mg/kg	5.8E+01	4.8E+02	2.0E+02	39	1000	1.85	
Al	mg/kg	2.5E+04	2.1E+05	8.5E+04	7800	200000	18500	17100
As	mg/kg	2.5E+01	2.1E+02	8.5E+01	0.43	3.8	19.9	18.2
Ba	mg/kg	1.1E+02	8.9E+02	3.7E+02	550	14000	61.5	51.8
Be	mg/kg	4.2E-01	3.5E+00	1.4E+00	16	410	1.05	1.2
Cd	mg/kg	4.6E+00	3.8E+01	1.6E+01	7.8	100	0.26	0.09
Co	mg/kg	2.3E+03	1.9E+04	7.8E+03	470	12000	15.1	6.85
Cr	mg/kg	1.3E+02	1.1E+03	4.3E+02	210	450	34.8	32.2
Cu	mg/kg	9.8E+02	8.1E+03	3.3E+03	310	8200	48.2	30.4
Fe	mg/kg	4.4E+04	3.7E+05	1.5E+05	2300	61000		
Hg	mg/kg	2.9E+00	2.4E+01	9.8E+00	2.3	61	0.62	0.23
Mn	mg/kg	1.9E+03	1.6E+04	6.5E+03	1100	4100	307	469
Ni	mg/kg	5.6E+01	4.6E+02	1.9E+02	160	4100	12.6	8.95
Pb	mg/kg	7.7E+01	6.4E+02	4.0E+02	400	100	180	51.7
Sb	mg/kg	1.4E+00	1.2E+01	4.8E+00	3.1	82	0.79	
Se	mg/kg	1.6E+01	1.3E+02	5.3E+01	39	1022	1.15	1.24
Sn	mg/kg	0.0E+00	0.0E+00	0.0E+00			9.38	
Tl	mg/kg	3.7E-02	3.0E-01	1.2E-01	0.55	14		1.24
V	mg/kg	1.9E+02	1.6E+03	6.5E+02	55	1400	48.9	49.4
Zn	mg/kg	1.5E+03	1.2E+04	5.1E+03	2300	61000	196	84.2
VOCs								
2-Butanone (MEK)	µg/kg	4.6E+03	3.8E+04	1.6E+04	4.70E+06			
1,1-DCE	µg/kg	4.8E+00	4.0E+01	1.6E+01	1100	9500		
Acetone	µg/kg	7.5E+02	6.2E+03	2.6E+03	7.80E+05			
Acrolein	µg/kg	1.5E+02	1.3E+03	5.2E+02	1.60E+05			
Carbon disulfide	µg/kg	2.3E+03	1.9E+04	7.8E+03	7.80E+05			
Ethylbenzene	µg/kg	1.8E+03	1.5E+04	6.1E+03	7.80E+05	2.00E+07		
Toluene	µg/kg	1.4E+03	1.2E+04	4.8E+03	1.60E+06	4.10E+07		
TCE	µg/kg	6.5E+00	5.4E+01	2.2E+01	5.80E+04	5.20E+05		
Xylene (total)	µg/kg	1.8E+04	1.5E+05	6.1E+04	1.60E+07			
SVOCs								
Benzo(a)anthracene	µg/kg	3.1E+02	2.6E+03	1.0E+03	870	7800		
Benzo(a)pyrene	µg/kg	1.3E+03	1.1E+04	4.5E+03	87	780		
Benzo(b)fluoranthene	µg/kg	9.6E+02	8.0E+03	3.3E+03	870	7800		
Benzo(k)fluoranthene	µg/kg	9.6E+03	8.0E+04	3.3E+04	8700	78000		
Chrysene	µg/kg	3.1E+04	2.6E+05	1.0E+05	87000	7.80E+05		
Dibenz(a,h)anthracene	µg/kg	2.9E+02	2.4E+03	9.8E+02	87	780		
Indeno(1,2,3-cd)pyrene	µg/kg	2.7E+03	2.2E+04	9.2E+03	870	7800		
Acenaphthene	µg/kg	1.0E+05	8.5E+05	3.5E+05	4.70E+05			
Acenaphthylene	µg/kg	1.5E+04	1.2E+05	5.0E+04	1.60E+05			
Anthracene	µg/kg	2.1E+06	1.8E+07	7.2E+06	2.30E+06	6.10E+07		
Benzo(g,h,i)perylene	µg/kg	1.8E+07	1.5E+08	6.3E+07	1.60E+05			
Benzoic acid	µg/kg	3.1E+04	2.6E+05	1.0E+05	3.10E+07			
bis(2-Ethylhexyl)phthalate	µg/kg	6.0E+05	4.9E+06	2.0E+06	46000			
Butylbenzylphthalate	µg/kg	4.8E+05	4.0E+06	1.6E+06	1.60E+06			
Dibenzofuran	µg/kg	2.1E+03	1.8E+04	7.2E+03	31000			
Di-n-butylphthalate	µg/kg	8.1E+05	6.7E+06	2.7E+06	7.80E+05			
Di-n-octylphthalate	µg/kg	5.2E+06	4.3E+07	1.8E+07	1.60E+05			
Fluoranthene	µg/kg	1.0E+06	8.6E+06	3.5E+06	3.10E+05	8.20E+06		
Fluorene	µg/kg	1.3E+05	1.1E+06	4.6E+05	3.10E+05	8.20E+06		
2-Methylnaphthalene	µg/kg	6.0E+03	4.9E+04	2.0E+04	1.60E+05	4.10E+06		
Naphthalene	µg/kg	9.6E+03	8.0E+04	3.3E+04	1.60E+05	4.10E+06		
Phenanthrene	µg/kg	4.8E+05	4.0E+06	1.6E+06	2.30E+05			
Pyrene	µg/kg	7.5E+05	6.2E+06	2.6E+06	2.30E+05	6.10E+06		
Pesticides & PCBs								
Aroclor-1260	µg/kg	1.9E+02	1.6E+03	1.0E+03	320	2900		
Dieldrin	µg/kg	7.3E-01	6.1E+00	2.5E+00	40	360		
gamma-Chlordane	µg/kg	1.8E+03	1.5E+04	6.2E+03	1800	16000		
4,4'-DDD	µg/kg	5.60E+02	4.6E+03	1.9E+03	2700	24000		
4,4'-DDE	µg/kg	1.80E+03	1.5E+04	6.1E+03	1900	17000		
4,4'-DDT	µg/kg	5.80E+01	4.8E+02	2.0E+02	1900	17000		

Appendix A

ZONE F SSL Calculations -- AOC 613/615/SWMU 175

Site No. Site-Specific DAF Constituent		AOC 613/615/ SWMU 175		Residential RBC	Industrial RBC	Surface Background	Subsurface Background
		I' = .00762 20.1 SSL for DAF=1	I' = .0305 5.8 Adjusted SSL				
Inorganics							
Ag	mg/kg	5.6E+01	1.1E+03	3.2E+02	39	1000	1.85
Al	mg/kg	1.1E+05	2.1E+06	6.2E+05	7800	200000	17100
As	mg/kg	7.4E+01	1.5E+03	4.3E+02	0.43	3.8	19.9
Ba	mg/kg	9.7E+01	2.0E+03	5.6E+02	550	14000	61.5
Be	mg/kg	7.5E-01	1.5E+01	4.4E+00	16	410	1.05
Cd	mg/kg	4.4E+00	8.9E+01	2.6E+01	7.8	100	0.26
Co	mg/kg	8.4E+03	1.7E+05	4.9E+04	470	12000	15.1
Cr	mg/kg	1.8E+02	3.6E+03	1.0E+03	210	450	34.8
Cu	mg/kg	5.4E+03	1.1E+05	3.1E+04	310	8200	48.2
Fe	mg/kg	8.1E+04	1.6E+06	4.7E+05	2300	61000	
Hg	mg/kg	2.8E+00	5.7E+01	1.6E+01	2.3	61	0.62
Mn	mg/kg	2.5E+04	5.0E+05	1.4E+05	1100	4100	307
Ni	mg/kg	2.4E+02	4.8E+03	1.4E+03	160	4100	12.6
Pb	mg/kg	3.5E+01	4.0E+02	4.0E+02	400	100	180
Sb	mg/kg	1.2E+00	2.3E+01	6.7E+00	3.1	82	0.79
Se	mg/kg	3.5E+01	6.9E+02	2.0E+02	39	1022	1.15
Sn	mg/kg	6.3E+04	1.3E+06	3.6E+05	4700		9.38
Tl	mg/kg	3.5E-02	6.9E-01	2.0E-01	0.55	14	
V	mg/kg	7.2E+02	1.4E+04	4.2E+03	55	1400	48.9
Zn	mg/kg	8.8E+03	1.8E+05	5.1E+04	2300	61000	198
VOCs							
2-Butanone (MEK)	µg/kg	4.6E+03	9.2E+04	2.7E+04	4.70E+06		
2-Hexanone	µg/kg	5.5E+02	1.1E+04	3.2E+03			
1,1-DCA	µg/kg	1.6E+03	3.2E+04	9.2E+03	7.80E+05		
1,1-DCE	µg/kg	4.8E+00	9.6E+01	2.8E+01	1100	9500	
1,2-DCE (total)	µg/kg	7.1E+01	1.4E+03	4.1E+02	7.00E+04	1.80E+06	
1,1,2,2,-PCA	µg/kg	3.5E-01	7.1E+00	2.1E+00			
Acetone	µg/kg	7.3E+02	1.5E+04	4.3E+03	7.80E+05		
Benzene	µg/kg	3.1E+00	6.2E+01	1.8E+01	2.20E+04	2.00E+05	
Carbon disulfide	µg/kg	1.9E+03	3.9E+04	1.1E+04	7.80E+05		
Ethylbenzene	µg/kg	1.9E+03	3.7E+04	1.1E+04	7.80E+05	2.00E+07	
Methylene chloride	µg/kg	1.4E+00	2.8E+01	8.2E+00	8.50E+04		
Toluene	µg/kg	1.5E+03	3.0E+04	8.7E+03	1.60E+06	4.10E+07	
PCE	µg/kg	6.8E+00	1.4E+02	3.9E+01	1.20E+04	1.10E+05	
TCE	µg/kg	6.8E+00	1.4E+02	4.0E+01	5.80E+04	5.20E+05	
Vinyl chloride	µg/kg	8.3E-01	1.7E+01	4.8E+00	3.40E+02	3.00E+03	
Xylene (total)	µg/kg	1.9E+04	3.7E+05	1.1E+05	1.60E+07		
SVOCs							
Benzo(a)anthracene	µg/kg	3.3E+02	6.6E+03	1.9E+03	870	7800	
Benzo(a)pyrene	µg/kg	1.4E+03	2.8E+04	8.2E+03	87	780	
Benzo(b)fluoranthene	µg/kg	9.7E+02	2.0E+04	5.6E+03	870	7800	
Benzo(k)fluoranthene	µg/kg	9.7E+02	2.0E+05	5.6E+04	8700	78000	
Chrysene	µg/kg	3.3E+04	6.6E+05	1.9E+05	87000	7.80E+05	
Dibenz(a,h)anthracene	µg/kg	3.1E+02	6.2E+03	1.8E+03	87	780	
Indeno(1,2,3-cd)pyrene	µg/kg	2.8E+03	5.7E+04	1.6E+04	870	7800	
Acenaphthene	µg/kg	1.1E+05	2.1E+06	6.2E+05	4.70E+05		
Acenaphthylene	µg/kg	1.6E+04	3.2E+05	9.2E+04	1.60E+05		
Anthracene	µg/kg	2.2E+06	4.4E+07	1.3E+07	2.30E+06	6.10E+07	
Benzo(g,h,i)perylene	µg/kg	1.9E+07	3.9E+08	1.1E+08	1.60E+05		
Benzoic acid	µg/kg	3.0E+04	6.0E+05	1.7E+05	3.10E+07		
bis(2-Ethylhexyl)phthalate	µg/kg	6.2E+05	1.2E+07	3.6E+06	46000		
Butylbenzophthalate	µg/kg	8.8E+04	1.8E+06	5.1E+05	1.60E+06		
Dibenzofuran	µg/kg	2.3E+03	4.6E+04	1.3E+04	31000		
Di-n-butylphthalate	µg/kg	2.2E+05	4.4E+06	1.3E+06	7.80E+05		
Fluoranthene	µg/kg	1.1E+06	2.1E+07	6.2E+06	3.10E+05	8.20E+06	
Fluorene	µg/kg	1.4E+05	2.8E+06	8.2E+05	3.10E+05	8.20E+06	
2-Methylnaphthalene	µg/kg	6.2E+03	1.2E+05	3.6E+04	1.60E+05	4.10E+06	
4-Methylphenol	µg/kg	1.4E+02	2.8E+03	8.2E+02	3.90E+04		
Isophorone	µg/kg	4.4E+01	8.9E+02	2.6E+02	6.70E+05		
Naphthalene	µg/kg	9.7E+03	2.0E+05	5.6E+04	1.60E+05	4.10E+06	
Phenanthrene	µg/kg	2.2E+05	4.4E+06	1.3E+06	2.30E+05		
Pyrene	µg/kg	7.9E+05	1.6E+07	4.6E+06	2.30E+05	6.10E+06	
Pesticides & PCBs							
4,4'-DDD	µg/kg	5.6E+02	1.1E+04	3.2E+03	2700	24000	
4,4'-DDE	µg/kg	1.8E+03	3.6E+04	1.0E+04	1900	17000	
4,4'-DDT	µg/kg	5.8E+01	1.2E+03	3.4E+02	1900	17000	
Endrin	µg/kg	1.7E+02	3.5E+03	1.0E+03	2300		
Heptaclor	µg/kg	3.9E+03	7.9E+04	2.3E+04	140	1300	

Appendix A

ZONE F SSL Calculations -- AOC 616 & AOC 617

Site No.		AOC 616 & AOC 617		I' = .00762	I' = .0305	Residential	Industrial	Surface	Subsurface
Site-Specific DAF		28.4		8.6		RBC	RBC	Background	Background
Constituent	SSL for DAF=1	Adjusted SSL	Adjusted SSL						
Inorganics									
Al	mg/kg	9.5E+05	2.7E+07	8.2E+06	7800	200000	18500	17100	
As	mg/kg	4.7E+01	1.3E+03	4.0E+02	0.43	3.8	19.9	18.2	
Ba	mg/kg	2.6E+02	7.4E+03	2.3E+03	550	14000	61.5	51.8	
Be	mg/kg	7.5E-01	2.1E+01	6.4E+00	16	410	1.05	1.2	
Cd	mg/kg	4.5E+00	1.3E+02	3.8E+01	7.8	100	0.26	0.09	
Co	mg/kg	5.3E+03	1.5E+05	4.6E+04	470	12000	15.1	6.85	
Cr	mg/kg	7.0E+02	2.0E+04	6.0E+03	210	450	34.8	32.2	
Cu	mg/kg	1.9E+03	5.5E+04	1.7E+04	310	8200	48.2	30.4	
Fe	mg/kg	5.5E+05	1.6E+07	4.8E+06	2300	61000			
Hg	mg/kg	2.9E+00	8.3E+01	2.5E+01	2.3	61	0.62	0.23	
Mn	mg/kg	4.3E+04	1.2E+06	3.7E+05	1100	4100	307	469	
Ni	mg/kg	2.9E+02	8.3E+03	2.5E+03	160	4100	12.6	8.85	
Pb	mg/kg	3.9E+01	1.1E+03	4.0E+02	400	100	180	51.7	
Sb	mg/kg	8.0E-01	2.3E+01	6.8E+00	3.1	82	0.79		
Se	mg/kg	1.5E+01	4.1E+02	1.3E+02	39	1022	1.15	1.24	
Tl	mg/kg	3.5E-02	9.9E-01	3.0E-01	0.55	14			
V	mg/kg	1.1E+03	3.0E+04	9.2E+03	55	1400	48.9	49.4	
Zn	mg/kg	2.1E+04	6.1E+05	1.8E+05	2300	61000	198	84.2	
VOCs									
2-Butanone (MEK)	µg/kg	4.5E+03	1.3E+05	3.8E+04	4.70E+06				
Acetone	µg/kg	1.2E+01	3.5E+02	1.1E+02	7.80E+05				
Benzene	µg/kg	2.2E+00	6.3E+01	1.9E+01	2.20E+04	2.00E+05			
Carbon disulfide	µg/kg	1.8E+03	5.2E+04	1.6E+04	7.80E+05				
TCE	µg/kg	4.6E+00	1.3E+02	3.9E+01	5.80E+04	5.20E+05			
SVOCs									
Benzo(a)anthracene	µg/kg	1.9E+02	5.5E+03	1.7E+03	870	7800			
Benzo(a)pyrene	µg/kg	8.3E+02	2.4E+04	7.2E+03	87	780			
Benzo(b)fluoranthene	µg/kg	6.0E+02	1.7E+04	5.2E+03	870	7800			
Benzo(k)fluoranthene	µg/kg	6.0E+03	1.7E+05	5.2E+04	8700	78000			
Chrysene	µg/kg	1.9E+04	5.5E+05	1.7E+05	87000	7.80E+05			
Dibenz(a,h)anthracene	µg/kg	1.8E+02	5.2E+03	1.6E+03	87	780			
Indeno(1,2,3-cd)pyrene	µg/kg	1.7E+03	5.0E+04	1.5E+04	870	7800			
Acenaphthene	µg/kg	6.4E+04	1.8E+06	5.5E+05	4.70E+05				
Anthracene	µg/kg	1.4E+06	3.9E+07	1.2E+07	2.30E+06	6.10E+07			
Benzo(g,h,i)perylene	µg/kg	1.2E+07	3.3E+08	1.0E+08	1.60E+05				
Benzoic acid	µg/kg	2.9E+04	8.3E+05	2.5E+05	3.10E+07				
bis(2-Ethylhexyl)phthalate	µg/kg	3.7E+05	1.0E+07	3.2E+06	46000				
Dibenzofuran	µg/kg	1.4E+03	3.9E+04	1.2E+04	31000				
Fluoranthene	µg/kg	6.5E+05	1.8E+07	5.6E+06	3.10E+05	8.20E+06			
Fluorene	µg/kg	8.4E+04	2.4E+06	7.3E+05	3.10E+05	8.20E+06			
2-Methylnaphthalene	µg/kg	3.7E+03	1.0E+05	3.2E+04	1.60E+05	4.10E+06			
Naphthalene	µg/kg	6.1E+03	1.7E+05	5.3E+04	1.60E+05	4.10E+06			
Phenanthrene	µg/kg	1.4E+05	3.9E+06	1.2E+06	2.30E+05				
Pyrene	µg/kg	4.8E+05	1.4E+07	4.1E+06	2.30E+05	6.10E+06			
Pesticides & PCBs									
4,4'-DDD	µg/kg	1.5E+03	4.1E+04	1.3E+04	2700	24000			
4,4'-DDE	µg/kg	4.6E+03	1.3E+05	3.9E+04	1900	17000			
4,4'-DDT	µg/kg	2.7E+03	7.7E+04	2.3E+04	1900	17000			
Aroclor-1260	µg/kg	6.3E+02	1.8E+04	1.0E+03	320	2900			
Herbicides									
2,4-D	µg/kg	6.2E+01	1.8E+03	5.3E+02	78000				

Appendix A

ZONE F SSL Calculations -- AOC 619/SWMU 4 & AOC620/SWMU36

Site No		AOC 004/619 & AOC 036/620		I' = 00762	I' = .0305	Residential	Industrial	Surface	Subsurface
Site-Specific DAF		23.7		6.7		RBC	RBC	Background	Background
Constituent		SSL for DAF=1	Adjusted SSL	Adjusted SSL					
Inorganics									
Ag	mg/kg	5.8E+01	1377	389		39	1000	1.85	
Al	mg/kg	1.5E+05	3522973	995946		7800	20000	18500	17100
As	mg/kg	8.1E+01	1922	543		0.43	3.8	19.9	18.2
Ba	mg/kg	1.5E+02	3523	996		550	14000	61.5	51.8
Be	mg/kg	1.8E+00	42	12		16	410	1.05	1.2
Cd	mg/kg	4.6E+00	109	31		7.8	100	0.26	0.09
Co	mg/kg	1.3E+04	304257	86014		470	12000	15.1	6.85
Cr	mg/kg	3.4E+02	8007	2264		210	450	34.8	32.2
Cu	mg/kg	4.3E+03	102486	28973		310	8200	48.2	30.4
Fe	mg/kg	5.1E+04	1217027	344054		2300	61000		
Hg	mg/kg	1.6E+00	38	11		2.3	61	0.62	0.23
Mn	mg/kg	1.8E+04	416351	117703		1100	4100	307	469
Ni	mg/kg	2.2E+02	5124	1449		160	4100	12.6	8.85
Pb	mg/kg	5.4E+01	1281	400		400	100	180	51.7
Sb	mg/kg	8.8E-01	21	6		3.1	82	0.79	
Se	mg/kg	6.8E-01	16	5		39	1022	1.15	1.24
Tl	mg/kg	3.5E-02	1	0		0.55	14		1.24
V	mg/kg	5.0E+02	11850	3350		55	1400	48.9	49.4
Zn	mg/kg	1.1E+03	26582	7515		2300	61000	198	84.2
VOCs									
2-Butanone (MEK)	µg/kg	4.9E+03	115297	32595		4.70E+06			
1,1-DCE	µg/kg	6.6E+00	157	44		1100	9500		
1,2-DCE (total)	µg/kg	7.7E+01	1826	516		7.00E+04	1.80E+06		
4-Methyl-2-Pentanone	µg/kg	1.1E+03	24981	7062		6.30E+05			
Acetone	µg/kg	7.7E+02	18255	5161		7.80E+05			
Benzene	µg/kg	4.3E+00	102	29		2.20E+04	2.00E+05		
Carbon disulfide	µg/kg	3.0E+03	70459	19919		7.80E+05			
Chlorobenzene	µg/kg	2.6E+02	6085	1720		1.60E+05			
Chloroform	µg/kg	6.5E+01	1537	435		1.00E+05			
Methylene chloride	µg/kg	1.6E+00	38	11		8.50E+04			
Toluene	µg/kg	2.3E+03	54446	15392		1.60E+06	4.10E+07		
TCE	µg/kg	1.0E+01	243	69		5.80E+04	5.20E+05		
Xylene (total)	µg/kg	2.8E+04	672568	190135		1.60E+07			
SVOCs									
Benzo(a)anthracene	µg/kg	5.3E+02	12491	3531		870	7800		
Benzo(a)pyrene	µg/kg	2.3E+03	54446	15392		87	780		
Benzo(b)fluoranthene	µg/kg	1.6E+03	38432	10865		870	7800		
Benzo(k)fluoranthene	µg/kg	1.6E+04	384324	108649		8700	78000		
Chrysene	µg/kg	1.9E+05	4483784	1267568		87000	7.80E+05		
Dibenz(a,h)anthracene	µg/kg	5.0E+02	11850	3350		87	780		
Indeno(1,2,3-cd)pyrene	µg/kg	4.6E+03	108892	30784		870	7800		
Acanaphthene	µg/kg	1.8E+05	4163514	1177027		4.70E+05			
Acanaphthylene	µg/kg	2.6E+04	608514	172027		1.60E+05			
Anthracene	µg/kg	3.5E+06	83270270	23540541		2.30E+06	6.10E+07		
Benzo(g,h,i)perylene	µg/kg	3.1E+07	736621622	208243243		1.60E+05			
Benzoic acid	µg/kg	3.1E+04	736622	208243		3.10E+07			
bis(2-Ethylhexyl)phthalate	µg/kg	1.0E+06	23700000	6700000		46000			
Butylbenzophthalate	µg/kg	6.2E+05	14732432	4164865		1.60E+06			
Dibenzofuran	µg/kg	3.6E+03	86473	24446		31000			
Diethylphthalate	µg/kg	9.7E+04	2305946	651892		6.30E+06			
Di-n-butylphthalate	µg/kg	1.4E+06	32027027	9054054		7.80E+05			
Di-n-octylphthalate	µg/kg	6.8E+06	160135135	45270270		1.60E+05			
Fluoranthene	µg/kg	1.8E+06	41635135	11770270		3.10E+05	8.20E+06		
Fluorene	µg/kg	2.3E+05	5444595	1539189		3.10E+05	8.20E+06		
2-Methylnaphthalene	µg/kg	9.9E+03	233797	66095		1.60E+05	4.10E+06		
4-Methylphenol	µg/kg	2.0E+02	4804	1358		3.90E+04			
Naphthalene	µg/kg	1.6E+04	384324	108649		1.60E+05	4.10E+06		
Pentachlorophenol	µg/kg	6.8E+00	160	45		5600			
Phenanthrene	µg/kg	3.6E+05	8647297	2444595		2.30E+05			
Pyrene	µg/kg	1.3E+06	30105405	8510811		2.30E+05	6.10E+06		
Pesticides & PCBs									
4,4'-DDD	µg/kg	3.9E+03	92878	26257		2700	24000		
4,4'-DDE	µg/kg	1.2E+04	291446	82392		1900	17000		
4,4'-DDT	µg/kg	7.3E+03	172946	48892		1900	17000		
Aroclor-1254	µg/kg	1.4E+02	3203	905		320	2900		
Aroclor-1260	µg/kg	1.4E+02	3203	1000		320	2900		
Endrin	µg/kg	2.7E+02	6405	1811		2300			
Heptaclor	µg/kg	6.2E+03	147324	41649		140	1300		
Heptaclor epoxide	µg/kg	1.9E+02	4484	1268		70	630		
alpha-Chlordane	µg/kg	1.5E+03	35230	9959		1800	16000		
gamma-Chlordane	µg/kg	3.1E+03	73662	20824		1800	16000		
Herbicides									
Dinoseb	µg/kg	2.8E+00	67	19		7800			

Appendix A
 ZONE F SSL Calculations – AOC709

Site No.		AOC 709	I' = .00762	I' = .0305	Residential	Industrial	Surface	Subsurface
Site-Specific DAF			32.2	8.8				
Constituent		SSL for DAF=1	Adjusted SSL	Adjusted SSL	RBC	RBC	Background	Background
Inorganics								
Al	mg/kg	5.0E+04	1.6E+06	4.4E+05	7800	200000	18500	17100
As	mg/kg	7.9E+01	2.6E+03	7.0E+02	0.43	3.8	19.9	18.2
Ba	mg/kg	9.7E+01	3.1E+03	8.5E+02	550	14000	61.5	51.8
Be	mg/kg	7.6E-01	2.5E+01	6.7E+00	16	410	1.05	1.2
Co	mg/kg	5.6E+03	1.8E+05	4.9E+04	470	12000	15.1	6.85
Cr	mg/kg	1.4E+02	4.5E+03	1.2E+03	210	450	34.8	32.2
Cu	mg/kg	2.9E+03	9.5E+04	2.6E+04	310	8200	48.2	30.4
Fe	mg/kg	1.8E+04	5.7E+05	1.6E+05	2300	61000		
Hg	mg/kg	2.9E+00	9.5E+01	2.6E+01	2.3	61	0.62	0.23
Mn	mg/kg	6.8E+03	2.2E+05	6.0E+04	1100	4100	307	469
Ni	mg/kg	1.5E+02	4.7E+03	1.3E+03	160	4100	12.6	8.85
Pb	mg/kg	1.2E+02	3.8E+03	4.0E+02	400	100	180	51.7
Se	mg/kg	3.2E+01	1.0E+03	2.8E+02	39	1022	1.15	1.24
V	mg/kg	3.8E+02	1.2E+04	3.4E+03	55	1400	48.9	49.4
Zn	mg/kg	7.9E+03	2.6E+05	7.0E+04	2300	61000	198	84.2
VOCs								
Acetone	µg/kg	1.29E+01	4.2E+02	1.1E+02	7.80E+05			
Carbon disulfide	µg/kg	4.7E+03	1.5E+05	4.1E+04	7.80E+05			
Ethylbenzene	µg/kg	5.3E+03	1.7E+05	4.7E+04	7.80E+05	2.00E+07		
Vinyl chloride	µg/kg	2.8E+00	8.9E+01	2.4E+01	3.40E+02	3.00E+03		
Xylenes	µg/kg	8.5E+03	2.7E+05	7.5E+04	1.60E+07			
SVOCs								
Benzo(a)anthracene	µg/kg	9.7E+02	3.1E+04	8.5E+03	870	7800		
Benzo(a)pyrene	µg/kg	4.1E+03	1.3E+05	3.6E+04	87	780		
Benzo(b)fluoranthene	µg/kg	2.9E+02	9.5E+03	2.6E+03	870	7800		
Benzo(k)fluoranthene	µg/kg	2.9E+04	9.5E+05	2.6E+05	8700	78000		
Chrysene	µg/kg	9.7E+04	3.1E+06	8.5E+05	87000	7.80E+05		
Dibenz(a,h)anthracene	µg/kg	2.3E+04	7.5E+05	2.0E+05	87	780		
Indeno(1,2,3-cd)pyrene	µg/kg	8.5E+03	2.7E+05	7.5E+04	870	7800		
Acenaphthene	µg/kg	3.2E+05	1.0E+07	2.8E+06	4.70E+05			
Anthracene	µg/kg	6.8E+06	2.2E+08	6.0E+07	2.30E+06	6.10E+07		
Benzo(g,h,i)perylene	µg/kg	5.9E+07	1.9E+09	5.2E+08	1.60E+05			
Benzoic acid	µg/kg	3.2E+04	1.0E+06	2.8E+05	3.10E+07			
bis(2-Ethylhexyl)phthalate	µg/kg	1.9E+06	6.0E+07	1.6E+07	46000			
Dibenzofuran	µg/kg	6.8E+03	2.2E+05	6.0E+04	31000			
Diethylphthalate	µg/kg	1.8E+05	5.7E+06	1.6E+06	6.30E+06			
Fluoranthene	µg/kg	3.2E+06	1.0E+08	2.8E+07	3.10E+05	8.20E+06		
Fluorene	µg/kg	4.1E+05	1.3E+07	3.6E+06	3.10E+05	8.20E+06		
2-Methylnaphthalene	µg/kg	1.9E+04	6.0E+05	1.6E+05	1.80E+05	4.10E+06		
Naphthalene	µg/kg	2.9E+04	9.5E+05	2.6E+05	1.60E+05	4.10E+06		
Phenanthrene	µg/kg	6.8E+05	2.2E+07	6.0E+06	2.30E+05			
Pyrene	µg/kg	2.4E+06	7.6E+07	2.1E+07	2.30E+05	6.10E+06		
Pesticides & PCBs								
4,4'-DDD	µg/kg	5.6E+02	1.8E+04	4.9E+03	2700	24000		
4,4'-DDE	µg/kg	1.8E+03	5.8E+04	1.6E+04	1900	17000		

Application of Soil-Screening Levels (SSLs) at Charleston Naval Complex (CNC)

PREPARED FOR: CNC BCT
PREPARED BY: Paul Favara
DATE: January 9, 2001

Introduction

The purpose of this memorandum is to present the rationale CH2M-Jones will use in developing Soil Screening Levels (SSLs) that are protective of groundwater. The development of SSLs is a process that considers data from a multitude of sources, ranging from laboratory results to literature referenced values. As data availability, and quantity, for different SWMUs / AOCs is variable, and data input sources to the SSL calculation can be from a wide variety of sources, it is not possible to develop a process that will precisely identify SSL development for every possible data availability scenario. However, this memorandum presents an overall approach to developing SSLs that should apply to the majority of sites at CNC.

Site-Specific SSLs for groundwater protection are derived using the methods presented in the OSWER Soil Screening Guidance, July 1996 (EPA, 1996). The guidance document requires development of two independent equations to deriving site-specific SSLs:

- Step 1: The first step involves solving a partitioning calculation, to derive target soil concentrations independent of aquifer characteristics.
- Step 2: The second step further revises the target concentration based on the dilution attenuation factor (DAF) of the aquifer.

Throughout this memorandum, SWMUs/AOCs in Zone F will be used as an example.

Step 1: Partitioning Calculations

Contaminants at CNC can be subdivided into two broad contaminant groups: organics and metals. Each group will follow a separate flow chart for the development of partitioning equation (See Figures 1 and 2).

Organics

A flow chart for developing a partition coefficient for organic compounds is presented in Figure 1. For organic compounds, the partitioning equation (Eqn 10 in the EPA, 1996) is used to calculate a soil concentration protective of groundwater. The target soil concentration is a function of the target leachate concentration, and soil characteristics such

as porosity, density, and fraction of organic carbon. The partitioning equation provides a target soil concentration assuming no dilution or attenuation within the aquifer (i.e., dilution-attenuation factor (DAF) = 1).

$$\text{Equation 10: } \text{SSL}_{\text{DAF}=1} = C_w \left[K_d + \frac{(\theta_w + \theta_a H')}{\gamma_{\text{dry}}} \right]$$

where SSL = Target soil screening level (with a DAF of 1)

C_w = target leachate concentration (MCL or other appropriate standard)

K_d = soil water partition coefficient (chemical specific), = $K_{oc} \times f_{oc}$

θ_w = water-filled soil porosity

θ_a = air-filled soil porosity

H' = Henry's Law constant (chemical-specific)

γ_{dry} = soil dry bulk density

At Zone F, soil parameters were measured at each site and the geometric mean was used when more than one sample was collected. Sites within Zone F were organized into seven site groupings according to proximity. The geometric mean of the fraction of soil that is organic carbon (also referred to as f_{oc}) for each site grouping was calculated and used as the central tendency f_{oc} value to allow for the probability that f_{oc} in soil is lognormally distributed. The table below presents f_{oc} data.

With respect to soil parameters (bulk density and water- and air-filled porosity) a zone-wide average was considered most representative of site conditions to account for variability of laboratory tests and the statistically low number of Shelby tube samples collected for this analysis.

Fraction of Organic Carbon at Zone F Site Groups

Site Group	f_{oc} in All Soil Samples ¹			f_{oc} in Surface Soil Samples ²		
	Number of Samples	Arithmetic Mean	Geometric Mean	Number of Samples	Arithmetic Mean	Geometric Mean
004/619 036/620	10	0.022	0.011	4	0.043	0.030
109	6	0.013	0.010	3	0.0095	0.0086
607	9	0.006	0.0051	3	0.0061	0.0056
609, 611	11	0.034	0.0065	5	0.069	0.016
613/615/ 175	7	0.013	0.007	3	0.0075	0.0067
616, 617	7	0.0049	0.0042	3	0.0028	0.0025
709	2	0.0205	0.0204	1	0.019	0.019

Notes:

-
- 1 = Use geometric mean of all site soil samples to calculate soil-to-groundwater SSLs.
 - 2 = Use geometric mean of site surface soil samples to calculate soil-to-air SSLs.

Equation 10 was used at Zone F to derive the partitioning component SSLs development for organic compounds.

Inorganics

A flow chart for developing a partition coefficient for inorganic constituents is presented in Figure 2. As provided for in EPA (1996), leach tests were used to develop SSLs for soil inorganics. SPLP tests were conducted on new samples from the AOCs and SWMUs and the leachate was compared to the related concentrations in the bulk samples. The methodology used to estimate contaminant release in soil leachate is based on the Freundlich equation, which was developed to model sorption from liquids to solids. The based Freundlich equation applied to the soil/water system is:

$$K_d = C_s / C_w^n$$

Where:

K_d = Freundlich soil/water partition coefficient (L/kg)

C_s = concentration sorbed on soil (mg/kg)

C_w = solution concentration (mg/L)

n = Freundlich exponent (dimensionless)

Assuming that adsorption is linear with respect to concentration, the equation can be rearranged to backcalculate a sorbed concentration (C_s):

$$C_s = (K_d)C_w$$

For the SSL calculation, C_w is the target soil leachate concentration.

To develop the K_d , soil was sampled from 2 to 4 locations at each AOC (except AOC 709) and analyzed for total organic carbon, VOCs, SVOCs, metals, cyanide, pesticides, and PCBs, and for SPLP on the above analyte list. Surface soil and subsurface soil samples were collected from each location. In general, PCBs, pesticides, and organic compounds were not detected in the leachate. Therefore, the K_d was used to calculate SSLs for inorganics, and the partitioning equation was used to calculate SSLs for organics and those inorganics with insufficient SPLP data. However, there were some instances where the inorganic analyte was not detected; methods to address these occurrences are listed below.

Situation	Resolution
Parameter detected in bulk, but nondetect in the leach	Use one-half the detection limit for leach samples as the leach value
Parameter detected in the leach but nondetect in the bulk	Use the detection limit for bulk samples as the bulk value
Parameter non-detect in both the bulk and the leach	No value assigned
Re-extraction analyses	Either use the re-extraction result or, if the original analysis uses lower detection limits, assign the original value to the bulk and/or leach

K_d was calculated for detected parameters in each sample and averaged geometrically to assign a central-tendency K_d value to each inorganic parameter at each site group. This central-tendency K_d was then used to calculate the parameter's target SSL (DAF = 1), using the equation shown above. Because sample sizes were small and the underlying K_d distributions were assumed to be lognormal, geometric means were used.

A zone-specific SSL was used when certain inorganics were not detected in both bulk and leach portions of any of the SPLP samples from a given site group. Zone-specific SSLs were developed by obtaining the geometric means of SSLs from all Zone F site groups with relevant data.

If an SSL was not available via SPLP in the rest of the zone, a modified version of equation 10 can be used:

Equation 10b:
$$SSL_{DAF=1} = C_w [K_d + \frac{\theta_w}{\gamma_{dry}}]$$

where SSL = Target soil screening level

C_w = target leachate concentration (MCL or RBC if MCL not available)

K_d = soil water partition coefficient (chemical specific),

θ_w = water-filled soil porosity

γ_{dry} = soil dry bulk density

Step 2: Dilution-Attenuation Factors

Dilution-attenuation factors (DAF) were calculated for each site within Zone F to account for the dilution effect of the aquifer on the soil leachate (either the hypothetical leachate calculated from the partitioning equation or the actual leachate observed in the SPLP.) The DAF is calculated using Equation 11 from the Soil Screening Guidance:

Equation 11: $DAF = 1 + \frac{Kid}{IL}$

Where K = hydraulic conductivity

i = hydraulic gradient

d = mixing zone thickness (from equation 12)

I = infiltration rate

L = source length parallel to groundwater flow direction

The gradient, source length, and mixing zone thickness are specific to each AOC.

The hydraulic conductivity was averaged from the various slug tests conducted within the Zone. A zone-wide average was considered most representative of site conditions to account for differences in well construction, test procedures, and the statistically low number of slug tests per site. Slug test results are presented below.

Zone F Hydraulic Conductivity

Wells	Hydraulic Conductivity (ft/day)	
	Falling Head	Rising Head
Shallow		
GDF001	6	8.4
607001	1.74	2
607002	0.42	0.62
607004	0.191	0.197
613001	0.83	1.3
613004	0.38	0.27
619002	0.11	0.11
619003	0.28	0.32
620002	0.42	0.41
GEL005	0.42	0.41
GEL007	0.31	0.21
SME004	8.70E-02	9.20E-02
Intermediate		
607011	1.3	1.2
607021	0.37	0.55
607041	0.7	0.66
Deep		
GDF01D	2.7	1.7
60701D	2.70E-02	NM
60702D	2.30E-02	NM
60704D	8.10E-03	NM
61302D	0.12	0.12
Average =	0.82	1.09
	Average for all values =	0.95
NM	Not measured	
	0.95 ft/day =	346.75 ft/yr 105.7 m/yr

The USGS estimated infiltration at CNC as 1.2 inch/year (in/yr) (USGS, 1999). However, Zone F is semi-industrial with a large percentage of overall area covered with an impervious surface, and numerous engineered drainage systems to divert runoff and potential recharge. A conservative estimate of 25% of the USGS value was used for Zone F, or 0.3 in/yr (.00762 m/yr), which is considered more realistic for the Zone F sites.

The mixing zone thickness is that portion of the aquifer thickness that may be assumed to transport the contamination. It is estimated from Equation 12 in the Soil Screening Guidance, and does not exceed the total aquifer thickness.

$$\text{Equation 12: } d = (0.0112L^2)^{0.5} + d_a[1 - \exp\{(-LI)/(Kid_a)\}]$$

Where d = mixing zone depth (m)

L = source length parallel to groundwater flow direction (m)

d_a = aquifer thickness (m)

I = infiltration rate (m/yr)

K = hydraulic conductivity (m/yr)

i = hydraulic gradient

The following table presents the parameters used to calculate the DAFs for each area within Zone F:

Site(s)	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient i (m/m)	Aquifer Thickness d_a (m)	Source Length L (m)	Infiltration Rate I (m/yr)	Mixing Zone D (m)	DAF
004/619, 036/620	105.7	0.02	9.8	120	0.00762	9.8	23.7
616,617	105.7	0.018	9.8	34	0.00762	3.7	28.4
607	105.7	0.0079	8.2	46	0.00762	5.3	13.6
609, 611	105.7	0.0043	8.5	38	0.00762	4.6	8.3
109	105.7	0.0058	7.6	30	0.00762	3.5	10.5
613/615/175	105.7	0.0227	9.1	150	0.00762	9.1	20.1
709	105.7	0.025	10.8	120	0.00762	10.8	32.2

The site-specific DAF is influenced by the source length, which may be interpreted to be the length of the spill area, if known, or the dimensions of the AOC, if no specific release area has been identified. It is very conservative to assume the entire AOC dimensions, and this parameter should be refined if possible. Actual DAFs may be assumed to be significantly higher than those presented in the table.

Site-Specific SSLs

When a partitioning coefficient is developed, the site-specific DAF is multiplied by the $SSL_{DAF=1}$ to arrive at the site-specific SSL:

$$SSL = [SSL_{L:AF=1}] [DAF]$$

When SPLP data is used in lieu of the partitioning equation, the K_d equation can be used to derive a target SSL by making $C(\text{leach})$ equivalent to the maximum acceptable groundwater concentration in the aquifer, and then calculating the corresponding C_s (when $C_s = (K_d)$ And C_w is set to the MCL. This value can then be multiplied by the DAF to define a site specific SSL:

$$SSL = [C_s] [DAF]$$

According to the EPA (1996), the average site soil concentration should be compared to the final SSL to evaluate if soil concentrations could potentially impact groundwater. Mapping areas in which maximum soil concentrations exceed SSLs may further reduce the source length L, which has the effect of increasing SSLs. Groundwater concentrations at the site should then be reviewed to evaluate if the soil may be a source of groundwater contamination.

Sensitivity Analysis

SSLs are most sensitive to changes in the dilution-attenuation factor. Thick aquifers show no source size effect because the increases in infiltration flux from a larger source area is balanced by a proportional increase in mixing zone depth, which increases dilution in the aquifer. For relatively thin aquifers, as is generally the case at CNC, the mixing zone depth is limited by the aquifer thickness and the increased infiltration flux predominates, decreasing the dilution factor for a larger source. Therefore, a conservative over-estimate of SWMU/AOC size will result in a lower than necessary DAF being applied to the site.

Attachment A is a detailed sensitivity analysis from the EPA (1996) and discusses sensitivity of other SSL parameters.

References

1. EPA, 1996. Soil Screening Guidance: Technical Background Document (EPA/540/R-95/128, May , 1996).
2. USGS, 1999. Hydrogeology and Simulation of Ground-Water Flow in the Surficial Aquifer System in the Area of Charleston Naval Base, North Charleston, South Carolina, 1995-1997.

Figure 1
Partitioning Calculations
Organics

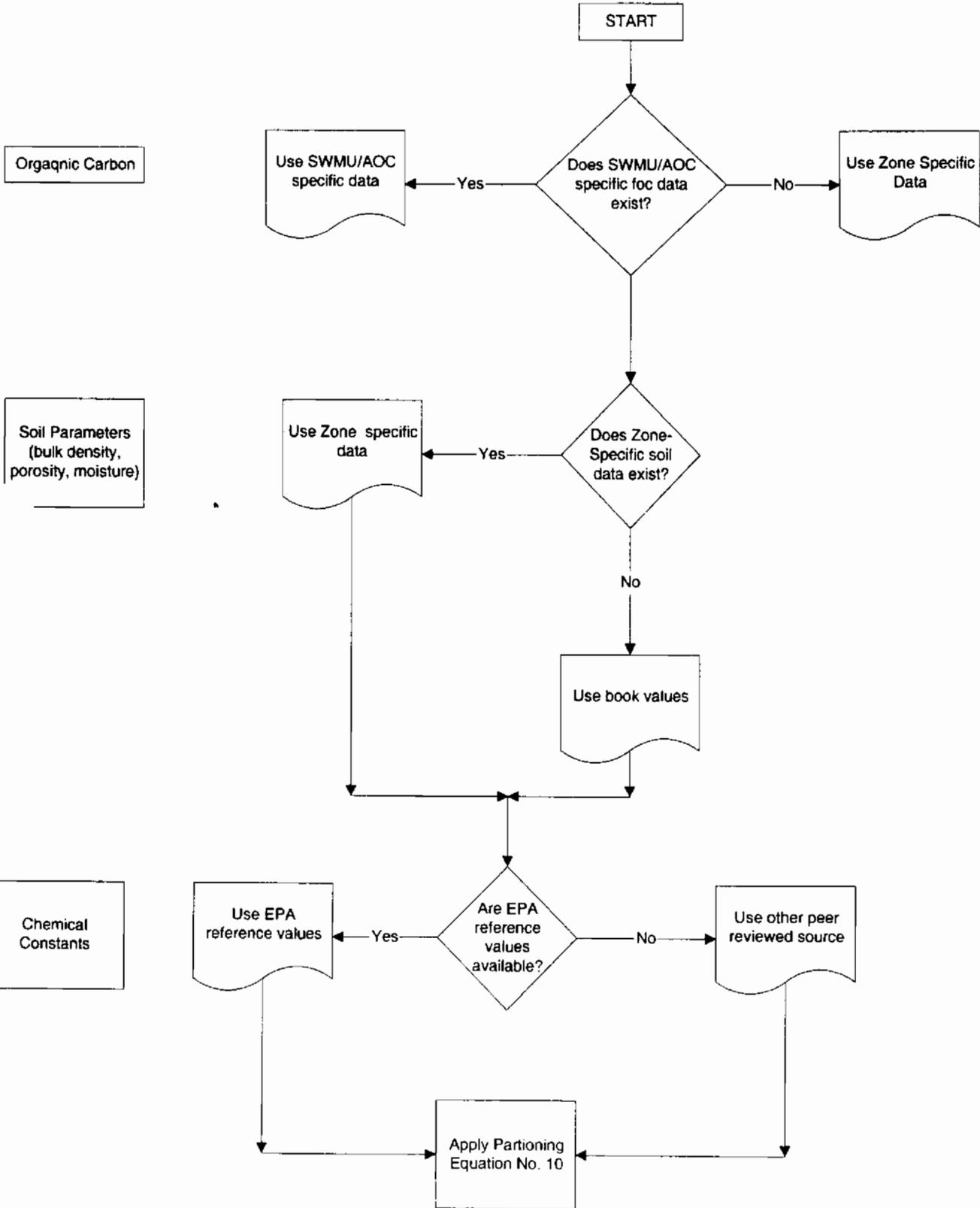
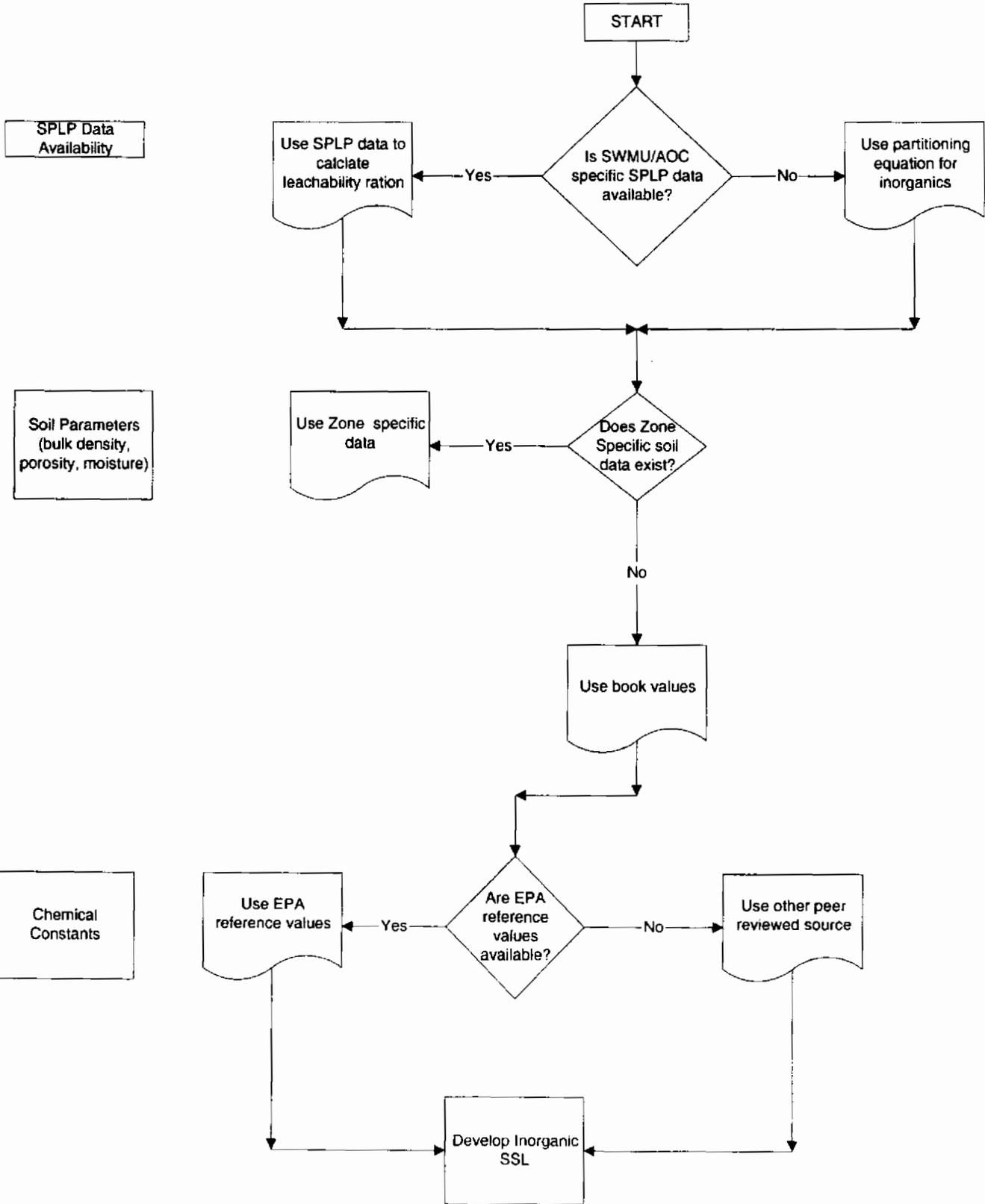


Figure 2
Partitioning Calculations
Inorganics



APPENDIX B

**Results of Work Plan Addendum
Scoping Meetings**

Results of 10/26/2000 & 11/14/2000 Zone F Scoping Meeting; Charleston Naval Complex; Draft Memo

TO: Susan Peterson/SCDHEC
Mihir Mehta/SCDHEC
Mansour Malik/SCDHEC
Mike Danielson/SCDHEC
Tom Beisel/CH2M HILL/ATL

COPIES: Dean Williamson/CH2M Hill/GNV
Paul Bergstrand/SCDHEC

FROM: Louise Palmer/CH2M HILL/CLT

DATE: November 20, 2000

The second part of the Charleston Naval Complex Zone F scoping meeting was held at the SCDHEC in Columbia, SC on October 26, 2000. The following people attended the meeting:

Susan Peterson/SCDHEC
Mihir Mehta/SCDHEC
Mansour Malik/SCDHEC
Louise Palmer/CH2M HILL/CLT
Tom Beisel/CH2M HILL/ATL

The Zone F scoping followup was completed at the BCT meeting on November 14, 2000, with Mike Danielson, Susan Peterson, Tom Beisel, and Mansour Malik in attendance. The meetings were conducted to finish reviewing and agreeing on the proposed plans for completing the fieldwork needed to finalize delineation of the nature and extent of contamination at the Zone F SWMUs and AOCs. Five of the 10 Zone F SWMUs and AOCs were discussed at a meeting on October 9, and a path forward to finalize delineation was agreed upon. The remaining 5 sites were discussed at the October 26 meeting. Site-specific actions for completing the RFI field sampling were agreed upon at the meetings and are presented below. These actions will be presented in the Zone F RFI Work Plan Addendum.

Several issues were discussed in the 10/26 meeting that applied to all Zone F sites:

- The RFI Work Plan Addendum should determine if potential site impacts to the storm sewer system and to surface water have been adequately covered. The RFI report must show that this path has been adequately addressed.
- The Work Plan Addendum and RFI report should also state if there is an oil/water separator on site (check the Master List), and the Work Plan addendum should state if its potential releases have been adequately evaluated.
- If the site contained a railroad, and if it is not identified as part of AOC 504 in the site area, then potential BEQ impacts believed to be caused by railroad use must be

demonstrated in the RFI report, such as by comparing samples along the railroad vs general site samples.

- The RFI report must explain differences in site location and configuration between the RFA and the RFI.
- The Work Plan Addendum should show DHEC's comments to Ensafe's Work Plan Addendum, along with CH2M HILL's responses. These scoping meeting minutes and scoping package text should also be appended.

In addition, there was a brief discussion of air sampling at AOC 607. The DHEC reported that there is a "high potential of public concern" at this site, and that the indoor air be sampled expeditiously.

AOC 617

Zinc in groundwater still needs to be delineated at this site. One additional well will be installed within the uppermost water-bearing unit near the sewer line northwest of the AOC. After the meeting, data from probe locations 037GP040 and 037GP041 west of the site (approximate upgradient location) were reviewed for zinc concentrations: these are 678 ug/L and 37.3 ug/L. Other probe samples in the vicinity showed zinc concentrations ranging from 4.3E5 ug/L (at the former building location) to 27 ug/L. This range appears to delineate the zinc concentrations within the 1100 ug/L RBC in the upgradient direction.

Two rounds of groundwater samples will be collected from the three existing site wells plus the newly installed well. Groundwater will be sampled for metals (As, Cd, Cr, Ni, Sb, Zn).

BEQs in soil will be evaluated in the RFI report by reviewing soil concentrations with respect to their distance from existing or previous railroad locations, and with respect to the background concentrations.

AOC 619/SWMU 004

RFI sampling had identified an unusual benzene concentration (69 ug/kg) in subsurface soil in 619SB001, in the northeast corner of AOC 619. Soil at this location was resampled to measure site-specific leaching properties, and no benzene was detected. It is suggested that the benzene had biodegraded during that time. In addition, revised calculations indicate an SSL (for soil-to-groundwater protection) for benzene of 102 ug/kg. Therefore, we will not pursue this compound at this site any further.

Soil at this site did not identify any unusually elevated locations of BEQ concentrations. These compounds will not be pursued further, beyond railroad and roadways.

We reviewed the soil data for TCE, in an effort to identify a source for a detect of 4 ug/kg in sediment within a catch basin at the site. Three surface soil samples at the site contained TCE concentrations of 2 ug/kg; no TCE source for runoff transport was identified. TCE in soil will not be further pursued at the site.

A figure showing naphthalene (and all PAH) concentrations in groundwater was presented, and it appeared that the low detects of this compound were not related to identifiable PAH

plumes at the site. We recommend no further investigation of naphthalene, but Mansour planned to review this decision with Paul Bergstrand.

It was decided not to pursue thallium in soil or groundwater; however, Mansour planned to review this decision with Paul Bergstrand.

Therefore, pending Mansour's two reviews, it was agreed that no further investigation was needed at AOC 619. As of the BCT meeting, Paul had no comments on this plan.

AOC 620/SWMU 036

PCBs were detected in soil south of the building, between the wall and the street. PCB's had not been sampled beneath the floor slab. A walk-through of Building 68 showed that there were two transformers inside the northern half of the building in the generator room, and oil stains on the floor slab near the transformers. The transformers transferred power through overhead conduits. The floor slab appeared in good condition, with one expansion joint and possibly one crack in the vicinity of the transformers.

In addition, there were two vats along the northern part of the east wall that had apparently drained beneath the east loading dock; drain lines have been removed beneath the dock in preparation for building demolition. A valve pit with a meter was located outside the building's northeast corner. Large acid tanks in the southern portion of the building were piped from above and drained to acid UST in front (south) of the building. Soil borings and groundwater probes and wells were sampled outside the building near this area, and SWMU 36 soil borings had been sampled within the acid tank room.

There appears to be an area outside the southeast building corner with arsenic slightly in excess of the background concentrations. This area has not been bounded to the southeast; 3 surface soil samples are proposed to delineate this arsenic. In addition, surface soil will be sampled for PCBs outside the north half of the building's west side and outside the north side of the building. In addition, the floor slab in the generator room will be cored in 3 places, along the slab joints or cracks in the vicinity of the transformers, and surface soil will be sampled below the slab.

SWMU 109

There was a question about AOC boundary; Ensafe shows it different from the RFA; the GIS shows three separate structures while the aerial photo shows one unit. The RFI report must explain the reason for different SWMU boundaries. The Work Plan and RFI will describe the actual configuration.

No further investigation is required for metals at this site. Check to see if AOC 504 is in the vicinity; otherwise review railroad influence on BEQs.

AOC 613/615/SWMU

Three soil samples are planned near F613SB022 to evaluate BEQs.

On the north side of the site, Al, Cr, V, and As are to be further investigated in soil by collecting 5 soil samples. Tl need not be further delineated; however, the RFI should discuss the reason for its presence in soil at this site.

Initial samples from GELGW014 contained BTEX near the solubility limit; subsequent samples did not report such high concentrations. Investigate potential product recovery efforts in the vicinity, or other corrective measures. Discuss in Work Plan why this product is related to the fuel lines and not to AOC or SWMU operations.

Collect a round of groundwater samples at 613GW003, 613GW004, and 613GW012 for CVOCs. Install and sample a monitoring well in the vicinity of 613GP040 to evaluate CVOCs downgradient of 613GP039.

During the BCT meeting we reviewed data near GELGW007 and concluded that CVOCs have been delineated to the southwest.

We will review data collected near oil water separators to determine if they have been adequately characterized. We will also review the previous location of Building 1169 to verify that RFI sampling covered the appropriate area.

Results of 10/9/2000 Zone F Scoping Meeting; Charleston Naval Complex

TO: Susan Peterson/SCDHEC
Mike Danielsen/SCDHEC
Paul Bergstrand/SCDHEC
Tom Beisel/CH2M HILL/ATL

COPIES: Mihir Mehta/SCDHEC
Mansour Malik/SCDHEC
Dean Williamson/CH2M Hill/GNV

FROM: Louise Palmer/CH2M HILL/CLT

DATE: October 16, 2000

The first part of the Charleston Naval Complex Zone F scoping meeting was held at the SCDHEC in Columbia, SC on October 9, 2000. The following people attended the meeting:

Susan Peterson/SCDHEC
Mike Danielsen/SCDHEC
Paul Bergstrand/SCDHEC
Louise Palmer/CH2M HILL/CLT
Tom Beisel/CH2M HILL/ATL
Dean Williamson/CH2M HILL/GNV (partial attendance)
Mihir Mehta/SCDHEC (partial attendance)

The meeting was conducted to review and agree on the proposed plans for completing the fieldwork needed to finalize delineation of the nature and extent of contamination at the Zone F SWMUs and AOCs. Five of the 10 Zone F SWMUs and AOCs were reviewed and a path forward to finalize delineation agreed to; the remaining 5 sites will be discussed at a later date. Site-specific actions for completing the RFI field sampling were agreed upon at the meeting and are presented below. These actions will be presented in the Zone F RFI Work Plan Addendum.

An initial discussion centered on the methods used to calculate site-specific soil screening levels (SSLs). Louise Palmer agreed to prepare a brief write-up of how the parameters were arrived at and their sources. For example, there were questions about how the mixing zone thickness was measured (or calculated). The SSLs were calculated using the formulas in the July 1996 EPA Soil Screening Guidance and for inorganics, using site-specific SPLP data; Attachment A to this memo contains details.

A copy of SCDHEC's minutes from the April 10/11 2000 team meeting was provided to CH2M HILL.

Paul Bergstrand brought up the point that because methylene chloride may have been used as a paint remover, its frequency of detect as well as possible usage at the SWMU will be

reviewed before it is assumed that the detections are related to laboratory contamination at those sites where paint removal operations may have occurred, such as AOCs 616 and 611. In addition, because bis(2-ethylhexyl)phthalate may have been a component of vacuum fluid it may not always be related to field and laboratory sampling contamination. Frequency of detect as well as possible historical usage of this compound will also be reviewed.

AOC 709

This site is part of the fuel distribution system. Site monitoring wells contained arsenic, which is not related to fuel. Data from monitoring wells upgradient from the site (SMEGW001 and SMEGW008) will be reviewed for arsenic concentrations to evaluate whether the arsenic detections are SWMU related or sporadic non-SWMU related detections. Another round of samples would be collected from site wells and evaluated for arsenic; otherwise, no further sampling was to be conducted at this site.

AOC 607

DHEC had not seen a number of groundwater plume maps for this site that Ensafe had prepared. These are copied in Attachment B of this memo. However, these maps did not contain the most recent data, which showed PCE around 20 ug/L from a shallow well near Avenue D. Chlorinated solvents had not previously been detected in that area. It was agreed to install and sample another shallow well near the property line between 607GW05D and 607GW03D. Monitoring well 607002 will be resampled for lead analyses. Soil data from the vicinity of this well will be evaluated for lead. No additional soil samples are planned.

Indoor air samples will be collected within Building 225, adjacent and west of site 607, and analyzed for the chlorinated solvent PCE and its degradation products (TCE, 1,2-DCE, and VC.)

AOC 609

It was suggested that surface soil BEQ and inorganic concentrations may have been caused by subsurface soil being spread over the site during UST removal. A review of the confirmation samples collected during the UST closure will provide information regarding potential contamination in the excavated soil, to see if it may be related to the RFI surface soil data. No matter whether the concentrations are related or not, we can assume that the area of surface disturbance from the UST removal is within the area already sampled at AOC 609, and no further soil sampling will be conducted.

Groundwater flow direction is to the east-southeast; the closest monitoring point in the downgradient direction from the waste oil site is near a former fuel UST on the southeast side of the building. This UST may have released product. Data from well TTNUS-P04, which may be a product recovery well, will be evaluated for metals that might have been released from the waste oil UST (and that we do not suspect to have been released from the fuel UST.) The waste oil UST removal report will be reviewed for soil data from below the tank and drainage line. If no metals were analyzed from TTNUS-P04, we will sample it for metals.

AOC 616

The RFI sampling did not include groundwater sampling at this site, because the well coverage was adequate among the adjacent sites. Groundwater issues potentially resulting from AOC 616 will be covered under AOC 617. Soil samples from this site did not exceed screening criteria; no further sampling is required.

AOC 611

A transformer vault just north of the site is a possible PCB source. Paul Bergstrand lent Louise Palmer a copy of the Interim Measure Report for this site. Louise will check the report for data relating to metals analyses in the confirmation samples. Samples from the base of the IM excavation will be collected and analyzed for PCBs, and for metals if not previously analyzed. In addition, PCBs will be sampled from surface soil surrounding the excavated zone.

AOCs 617, 619/004, 620/036, 613/615/175, and SWMU 109 will be discussed at the next meeting, scheduled for October 26, 2000.

Attachment A – Derivation of Site-Specific SSLs

Attachment B – Soil and Groundwater Plume Maps from AOC 607 Ensafe draft CMS,
December 1999

Shallow Groundwater Elevation – 4/20/99

Shallow Groundwater Elevation – 6/22/99

Shallow Groundwater Elevation – 10/99

Intermediate Groundwater Potentiometric Surface – 10/99

Deep Groundwater Potentiometric Surface – 10/99

PCE in Upper Soil (0-2 ft)

PCE in Lower Soil (2-5 ft)

PCE in Upper Groundwater – 10/99

TCE in Upper Groundwater – 10/99

1,2-DCE in Upper Groundwater – 10/99

Vinyl Chloride in Upper Groundwater – 10/99

PCE in Lower Groundwater – 10/99

TCE in Lower Groundwater – 10/99

1,2-DCE in Lower Groundwater – 10/99

Vinyl Chloride in Lower Groundwater – 10/99

Attachment A – Site Specific SSL Derivation

Site-Specific SSLs for groundwater protection were derived using the methods presented in the OSWER Soil Screening Guidance, July 1996. The guidance document provides a two-step process for deriving site-specific SSLs. The first first step involves a partitioning calculation to derive target soil concentrations independent of aquifer characteristics, and the second step further revises the target concentration based on the dilution and attenuation of the aquifer.

Partitioning Calculations

For organic compounds, the partitioning equation (Eqn 10 in the Guidance) was used to calculate a soil concentration protective of groundwater. The target soil concentration is a function of the target leachate concentration, soil characteristics such as porosity, density, and fraction of organic carbon, and chemical-specific parameters such as soil-water partitioning coefficient. The partitioning equation provides a target soil concentration assuming no dilution or attenuation within the aquifer, i.e., dilution-attenuation factor (DAF) = 1.

$$\text{Equation 10: } \text{SSL}_{\text{DAF}=1} = C_w \left[K_d + \frac{(\theta_w + \theta_a H')}{\gamma_{\text{dry}}} \right]$$

where SSL = Target soil screening level

C_w = target leachate concentration (MCL or RBC if MCL not available)

K_d = soil water partition coefficient (chemical specific), = $K_{oc} \times f_{oc}$

θ_w = water-filled soil porosity

θ_a = air-filled soil porosity

H' = Henry's Law constant (chemical-specific)

γ_{dry} = soil dry bulk density

The soil parameters were measured at each site and the geometric mean used to calculate SSLs. Ensafe collected TOC samples at each site, and used the f_{oc} to calculate the soil water partition coefficients. Sites within Zone F were organized into seven site groupings according to proximity. The geometric mean of the TOC data for each site grouping was calculated and used as the central tendency f_{oc} value to allow for the probability that f_{oc} in soil is lognormally distributed. The table below presents Ensafe's f_{oc} data.

Fraction of Organic Carbon at Zone F Site Groups

Site Group	f_{oc} in All Soil Samples ¹			f_{oc} in Surface Soil Samples ²		
	Number of Samples	Arithmetic Mean	Geometric Mean	Number of Samples	Arithmetic Mean	Geometric Mean
004/619 036/620	10	0.022	0.011	4	0.043	0.030
109	6	0.013	0.010	3	0.0095	0.0086
607	9	0.006	0.0051	3	0.0061	0.0056
609, 611	11	0.034	0.0065	5	0.069	0.016
613/615/ 175	7	0.013	0.007	3	0.0075	0.0067
616, 617	7	0.0049	0.0042	3	0.0028	0.0025
709	2	0.0205	0.0204	1	0.019	0.019

Notes:

- ¹ = Use geometric mean of all site soil samples to calculate soil-to-groundwater SSLs.
- ² = Use geometric mean of site surface soil samples to calculate soil-to-air SSLs.

Equation 10 was used at Zone F to derive SSLs (assuming DAF = 1) for organic compounds. As described in the Soil Screening Guidance, leach tests were used to develop SSLs for soil inorganics. SPLP tests were conducted on new samples from the AOCs and SWMUs and the leachate was compared to the related concentrations in the bulk samples. The test results were compared and applied directly to SSL development using:

$$C(\text{soil}) \times LR = C(\text{leach})$$

Where:

- C(soil) = concentration sorbed to soil
- C(leach) = concentration in leachate
- LR = leachability ratio

LR is the reciprocal of the Freundlich adsorption constant, which is assumed to be linear. C(soil) and C(leach) are measured in the bulk and leach samples, respectively. Assuming a DAF of 1, the LR equation can be used to derive a target SSL by making C(leach) equivalent to the maximum acceptable groundwater concentration in the aquifer, and then calculating the corresponding C(soil).

To develop the LR, soil was sampled from 2 to 4 locations at each AOC (except AOC 709) and analyzed for Total organic content, VOCs, SVOCs, metals, cyanide, pesticides, and

PCBs, and for SPLP on the above analyte list. Surface soil and subsurface soil samples were collected from each location. In general, PCBs, pesticides, and organic compounds were not detected in the leachate. Therefore, the LR was used to calculate SSLs for inorganics, and the partitioning equation was used to calculate SSLs for organics and those inorganics with insufficient SPLP data. However, there were some instances where the analyte was not detected; methods to address these occurrences are listed below.

Situation	Resolution
Parameter detected in bulk, but nondetect in the leach	Use one-half the detection limit for leach samples as the leach value
Parameter detected in the leach but nondetect in the bulk	Use the detection limit for bulk samples as the bulk value
Parameter non-detect in both the bulk and the leach	No value assigned
Re-extraction analyses	Either use the re-extraction result or, if the original analysis uses lower detection limits, assign the original value to the bulk and/or leach

LRs were calculated for detected parameters in each sample and averaged geometrically to assign a central-tendency LR value to each inorganic parameter at each site group. This central-tendency LR was then used to calculate the parameter's target SSL (DAF = 1), using the equation shown above. Because sample sizes were small and the underlying LR distributions were assumed to be lognormal, uncorrected geometric means were used.

A zone-specific SSL was used when certain inorganics were not detected in both bulk and leach portions of any of the SPLP samples from a given site group. Zone-specific SSLs were developed by obtaining the geometric means of SSLs from all Zone F site groups with relevant data.

Dilution-Attenuation Factors

Dilution-attenuation factors (DAF) were calculated for each site within Zone F to account for the dilution effect of the aquifer on the soil leachate (either the hypothetical leachate calculated from the partitioning equation or the actual leachate observed in the SPLP.) The DAF is calculated using Equation 11 from the Soil Screening Guidance:

Equation 11:
$$DAF = 1 + \frac{K_i d}{IL}$$

Where K = hydraulic conductivity

i = hydraulic gradient

d = mixing zone thickness (from equation 12)

I = infiltration rate

L = source length parallel to groundwater flow direction

The gradient, source length, and mixing zone thickness are specific to each AOC.

The hydraulic conductivity was averaged from the various slug tests conducted within the Zone. A zone-wide average was considered most representative of site conditions to account for differences in well construction, test procedures, and the statistically low number of slug tests per site. Slug test results are presented below.

Zone F Hydraulic Conductivity		
Wells	Hydraulic Conductivity (ft/day)	
	Falling Head	Rising Head
Shallow		
GDF001	6	8.4
607001	1.74	2
607002	0.42	0.62
607004	0.191	0.197
613001	0.83	1.3
613004	0.38	0.27
619002	0.11	0.11
619003	0.28	0.32
620002	0.42	0.41
GEL005	0.42	0.41
GEL007	0.31	0.21
SME004	8.70E-02	9.20E-02
Intermediate		
60701I	1.3	1.2
60702I	0.37	0.55
60704I	0.7	0.66
Deep		
GDF01D	2.7	1.7
60701D	2.70E-02	NM
60702D	2.30E-02	NM
60704D	8.10E-03	NM
61302D	0.12	0.12
Average =	0.82	1.09
	Average for all values =	0.95
NM	Not measured	
	0.95 ft/day =	346.75 ft/yr 105.7 m/yr

Ensafe estimated the average zone-wide infiltration rate by first using the USGS model report of 1.2 inch/year (in/yr), which USGS had uniformly applied across the base. However, Zone F is semi-industrial with a large percentage of overall area covered with an impervious surface, and numerous engineered drainage systems to divert runoff and

potential recharge. A conservative estimate of 25% of the USGS value was used for Zone F, or 0.3 in/yr (.00762 m/yr), which is considered more realistic for the Zone F sites.

The mixing zone thickness is that portion of the aquifer thickness that may be assumed to transport the contamination. It is estimated from Equation 12 in the Soil Screening Guidance, and does not exceed the total aquifer thickness.

Equation 12: $d = (0.0112L^2)^{0.5} + d_a[1 - \exp\{-LI/(Kd_a)\}]$

Where d = mixing zone depth (m)

L = source length parallel to groundwater flow direction (m)

d_a = aquifer thickness (m)

I = infiltration rate (m/yr)

K = hydraulic conductivity (m/yr)

i = hydraulic gradient

The following table presents the parameters used to calculate the DAFs for each area within Zone F:

Site(s)	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient i (m/m)	Aquifer Thickness d _a (m)	Source Length L (m)	Infiltration Rate I (m/yr)	Mixing Zone d (m)	DAF
004/619, 036/620	105.7	0.02	9.8	120	0.00762	9.8	23.7
616,617	105.7	0.018	9.8	34	0.00762	3.7	28.4
607	105.7	0.0079	8.2	46	0.00762	5.3	13.6
609, 611	105.7	0.0043	8.5	38	0.00762	4.6	8.3
109	105.7	0.0058	7.6	30	0.00762	3.5	10.5
613/615/175	105.7	0.0227	9.1	150	0.00762	9.1	20.1
709	105.7	0.025	10.8	120	0.00762	10.8	32.2

The site-specific DAF is influenced by the source length, which may be interpreted to be the length of the spill area, if known, or the dimensions of the AOC, if no specific release area has been identified. It is very conservative to assume the entire AOC dimensions, and this parameter should be refined if possible. Actual DAFs may be assumed to be significantly higher than those presented in the table.

Site-Specific SSLs

The site-specific DAF is then multiplied by the $SSL_{DAF=1}$ to arrive at the site-specific SSL. According to the EPA soil guidance, the average site soil concentration should be compared to the final SSL to evaluate if soil concentrations could potentially impact groundwater. Mapping areas in which maximum soil concentrations exceed SSLs may further reduce the source length L, which has the effect of increasing SSLs. Groundwater concentrations at the site should then be reviewed to evaluate if the soil may be a source of groundwater contamination.

Zone F – Basis for Work Plan Addendum

AOC 709 – Former Fuels Distribution System

This site was originally included in the investigation of the base-wide underground Fuel Distribution System (FDS) at CNC, and was identified as Area 16 in that study. During the study, elevated concentrations of inorganic analytes (arsenic and iron) were detected in shallow groundwater in one well, FDS16B. The BCT determined that a RFI was required at the site due to the detection of these inorganics. The primary concern was the detection of arsenic in well FDS16B. A review of past operations and historic maps did not identify a source for the arsenic. Anecdotal evidence from Ensafe indicates that application of arsenate-based pesticides and herbicides may have occurred on adjacent grass fields. The FDS was utilized to convey fuel products, not waste oil, or any other waste material that could contain arsenic or other metals.

The Revision 0 RFI Report Addendum (3/99) RFI results showed no VOCs or SVOCs detected in any of 3 rounds of groundwater monitoring. Three VOCs and 19 SVOCs were detected in subsurface soils collected near the pipeline, but all at levels below SSLs. Twenty-one metals, including arsenic, were detected in groundwater. Thallium exceeded the MCL in the first event only. Arsenic was detected in all groundwater samples from all events, at concentrations up to 160 ug/l. Boring logs indicated subsurface sediments in the screened zone of the shallow wells consist of silty clay/sand, clayey sand and clay.

Ensafe Work Plan Addendum, 11/99

Site not specifically addressed.

SCDHEC Comments on Work Plan Addendum

Site not specifically addressed.

RFI- Results of Additional Field Activities

Fourth and fifth quarters of groundwater sampling, (not reported in the draft RFI report) did not contain concentrations of metals higher than previous samples.

4/12/2000 Project Team Meeting

It was agreed to defer further investigation of arsenic in groundwater at this AOC until the results of the base-wide groundwater inorganics study are available.

CH2M- Jones Team Recommendations

The fluctuating metals concentrations in shallow groundwater at this AOC could be related to rainfall recharge events, and to the variable turbidity observed in groundwater samples, which may contain suspended clay particles.

Because the shallow monitor wells are screened in clayey aquifer materials, and metals are not COPCs at this AOC, and because no fuel constituent contamination is present in soil or groundwater above criteria levels, no further investigation is warranted for this AOC.

AOC 607 – Former Dry Cleaning/Laundry, Building 1189

The former dry cleaning operation operated from 1942 to 1986; from 1986 to closure in 1995 only laundry operations were conducted. The Ensafe RFI included DPT sampling of soils/groundwater and stormwater catch basin sediments, soil borings, monitor well installation. Radial groundwater flow to well 607006 identified potential infiltration of groundwater into storm sewer system. COCs identified were PCE, TCE, DCE, Vinyl Chloride in shallow and intermediate groundwater, centered around well 607006. Soil PCE concentration of 710 ug/Kg in boring 607SB004 exceeded subsurface SSL(DAF=20) of 60 ug/Kg. Metals were widely detected in soil and groundwater, with arsenic, lead, mercury and thallium exceeding MCLs in groundwater. Aluminum, iron, manganese and vanadium exceeded both RBCs and background randomly in groundwater. VOCs and metals were detected in sewer catch basin sediment samples.

SCDHEC Comments on Draft RFI

Concerns were expressed over delineation of extent of PCE around Boring 607SB004, and regarding vertical delineation of DNAPL/VOCs in groundwater.

Ensafe Work Plan Addendum, 11/99

Site not included.

SCDHEC Comments on Work Plan Addendum

Site not included.

RFI- Results of Additional Field Activities

Soil Sampling – Soil sampling during boring installation through floor of Building 1189 did not reveal major PCE soil contamination. Additional soil samples located around boring 607SB004 delineated extent of PCE contamination.

Sediment Sampling - Paved parking lot catch basin samples contained 27 SVOCs, only one of which was also detected in soils, and 22 different metals, all also detected in soils. Subsequent to the sampling, sediment in catch basins has been removed by the Detachment.

Groundwater Sampling – additional rounds of groundwater sampling indicate decreasing levels of VOCs with time. Newer wells installed through floor of Building 1189 confirms localized shallow PCE/TCE/DCE groundwater contamination confined to area under building near existing monitor well 607006, still exceeding MCL at last sampling. Intermediate/deep groundwater VOC contamination still centered around Well 607006. Refer to plume delineation maps in Dec 1999 Ensafe Draft CMS.

4/12/2000 Project Team Meeting

Installation of an additional deep well, 60707D, was proposed near shallow well 607007 to address deep VOC distribution. Resampling of all deep wells was proposed. Resampling of well 607002 was proposed to address a solitary detection of lead at 245 ug/l in latest

sampling event. It was proposed to collect both filtered and unfiltered fractions to evaluate the cause of the detection. It was agreed that lead is not a COPC at dry cleaning operations.

CH2M- Jones Team Recommendations

Extent of contamination in soils and groundwater from site-related COCs is sufficiently defined to proceed with CMS. Re-sample groundwater to confirm present VOC distribution. Metals detected in site groundwater are not related to dry cleaning solvent use, are ubiquitous in site soils across Zone F and other Zones.

With a site-specific SSL calculation (DAF= 13), only aluminum exceeds both RBCs and background in soils at one location, boring 607SB008. Aluminum occurs naturally in clay soils, and is not known or suspected to be a contaminant released from dry cleaning operations. No further investigation of metals in soils is warranted.

AOC 609 – Service Station, Building 1346

Building 1346 is a former gasoline station and automotive repair and maintenance shop. The focus of the RFI is a 560-gallon waste oil UST, removed in 1996. Other materials stored or potentially released at the site include gasoline, diesel fuel, motor/lubricating oils, degreasing solvents, antifreeze. A fuel recovery system is in operation at the site, responding to releases from the gasoline and diesel fuel USTs. This operation is being performed under the SCDHEC UST program. Revision 0 RFI Report (12/97) identified risk drivers: BEQs and metals (As, Be, Sb, Mn) in surface soil and BTEX, SVOCs (mainly PAHs), Al, and As in groundwater.

Ensafe Work Plan Addendum, 11/99

Surface Soil and Subsurface Soil (0-1 feet bgs, 3 to 5 feet bgs) - Recommended six additional borings (609SB007 through 609SB012) to define the extent of chromium in surface and subsurface soil in the area northeast, northwest, west, and southwest of 609SB002. Samples will be analyzed for metals at DQO Level III.

Groundwater – Conduct additional shallow groundwater sampling at monitoring wells 609001 and 609002. Samples will be analyzed for metals and VOCs.

Response to SCDHEC Comments on Work Plan Addendum, 12/99

1. SCDHEC: Use site-specific SSL's to screen. ENSAFE: Will do; have collected necessary samples and will document the process for SSL development.

RFI – Results of Additional Field Activities

Surface Soil: Six additional borings (609SB007 – 609SB012) were completed and were evaluated for SW-846 Metals at DQO Level III. The following constituents detected above RBCs and background at location 609SB007 include:

– Antimony	18.5 mg/kg	(Residential RBC = 3.1)
– Chromium	50.6 mg/kg	(Residential RBC = 23)
– Copper	480 mg/kg	(Residential RBC = 310)
– Iron	23,800 mg/kg	(Residential RBC = 2300)
– Lead	511 mg/kg	(Residential RBC = 400)
– Zinc	2,650 mg/kg	(Residential RBC = 2300)

Other boring locations detected these metals below their respective RBC or background screening levels.

Subsurface Soil: All concentrations were either not detected or below their respective SSLs or backgrounds.

In addition to the new soil borings, previous sample locations 609SB001 and 609SB002 were resampled for total analytes and SPLP analytes. The results are shown on the attached table.

Groundwater – Two rounds of sampling was conducted at 609GW001 and 609GW002 and analyzed for metals, VOCs, SVOCs, pesticides, and PCBs. No VOCs, SVOCs, pesticides, or PCBs were detected in the samples. Constituents detected above RBCs and background include:

- Aluminum 7,440 µg/l (Residential RBC = 3700)
- Chromium 13.4 µg/l (Residential RBC = 11)

The second round of sampling at location 609GW001 detected arsenic at 47.3 µg/l above the RBC and background of 0.045 µg/l and 16.2 µg/l, respectively. Arsenic was also detected at location 609GW002, during both the first and second rounds of sampling at respective concentrations of 105 µg/l and 30.1 µg/l. The MCL for arsenic is 50 µg/l. Aluminum and chromium was either not detected or detected below the screening levels in the second round of sampling at 609GW001 and in both rounds at 609GW002.

Issues Discussed at 04/11/2000 Project Team Mtg and Ensafe Proposed Action

- The information and findings of the waste oil UST removal report will be summarized and included in the final RFI.
- The waste oil UST removal report indicated that the piping from Building 1346 to the UST had leaked. The concern was raised that confirmation samples were insufficient to assure all contamination had been identified. To investigate the potential for VOC contamination along the former waste oil pipeline, additional soil samples are proposed.
- There was also a question of adequate characterization of the waste oil UST excavation area. DPT samples are proposed to investigate the soil and shallow groundwater at the location of the former waste oil UST. These samples will be analyzed for VOCs and metals. The metals portion of the groundwater samples would be analyzed for both total (unfiltered) and dissolved (filtered).
- Delineation of manganese in surface soil above it's residential RBC and aluminum in shallow groundwater above it's tap water RBC is not complete based on comparison to RBCs using a THQ of 0.1 rather than 1.0. Because only six noncarcinogenic COPCs were detected in soil and four noncarcinogenic COPCs were detected in groundwater, use of these adjusted screening values is believed to be overly conservative for purposes of delineating the extent. Comparison to unadjusted values would result in no exceedances for these constituents, meaning no further sampling for these analytes is necessary.
- Shallow groundwater at monitoring well SME005 has been impacted by fuel constituents. Detections of the VOCs, benzene, ethylbenzene, toluene, xylene and the SVOCs 2,4-Dimethylphenol, 2-Methylnaphthalene, 2-Methylphenol, 4 Methylphenol, and naphthalene consistently exceeded the MCLs and RBCs in well SME005, located closest to the fuel USTs. Down-gradient monitoring wells 609001 and 609002 have not detected these constituents, effectively delineating the extent of contamination.
- The distribution and sporadic occurrence of inorganic exceedances in shallow groundwater is inconsistent with the waste oil UST as their source. Of these inorganic COPCs only iron is commonly associated with waste oil. The aluminum, antimony, iron and manganese exceedances were detected primarily in wells SME001 and SME007, which are located side

gradient to the waste oil UST. The arsenic was distributed more evenly across the site; concentrations do not indicate the UST area as a source. Arsenic is one of the analytes of interest of the basewide inorganics study. Based on these factors no additional sampling is proposed to delineate inorganics in groundwater at AOC 609.

CH2M-Jones Team Recommendation

Surface Soil: No further investigation. Surface sample location 609SB001 detected Benzo(a)pyrene at 480 µg/kg, above its RBC of 87 µg/kg. Surface soil concentrations are not expected to be related to subsurface releases from a UST or buried piping this site, and may be attributed to other anthropogenic sources. Metal exceedances have been effectively delineated at 609SB002 and 609SB007.

Subsurface Soil: No further investigation. Concentrations were either not detected or below their respective SSLs or backgrounds.

Groundwater – No further investigation. VOCs, SVOCs, Pesticides/PCBs were not detected in both rounds of sampling at 609GW001 and 609GW002, which are down gradient from the waste oil UST area. Detection of metals was sporadic with only arsenic consistently detected at exceedance values in both the 5th and 6th sampling events (1st and 2nd round for 609GW002). The highest concentration of manganese was detected in 609SB009 at 398 µg/l, which is below the RBC of 1100 µg/l. Arsenic was also detected at exceedance concentrations at shallow wells SME008 and SME001. This suggests impacts from arsenic are coming from outside the AOC 609 area with respect to the defined shallow gradient at AOC 609. Aluminum presence in groundwater may be part of the Zone specific occurrence of metals in groundwater.

AOC 611 – Grease Rack and Hobby Shop, Former Building 1264

Former Building 1264 was used as an automotive hobby shop from the 1950s to the 1960s. The site is currently partially paved and partially lawn area. Materials potentially released at the site include petroleum products, solvents, degreasers, paints, and lead. Draft RFI Report (12/97) identified risk drivers in surface soils: BEQs, PCBs, and metals (As, Cr, Cu, Pb, Hg).

Interim Measures

Interim Measures at the site included removal of approximately 280 cubic yards of RCRA Metals and PAH contaminated surface soil. The area excavated and removed was approximately 75 feet by 100 feet by 1 foot in depth. Confirmatory samples indicated 2 exceedances of Arsenic (NBCF611S0004) and Benzo(a)pyrene (NBCF611S0007) above the RBC. Therefore two additional samples were obtained from 2 foot by 2 foot by 1-foot deep excavations. Sample results indicated concentrations of arsenic below the background concentration for surface soil (19 mg/kg) (NBCF611S0009) and the b(a)p below the USEPA Region III RBC (NBCF611S0010). Subsurface soils were not addressed by the Interim Measure.

Ensafe Work Plan Addendum, 11/99

Surface Soil and Subsurface Soil (0-1 feet bgs, 3 to 5 feet bgs) - Interim measure soil removal did not extend to location 611SB005. Recommended five additional borings to define the extent of chromium in surface and subsurface soil in the area southwest, south, southeast, east, and northeast of 611SB005.

Summary of SCDHEC Comments on Work Plan Addendum, 12/17/99

Regarding the Interim measures report

The Interim Measure analysis was only for PAH and RCRA Metals and not for the full range of potential contamination. This limited suite of analysis will complicate the use of the IM data in the RFI Report. *Response:* The Navy concurs, and proposes that the lack of PCB analyses be discussed at the February 2000 Project Team meeting.

There were apparently no PCB confirmation or waste characteristic samples from the IM. *Response:* Agree; see response above. It is probable that the majority of the PCBs were removed during the 1-ft minimum excavation.

PAH confirmation samples 1,2, and 3 were diluted (10x, 40x, and 10x) as a result of matrix interference. How these elevated detection levels may compare with the RBC was not addressed in the report. *Response:* Elevated TPH concentrations provide an indication that the matrix interference was most likely a result of one or more of the numerous constituents of which TPH is comprised that are not included on a standard Method 8270 analyte list. Situations such as this where an obvious petroleum release has occurred, yet no constituents are identified which drive risk requires a risk management decision from the team with respect to how the site should be addressed. The report will be revised to include a discussion of the data usefulness based on the conditions causing the matrix interference and the elevated reporting limits.

Confirmation sample location 2 (611-004) reported strong petroleum odor and the TPH analysis confirmed 28,500 ppm at the site. *Response:* The site is one of several where the remedial goals

were based on the petroleum indicator compounds for which risk based cleanup goals have been established, not TPH. The Navy addressed these situations in detail in Appendix A of the Zone C CMS Work Plan (EnSafe, June 23, 1998). The Project Team will collectively decide how to deal with these situations. This matter should be resolved prior to attempting to submit the revised RFI report.

Maps and figures from the IM Report and the Work Plan Addendum of the excavated area do not agree. *Response:* The work plan addendum shows the footprint of the former building, not the area of the IM excavation. The Project Team has agreed that the term "site boundary" should refer to the boundary of the site as it was described in the RFA which is going to be different from the boundary associated with the extent of contamination at a site. A map showing the extent of the IM excavation will be included as part of the revised RFI report. As discussed during the April Project Team meeting, Dean Williamson drafted this definition of a site boundary:

The boundary of a site (SWMU or AOC) will be the larger of either:

- 1) the originally identified footprint in the RFA or
- 2) the extent of contamination linked to the activities conducted at the site

The "extent of contamination" is considered to "unrestricted land use" outside of Zone E and for "restricted use" inside Zone E. In cases where contamination is identified that may not be linked to the site, the team will make a case-by-case decision on how to delineate the site boundary.

RFI – Results of Additional Field Activities

Surface Soil: Seven additional borings (611SB008 – 611SB014) were completed and were evaluated for SW-846 Metals at DQO Level III. The following constituents were detected above RBCs and background:

- | | | | |
|------------|------------|----------|--------------------------|
| - Mercury | 8.8 mg/kg | 611SB008 | (Residential RBC = 2.3) |
| - Thallium | 0.97 mg/kg | 611SB011 | (Residential RBC = 0.55) |

Subsurface concentrations were detected below their respective SSL and background concentrations.

Issues Discussed at 04/11/2000 Project Team Mtg and Ensafe Proposed Action

Delineation of mercury and thallium in soil is not complete based on comparison to residential RBCs using a THQ of 0.1 rather than 1.0 to ensure that chemicals with additive effects are not prematurely screened out. Because only four non-carcinogenic COPCs were detected in soil, use of the adjusted RBC is believed to be overly conservative for purposes of delineating the extent. Comparison to unadjusted RBC values would result in no exceedances, meaning no further sampling for these elements is necessary.

During the IM, PAHs, PCBs, dioxin, and lead that had been detected in surface soil, within the footprint of the soil excavation, were either not analyzed for or were not completely delineated. Seven samples are proposed to address those concerns. Although five cPAHs were detected at AOC 611, the site history, consistent distribution of exceedances (611SB006) and the fact that the

area is not heavily industrial, suggest these detections are site related and therefore should be delineated.

CH2M-Jones Team Recommendation

Surface and Subsurface Soil: Additional delineation activities are not warranted for mercury and thallium detected in surface soil. Locations of mercury and thallium detected in the surface soil samples are sporadic and are not indicative of any specific materials previously used at the site. Mercury detected in sample 611SB008 was further delineated by soil samples 611SB003, 611SB011, 611SB013 and 611SB014. Thallium detected in sample 611SB011 was further delineated by soil samples 611SB008, 611SB009, 611SB012, and 611SB013. Lead was detected in surface soil at or above the residential RBC (400mg/kg) and background (180mg/kg) at 611SB002 (400mg/kg) and 611SB007 (566.7mg/kg). *both areas have been removed*

The one area of lead exceedance was removed during the IM; confirmation samples did not exceed RBCs for lead. IM confirmatory samples were also evaluated for PAHs with one RBC exceedance at NBCF611S0007; resampling resulted in concentrations below the RBC's. Other confirmatory samples obtained around NBCF611S007 include NBCF611S003 through NBCF611S005 and NBCF611S008 with no PAHs RBC exceedances. As a result, additional investigation activities in surface and subsurface soil are not recommended for metals or PAHs.

Recommend surface and subsurface confirmatory samples for PCBs. Dioxins are not related to site usage, and sampling for them is not recommended.

Groundwater: Nearby down-gradient monitoring wells 609001 and 609002 have not detected impacts that can be associated with AOC 611; no investigation is warranted.

AOC 616 – Paint Shop, Former Bldg 1201

Materials potentially released from plant would be paint supply products (metals) and solvents (VOCs). Building is demolished and site is currently paved with asphalt, next to railroad tracks. The Revision 0 RFI Report (12/97) identified no risk drivers in soil; groundwater investigation was covered under adjacent site investigations. Site is recommended for No Further Action.

Ensafe Work Plan Addendum, 11/99

This site was not included

SCDHEC Comments on Work Plan Addendum, 12/99

No comments specific to this site

RFI – Results of Additional Field Activities

- Soil samples (both surface and subsurface) taken again at 616SB002 for SPLP on CN, VOCs, SVOCs, PCBs, Pest, and Metals. (Note: surface samples were taken below the pavement.) Results for detected constituents – see attached tables. SPLP leachate was detected for metals only.

Issues Discussed at Project Team Mtg, 4/11/2000

None.

CH2M-Jones Team Recommendation

No additional sampling; prepare CMS work plan for NFA.

AOC 617 – Galvanizing Plant, Former Bldg 1176

Materials potentially released from plant would be inorganic acids and zinc solutions. A 3000-gallon UST (unknown location) was used for chemical storage. Plant is demolished and site is currently paved with asphalt. The Revision 0 RFI Report (12/97) identified risk drivers: BEQs in surface soil and metals (Al, As, Cd, Co, Mn, Ni, Tl, Zn) in groundwater.

Ensafe Work Plan Addendum, 11/99

This site was not included

SCDHEC Comments on Work Plan Addendum, 12/99

No comments specific to this site

RFI – Results of Additional Field Activities

- Shallow gw well 617GW003 was installed in downgradient location (NW side of site) and sampled once. VOC, SVOC, Pest, PCB all non-detect. Metals detected above background and RBCs:
 - Cd 3.4 J ug/l (Residential RBC = 1.8)
 - Fe 25800 J (Residential RBC = 1100)
 - Ni 114 (Residential RBC = 73)
 - Sb 54.9 J (Residential RBC = 1.5)
 - Zn 30600 (Residential RBC = 1100)
 - As, Co, Mn, Tl either non-detect or below Background/RBCs.
- Wells north of 617, across 11th street (GEL011 and GEL005) have similar Al concentrations as the maximum detects at 617. These wells are located on the other side of a gw trough north of 617; gw from both sites flows toward Cooper River.
- Soil samples (both surface and subsurface) taken again at 617SB003 and 617SB004 for SPLP on CN, VOCs, SVOCs, PCBs, Pest, and Metals. (Note: surface samples were taken below the pavement.) Results for detected constituents – see attached tables. SPLP leachate was detected for metals only.

Issues Discussed at 4/11/2000 Project Team Mtg and Ensafe Proposed Action

- Groundwater metals need to be delineated; an additional upgradient well should be installed south of 617SB002. Sample all wells in the vicinity.
- Groundwater flow direction and gradient may be caused by sewers or an old creek channel. Public works map (1909) shows that the site is at the edge of the water front near a tidal marsh; no creeks shown.
- Collect more soil samples to evaluate benzo(a)pyrene, benzo(a)anthracene, and antimony

CH2M-Jones Team Recommendation

Surface and Subsurface Soil: BEQs in surface and subsurface soil do not appear related to a potential release from AOC 617; likely an artifact from non-site related sources.

Furthermore, they have not been detected in groundwater, and PAH leachate has not been detected in the SPLP tests. A review of metals exceedances in soil, using SSLs based on site-specific parameters (DAF = 28.5), indicates that all detects are lower than either background, RBCs, or SSLs (in particular, antimony and thallium). Therefore, no further investigation is warranted.

Groundwater: Install upgradient well for metals consideration. Resample site and adjacent wells, driven by sporadic detects of Cd, Cr, Ni, Sb, Zn. Al and Fe are major components of site clays.

SWMU 4/AOC 619 – Pesticide Storage Building 381 / Former Oil Storage Yard

Materials potentially released from Building 381 include pesticides and metals. Entire area of AOC 619 was an oil storage yard; materials potentially released would be petroleum products (PAHs, possibly PCBs, BTEX, lead). No spills are documented. Site is surrounded by railroad tracks. Shallow groundwater prevented collection of some planned subsurface samples. The Revision 0 RFI Report (12/97) identified risk drivers: BEQs and manganese in surface soil; chloromethane and thallium in groundwater. Within AOC 619 area is Bldg 1824, Hazardous Material Storage Bldg. Potential releases could include VOCs, SVOCS, metals, CN.

Ensafe Work Plan Addendum, 11/99

Surface and subsurface soil: Numerous detections of BEQs above RBC in north half of site. Recommended 7 borings to delineate BEQs.

Groundwater: No further sampling.

Summary of SCDHEC Comments on Work Plan Addendum, 12/99

Include Bldg 1824 (Flammable and Hazardous Waste Storage) in AOC 619. *Response:* Agreed.

Repairs on sewer line along 13th St could affect groundwater flow. *Response:* Site characterization is not changed.

RFI – Results of Additional Field Activities

- Fourth quarter of groundwater sampling, (not reported in the draft RFI report) did not contain concentrations higher than previous samples, with the exception of Vanadium at 619GW002: 14.7 ug/l, compared to an RBC of 26. In addition, geoprobe samples within the site did not detect the two COCs thallium or chloromethane.
- 5 soil borings (619SB016, 619SB017, 619SB018, 619SB019, and 619SB020) were sampled along the north edge of the site, in a former railroad track area and against Ramsey Road; these were analyzed for SVOCS. In surface soil, BEQs were detected only at 619SB017, at 118 ug/kg; benzo(a)pyrene was detected at 94 ug/kg (RBC = 87). Data is presented in the attached tables.
- Soil (both surface and subsurface) was sampled again at 619SB001, 619SB004, and 619SB015 for SPLP on CN, VOCs, SVOCS, PCBs, Pest, and Metals. Results for detected constituents – see attached tables. SPLP leachate was detected for metals only.

Issues Discussed at 4/11/2000 Project Team Mtg and Ensafe Proposed Action

- Include Bldg 1824 in the investigation: Existing samples for AOC 619 were adequate.

- Additional samples near northwest corner of AOC, at railroad tracks and Ramsey Rd, should look for PAH and VOC impacts from former structures in this area (Tank Car Loading Pumphouse (Bldg 175) and AST 3908).
- Concern about possible release from a wash rack south of Bldg 1824: no sediment available to sample.
- Clarify source of sediment TCE in sample 619M001. Investigate potential source areas and contaminant migration pathways from Bldg 381. (No sewers shown on dwgs, although connections would be on south or west sides of bldg.)
- Naphthalene was detected in 619GW003 groundwater; needs delineation, depending on comparison value used (RBC or $0.1 \times$ RBC). Currently the well is downgradient of site because sewer acts as gw sink; may not be downgradient if sewer condition is modified.
- Benzo(a)pyrene has not been delineated in soil; too many anthropogenic sources.
- Sample soil to evaluate benzene, methylene chloride, pentachlorophenol, and thallium.

CH2M-Jones Team Recommendation

Surface and Subsurface Soil:

- Benzo(a)pyrene has been delineated up to railroad tracks and asphalt-paved area. Releases from non-site related sources are not related to this AOC. No further pursuit of PAHs is advised.
- 619SB001 detected benzene at 62 ug/kg, compared to SSL of 36, although none was detected in site groundwater. This location was resampled in 1999 as part of the SPLP data collection effort, and benzene was not detected. No further pursuit of benzene is recommended.
- Methylene chloride is a common laboratory contaminant. It was detected in subsurface soil at 619SB004, although when this location was resampled in 1999 it was not detected. No further pursuit of methylene chloride is advised.
- Pentachlorophenol was detected once in a duplicate sample, but not in any other site samples. The detection was measured at 74 J ug/kg, whereas the other samples reported an average of 1900 U for this compound. The detect is too low to be considered precise. No further pursuit of pentachlorophenol is advised.
- Thallium was detected three times from 48 soil samples at the site. All detects were qualified "J" and were in the same range as the reporting limit. These detects may be attributed to instrument noise; no further investigation is advised.

Sediment: TCE was estimated (2 J ug/kg) in surface soil near the catch basin (619SB010), across 13th Street (619SB013), and north of Bldg 1824 (619SB004). These random locations, and the extremely low concentrations, do not support a surface release scenario. The low concentration detected in the sediment (4 J) does not warrant further investigation of this compound.

Groundwater: Naphthalene was detected at estimated values (1 and 2 J) below the reporting limit (10 ug/l), in groundwater beneath 13th St. and near railroad tracks – no naphthalene was detected in vicinity soil samples. 620GW001 is located east of 619GW003, in anticipated flow path toward Cooper River (before sewer created a sink). Naphthalene was not detected in this well. No action recommended.

SWMU 109 – Abrasive Blast Media Storage Area

This site consists of three hoppers identified as Buildings 1364, 1365, and 1393 used to store abrasive blast media unloaded from trains, subsequently transferred to other vehicles to transport to blasting locations (remote from SWMU 109). Material stored at the site included aluminum oxide and “black beauty” (quenched liquid coal slag) blast media. Revision 0 RFI Report (12/97) identified risk drivers: BEQs and metals (As, Be, Cr, Mn, V) in surface soil.

Ensafe Work Plan Addendum, 11/99

Surface Soil and Subsurface Soil (0-1 feet bgs, 3 to 5 feet bgs) - Recommended one additional soil boring (109SB010) to define the extent of metals in surface and subsurface soil southwest of 109SB004.

Groundwater: Another gw monitoring well had been installed, and no data gaps were identified. No additional groundwater samples recommended.

Summary of SCDHEC Comments on Work Plan Addendum, 12/17/99

Further soil sampling should be made at locations where contaminants exceeded RBC and/or background by very marginal amounts. *Response:* The revised RFI report will delineate or provide the appropriate justification for not collecting additional samples.

RFI – Results of Additional Field Activities

Surface Soil: One additional boring (109SB010) was completed and evaluated for metals. Concentrations were either not detected or below their respective RBCs or backgrounds.

Subsurface Soil: Concentrations were either not detected or below their respective SSLs or backgrounds.

Groundwater: see note above about second well installed.

Issues Discussed at 04/11/2000 Project Team Mtg and Ensafé Proposed Action

- Delineation of chromium and vanadium is not complete based on comparison to residential soil RBCs using a THQ of 0.1 rather than 1.0 to ensure that chemicals with additive effects are not prematurely screened out. Because only three noncarcinogenic COPCs were detected in soil, use of the adjusted RBC is believed to be overly conservative for purposes of delineating the extent. Comparison to RBC unadjusted values would result in no exceedances, meaning no further sampling for these elements.
- Arsenic and iron need more delineation; propose 5 more soil samples.
- Benzo(a)pyrene and dibenz(a,h)anthracene, which have exceeded RBCs, would not be expected to be associated with the storage of unused blast media. Suggest these compounds are from anthropogenic sources; recommend no further sampling.

CH2M-Jones Team Recommendation

Surface Soil: No further investigation. PAHs are not related to site activities. Benzo(a)pyrene, chrysene, and dibenz(a,h)anthracene are estimated (J) values.

Exceedance concentrations of chromium at 109SB004, iron at 109SB004 and 109SB005 and vanadium at 109SB005 were detected. Arsenic concentrations at locations 109SB004, 109SB005, 109SB007, and 109SB008 exceeded the RBCs and background. All concentrations were below the SSLs. Iron, detected at locations 109SB004 and 109SB005 at concentrations of 29,500 mg/kg and 28,000 mg/kg, respectively, is close to the Zone F background value 23,700 mg/kg. No specific historical activity relating to the blast media storage area can be traced to these detections other than anthropogenic impacts from railroading operations at the site.

Subsurface Soil: No further investigation. Concentrations were either not detected or below their respective SSLs or backgrounds.

Groundwater: No further investigation. No concentration exceedances were detected for metals after five rounds of sampling at locations 109001 and 109002.

Zone F – Basis for Work Plan Addendum

AOC 613/AOC 615/SWMU 175– Old Locomotive Repair Shop Former Bldg 1169; Old Chain Locker Bldg 1391; Crane Painting Area near Bldg 1277

Former Bldg 1169 was a locomotive and crane repair shop at the present location of Bldg 242. Materials potentially released included oil, grease, diesel fuel, and cleaning solvents. Former Bldg 1391 was used to store and service anchor chain. Epoxies and resins were stored in large tanks onsite; epoxy and resin wastes were stored in drums behind the building. The former crane painting area, located on an asphalt-paved road, was investigated to evaluate a possible release of blast media, paint constituents, heavy metals, and solvents. These sites are located to the east of Hobson Avenue in a heavily industrial area.

The area was initially investigated under the SCDHEC petroleum program and as part of the Fuel Distribution System investigation. RFI sampling involved soil and groundwater samples from 65 probe locations and 14 wells. At each probe location, composite samples of unsaturated soil were collected, and a groundwater sample was collected if it yielded water. The Revision 0 RFI Report (12/97) identified risk drivers at this site: BEQs, beryllium, and arsenic in surface soil; numerous constituents (VOCs, SVOCs – including PAHs, aluminum and arsenic) in groundwater.

Ensafe Work Plan Addendum, 11/99

Surface and subsurface soil: Although the extent of BEQs had been delineated, metals and other SVOCs were not delineated in all directions. Recommended 25 soil borings (surface and subsurface samples), distributed outside the probe area, on the southeast, east, north, and northwest sides of the sites area.

Groundwater: Many analytes decreased to below screening values in latter sampling events. Need more delineation of VOCs, SVOCs, and Fe north of site. Recommended 2 new wells installed, plus resampling existing wells 613006, GEL014, FDS17A, and FDS17B for VOC, SVOC, and metals, and existing well 613001 for VOCs.

Summary of SCDHEC Comments on Work Plan Addendum, 12/99

Be aware that the UST program effort by the Rapid Assessment contractor may provide an incomplete or partial analysis of hazardous constituents. *Response:* Agreed. There is a nearby source for petroleum contamination that is likely unrelated to this site.

Additional sampling is needed near 613SP008 (north side of site) and 613SP036 (sw corner), where there were slight exceedances of contaminant levels. *Response:* Additional sampling was done near 613SP008. The requested areas are removed from the potential source areas,

and most likely represent anthropogenic background conditions; additional delineation is not warranted in these directions.

RFI – Results of Additional Field Activities

- The Revision 0 RFI report described up to 3 groundwater sampling events. The RFI wells were sampled for one more quarter in 1997, and selectively thereafter. Additional wells 613006, 613007, and 613008 were installed on the north side of site. Various wells were resampled for specific analytes, considered the 5th, 6th, 7th, and 8th sampling events. Except for those listed below, the majority of analytes detected in these subsequent sampling events (that exceeded background and/or RBCs) did not exceed previous site concentrations.
 - Naphthalene, at 5 ug/l at 613GW006, compared to RBC 0.65 ug/L
 - Gamma-BHC at 0.074 ug/l at 613GW006, compared to RBC 0.052 and MCL 0.2 ug/l
 - Arsenic at 207 and 211 ug/l at 613GW006, compared to RBC 0.045 ug/l
 - Manganese at 2930 ug/l in deep groundwater at 613GW02D, compared to RBC 73 ug/l; believed to be related to possible turbidity in the sample
- 29 soil borings surrounding the northern half of the site and the southeast corner were sampled (surface and subsurface); these were analyzed for metals and SVOCs. SVOCs that exceeded RBCs: b(a)a, b(a)p, b(b)f, and dibenz(a,h)anthracene – see attached tables. Metals that exceeded both background and RBCs: Al, As, Cr, Fe, Pb, Sb, Tl, V – see attached tables.
- Soil (both surface and subsurface) was sampled again at 613SP022, 613SP027, and 613SP051 for CN, VOCs, SVOCs, PCBs, Pest, and Metals, and for SPLP on the same analytes. Results for detected constituents – see attached tables.

Issues Discussed at 4/11/2000 Project Team Mtg

This site was not discussed at the 4/11/2000 meeting.

CH2M-Jones Team Recommendations

Surface and Subsurface Soil:

- A DAF of 20.1 has been calculated for this site, using parameters specific to Zone F and source length of 150 m. With the exception of methylene chloride, soil samples do not exceed their site-specific SSLs; all constituents in subsurface soil are therefore delineated.
- 7 soil probe samples (out of 65) reported methylene chloride detections: 2 @ 50 J ug/kg, 5 samples ranging from 1 J to 4 J ug/kg. The remaining 58 samples reported non-detects with reporting limits up to 74 U ug/kg. All the detections were in the same range as the non-detects. Methylene chloride is a common lab contaminant; recommend that this compound not be further pursued in soil.
- Assuming that surface soil constituents are compared to RBCs calculated for a residential scenario, the following analytes exceed screening criteria: most of the

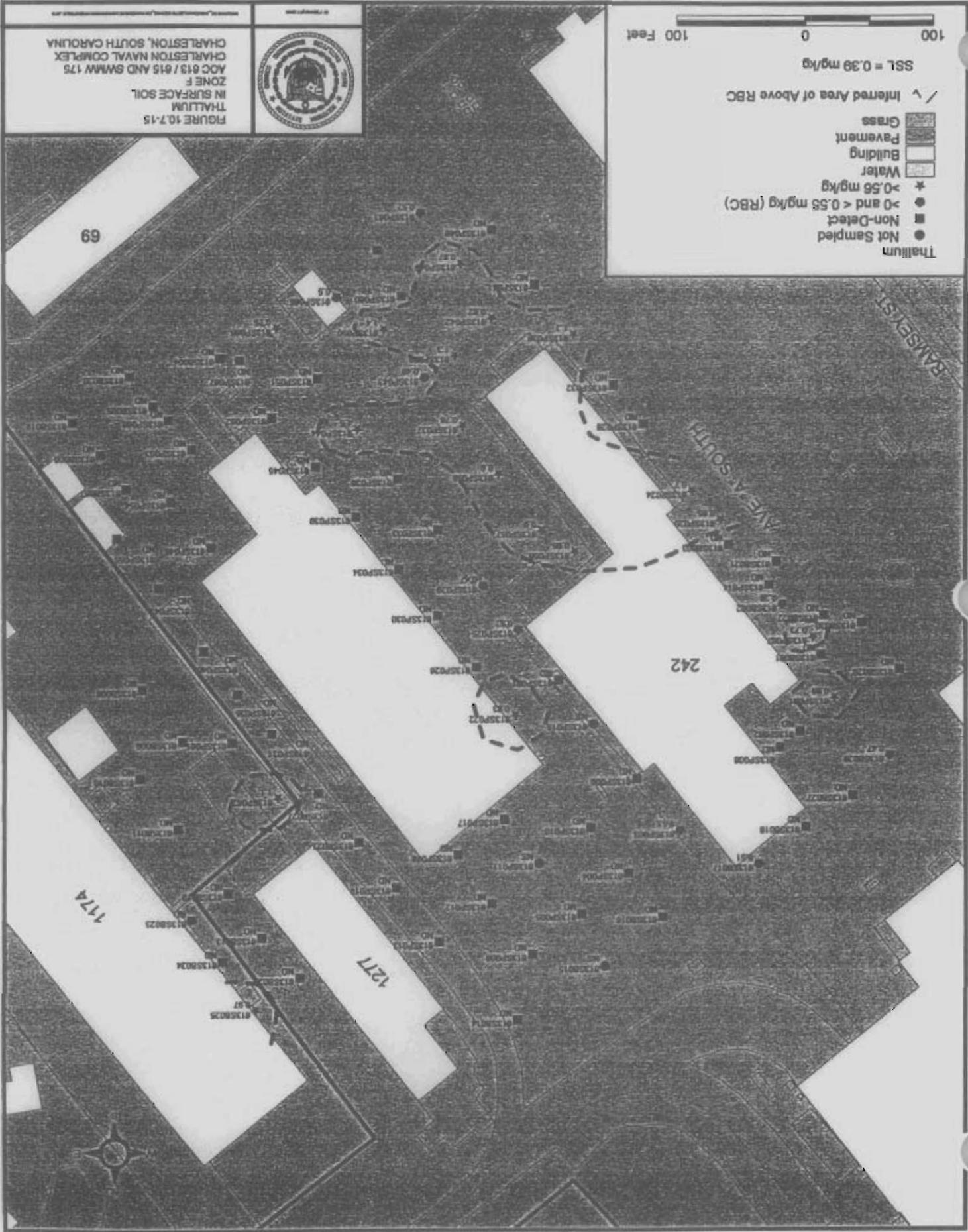
constituents of BEQs, Al, As, Sb, Cr, Fe, Pb, Mn, Tl, V. Of these constituents, only lead has been delineated to residential RBCs.

- Benzo(a)pyrene, as a representative of PAHs considered typical of releases from the locomotive servicing area, has been delineated to the residential RBC (.087 mg/kg) in the vicinity of the former service pits, located along the railroad tracks on the east side of AOC 613. B(a)p concentrations are shown in the attached figure. Areas in which it has not been delineated to residential standards include a) southwest of AOC 615, where it does not appear related to chain locker operations; b) southwest, southeast, and east of SWMU 175, where it does not appear related to crane painting operations; and c) west of AOC 613. The area west of AOC 613 contains b(a)p in excess of industrial soil RBC (0.78 ug/kg), although it does not appear to be related to the service pits (maximum concentrations are centered around the asphalt-paved parking area west of Building 242).
- Exceedances of the other constituents of BEQs in surface soil all are within the same exceedance locations as the b(a)p exceedances. Therefore, we do not recommend further pursuit of b(a)p or BEQs in surface soil.
- Aluminum and arsenic concentrations above background values have been delineated except at the northern and western edges of AOC 613 (see figures 10.7-9 and 10.7-10 attached). This area appears to be remote from contamination related to SWMU 175, and these metals are not related to operations at AOC 613. Therefore, we do not recommend further delineation of Al or As in surface soil.
- Chromium and vanadium concentrations above background and or residential RBCs have similar patterns, with exceedance areas not delineated to the north and west of AOC 613, similar to Al and As (see figures 10.7-11 and 10.7-16 attached). However, the pattern appears to show a trend of concentrations slightly above screening criteria leading westward from the SWMU 175 area on the north. Therefore, it appears that these concentrations could be related to SWMU 175 releases. However, if industrial exposure RBCs are used for screening, which are approximately an order of magnitude higher than the residential RBCs, then there are no exceedances at this site. If the extent must be delineated to residential standards, then we propose sampling surface soil north of Building 242 to complete the delineation. In addition, chromium extent would need to be defined in the direction south of SWMU 175.
- Thallium concentrations in excess of the residential RBC (0.55 mg/kg) are shown on figure 10.7-15. The exceedances are located within AOC 613. Because thallium is not related to operations at the locomotive repair shop, we do not recommend further pursuit of this metal in surface soil.

FIGURE 10.7-15
THALIUM
IN SURFACE SOIL
ZONE F
AOC 613 / 615 AND SMMW 175
CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA



- Thallium
- Not Sampled
 - Non-Detect
 - >0 and < 0.55 mg/kg (RBC)
 - * >0.55 mg/kg
 - Water
 - Building
 - Pavement
 - Grass
 - / \ Inferred Area of Above RBC
- SSL = 0.39 mg/kg



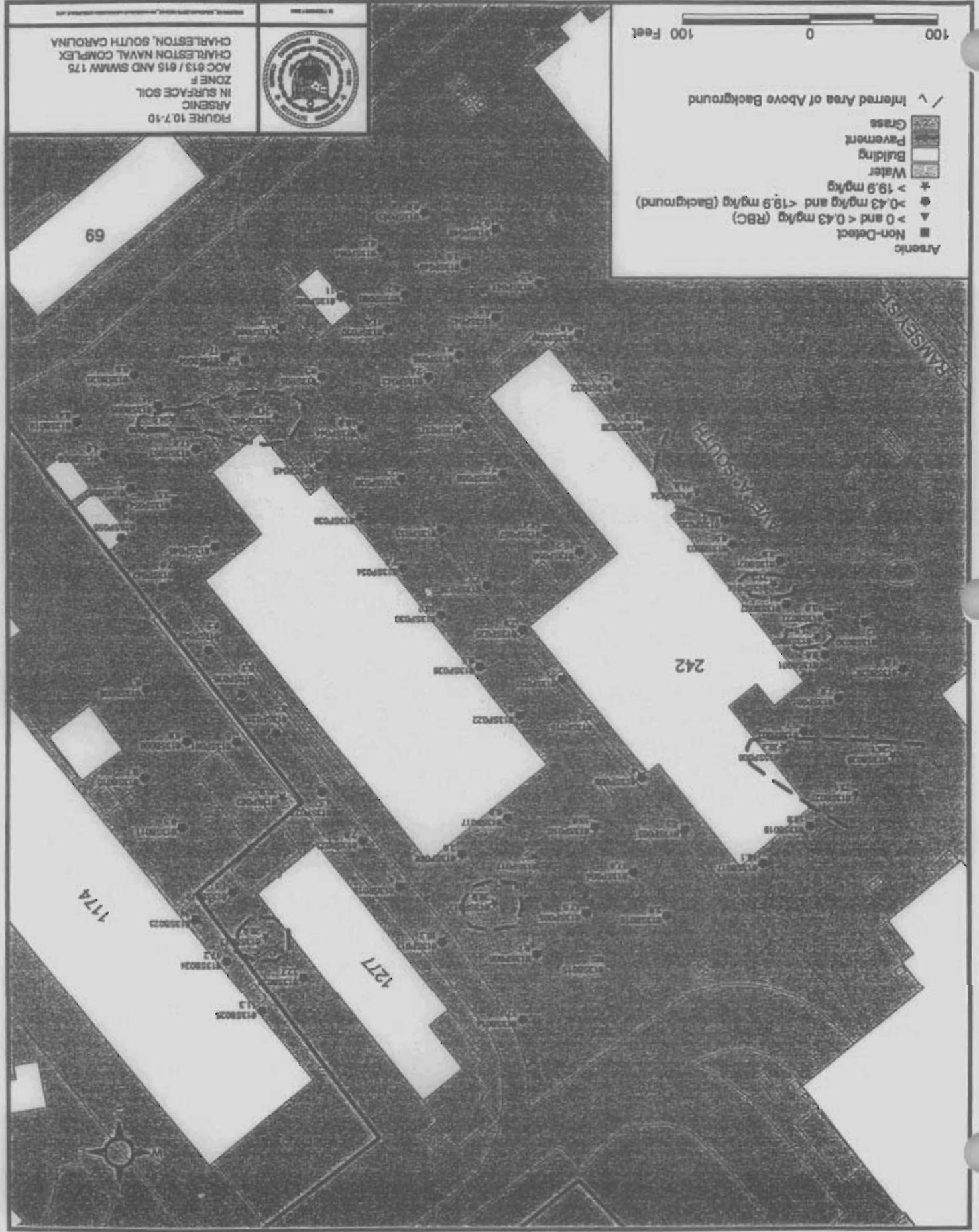
UNCLASSIFIED//FOR OFFICIAL USE ONLY

DATE: 10/10/00

FIGURE 10.7-10
ARSENIC
IN SURFACE SOIL
ZONE F
AOC 813 / 815 AND SWMM 175
CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA



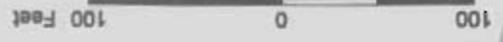
- Arsenic
- ▲ Non-Detect
- > 0 and < 0.43 mg/kg (RBC)
- ◆ > 0.43 mg/kg and < 19.9 mg/kg (Background)
- * > 19.9 mg/kg
- Water
- Building
- Pavement
- Grass
- ^ / Inferred Area of Above Background



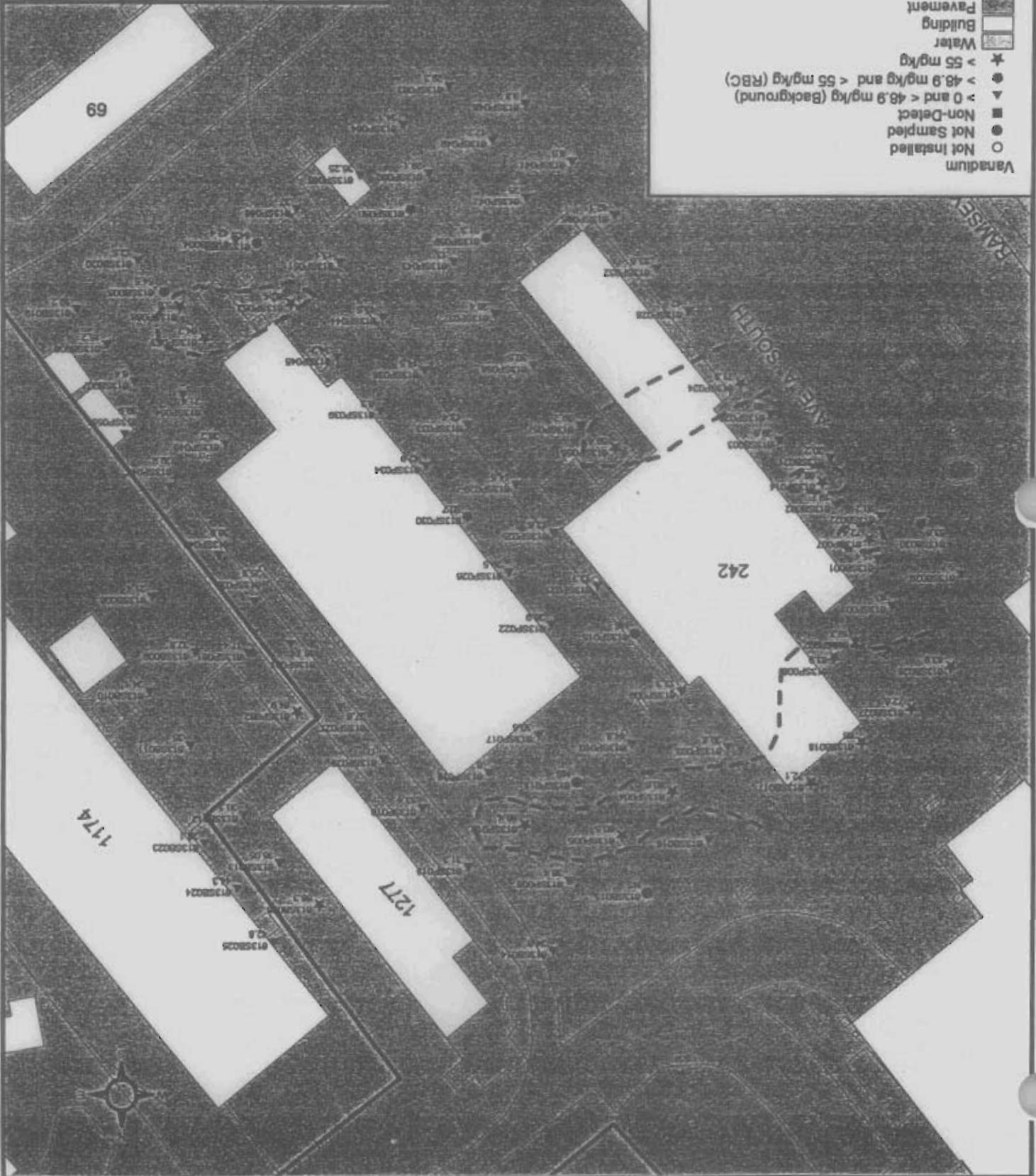
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SCALE: 1" = 100'

FIGURE 10-7-16
VANADIUM
IN SURFACE SOIL
ZONE F
AOC 613 / 615 AND SWMM 175
CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA



- Vanadium Not Installed
- Vanadium Not Sampled
- Non-Detect
- ▲ > 0 and < 48.9 mg/kg (Background)
- > 48.9 mg/kg and < 55 mg/kg (RBC)
- * > 55 mg/kg
- Water
- Building
- Pavement
- Grass
- ✓ Inferred Area of Above RBC



AOC 613/AOC 615/SWMU 175– Old Locomotive Repair Shop Former Bldg 1169; Old Chain Locker Bldg 1391; Crane Painting Area near Bldg 1277

CH2M-Jones Team Recommendations

Groundwater VOCs:

Exceedances of residential RBCs (THQ = 0.1) for chlorinated solvents and daughter products (PCE, TCE, 1,1-DCE, 1,2-DCE, and VC) were identified near the center of the site at 613GP039 and 613GW004, and at the north side of the site. At AOC 613, geoprobe samples collected in 1996 during the RFI contained relatively large amounts of solvents in an isolated area near the center of the site (613GP039), and minor amounts at the north side.

Groundwater monitoring wells installed near 613GP039 contained constituents at concentrations 2 orders of magnitude lower than the probe samples. Samples from groundwater monitoring wells installed at the north side revealed very limited concentrations, showing similar reductions in concentration. The attached figure shows the areas with detected chlorinated solvent concentrations. Although it appears that the area to the north might be delineated; we recommend that groundwater at two locations to the north be sampled for VOCs.

The Environmental Baseline Study performed by GEL reported petroleum product in monitoring well GEL014, in the vicinity of buried fuel lines. The first RFI sample collected from this well contained benzene at 3800 ug/l and toluene at 4900 ug/l. (It is likely that this concentration of benzene resulted from a release of light petroleum product from the fuel line, rather than from heavier oils or greases released from the locomotive repair shop.) Subsequent samples from this and adjacent wells contained benzene concentrations no greater than 4 ug/l. As shown on the attached figure, benzene has been delineated in groundwater. Toluene likewise was detected only once at this well, although it has consistently been detected in the deeper well 613GW02D at concentrations no greater than 24 ug/l (compared to the RBC of 75 ug/L.) Benzene is therefore adequately delineated at this site.

Groundwater SVOCs:

One detect of pentachlorophenol at 2J ug/l (compared to the typical reporting limit of 50 ug/l) was identified at well GEL013 during one of 4 rounds of sampling. This detect was not reproduced in other sampling rounds, nor was the compound detected in any other site well or geoprobe location. We do not consider this single detection to be meaningful and do not recommend further pursuit of this compound.

PAHs, consisting of 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, and pyrene were all detected in the first round of sampling at GEL014 at concentrations indicative of fuel product. Subsequent rounds of sampling contained these compounds at concentrations 3 to 4 orders of magnitude lower than the first round. These PAHs, along with naphthalene, are concentrated around the area defined by GEL014 and

613GW006. In addition, naphthalene has been identified at low concentrations at the southern edge of the site, defined by area GEL005 and 613GP065. These two areas are bounded by samples that have not detected SVOCs above screening criteria, and have been adequately delineated.

Groundwater Inorganics:

A number of metals were detected at various sampling events, with exceedances of RBCs and background values. Of these, Al, Sb, Cd, Cr, Pb, Tl, V, and Zn occur at extremely variable concentrations, not reproducible over time. An example of the variations noted throughout the sampling periods, for aluminum, is shown in the attached figure. This pattern of variability could be attributed to naturally occurring metals in the aquifer's clayey soils; fine soil particles could have been inadvertently included in the samples. We do not recommend further pursuit of these metals.

Mn was also detected in excess of RBCs and background concentrations. Manganese is a major component of the clayey soils in this area, and is naturally occurring at variable concentrations. For example, the highest concentration detected at the site, 7940 ug/l, was detected at 613GW001 on 9/4/97. It is interesting to note that the subsequent sampling event at that location contained groundwater with Mn at 51 J ug/l. Because it is naturally occurring in the site clays and the detections are not consistent, we do not recommend further delineation of Mn.

Arsenic was detected at concentrations in excess of background concentrations near the northeast corner of the site, at well locations GELGW014 and FDSGW17B, shown in the attached figure. This area is bounded by monitoring wells that have routinely recorded concentrations within or less than the background levels. The groundwater in the southwest corner of the site also had sporadic exceedances of background values. We recommend that another round of groundwater sampling be conducted at this site to further evaluate arsenic concentrations.

Iron could be expected to have been released at this site, although it is also a naturally occurring metal in the aquifer's clay soils, along with manganese. Concentrations of iron in excess of the background (22,300 ug/l) were detected at GELGW011 and 613GW005 near 11th St to the south, but these do not appear to be related to site operations (i.e., high concentration area is remote from the source area). An additional exceedance area in the vicinity of 613GW006 and GELGW014 appears to be bounded by other wells with samples near or below background values. Therefore, we do not recommend further delineation of iron in groundwater.

SWMU 109

Location F109SB001

Sample no.	conc.			SPLP	Kd, L/KG
109SB001T1 surface	Ag 1.00 MG/KG	J	109SB001S1 surface	Ag 0.50 UG/L	U 4000
	Al 14600.00 MG/KG	=		Al 37300.00 UG/L	J 391
	As 16.90 MG/KG	=		As 19.40 UG/L	= 871
	Ba 74.30 MG/KG	=		Ba 2350.00 UG/L	= 32
	Be 0.67 MG/KG	=		Be 0.90 UG/L	U 1489
	Ca 16800.00 MG/KG	J		Ca 17200.00 UG/L	= 977
	Cd 0.24 MG/KG	J		Cd 0.30 UG/L	U 1600
	Co 16.90 MG/KG	=		Co 5.40 UG/L	J 3130
	Cr 26.00 MG/KG	J		Cr 50.60 UG/L	= 514
	Cu 48.70 MG/KG	J		Cu 45.30 UG/L	= 1075
	Fe 17700.00 MG/KG	J		Fe 28100.00 UG/L	J 630
	Hg 3.70 MG/KG	=		Hg 1.40 UG/L	= 2643
	K 1110.00 MG/KG	J		K 4630.00 UG/L	J 240
	Mg 1970.00 MG/KG	J		Mg 3960.00 UG/L	J 497
	Mn 282.00 MG/KG	J		Mn 174.00 UG/L	= 1621
	Na 265.00 MG/KG	J		Na 14000.00 UG/L	= 19
	Ni 11.30 MG/KG	J		Ni 17.10 UG/L	J 661
	Pb 476.00 MG/KG	J		Pb 176.00 UG/L	= 2705
	Sb 1.30 MG/KG	UJ		Sb 2.40 UG/L	U none
	Se 1.60 MG/KG	=		Se 3.20 UG/L	U 1000
	Sn 6.30 MG/KG	U		Sn 3.90 UG/L	J 1615
	Tl 0.28 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 36.40 MG/KG	=		V 70.20 UG/L	= 519
	Zn 419.00 MG/KG	J		Zn 1920.00 UG/L	= 218
109SB001T2 subsurface	Ag 0.04 MG/KG	U	109SB001S2 subsurface	Ag 0.50 UG/L	U none
	Al 9300.00 MG/KG	=		Al 9330.00 UG/L	J 997
	As 4.40 MG/KG	=		As 6.30 UG/L	J 698
	Ba 22.10 MG/KG	=		Ba 893.00 UG/L	= 25
	Be 0.30 MG/KG	J		Be 0.90 UG/L	U 667
	Ca 3980.00 MG/KG	J		Ca 13700.00 UG/L	= 291
	Cd 0.03 MG/KG	U		Cd 0.30 UG/L	U none
	Co 2.80 MG/KG	J		Co 0.50 UG/L	UJ 11200
	Cr 15.50 MG/KG	J		Cr 12.50 UG/L	= 1240
	Cu 4.80 MG/KG	J		Cu 3.00 UG/L	J 1600
	Fe 9850.00 MG/KG	J		Fe 5890.00 UG/L	J 1672
	Hg 0.10 MG/KG	=		Hg 0.40 UG/L	U 500
	K 732.00 MG/KG	J		K 1000.00 UG/L	J 732
	Mg 1090.00 MG/KG	J		Mg 1470.00 UG/L	J 741
	Mn 82.00 MG/KG	J		Mn 23.20 UG/L	= 3534
	Na 154.00 MG/KG	J		Na 1970.00 UG/L	J 78
	Ni 5.00 MG/KG	J		Ni 5.20 UG/L	J 962
	Pb 18.70 MG/KG	J		Pb 18.40 UG/L	= 1016
	Sb 0.70 MG/KG	UJ		Sb 3.00 UG/L	J 233
	Se 1.10 MG/KG	=		Se 4.10 UG/L	U 537
	Sn 5.50 MG/KG	U		Sn 2.90 UG/L	J 1897
	Tl 0.21 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 19.90 MG/KG	=		V 28.90 UG/L	J 689
	Zn 20.70 MG/KG	J		Zn 285.00 UG/L	= 73

SWMU 109

Location F109SB001

Sample no.	conc.			SPLP		Kd, L/KG
109SB004T1 surface	Ag 0.04 MG/KG	U	109SB004S1 surface	Ag 0.50 UG/L	UJ	none
	Al 2190.00 MG/KG	=		Al 5410.00 UG/L	=	405
	As 5.00 MG/KG	J		As 5.70 UG/L	J	877
	Ba 9.10 MG/KG	J		Ba 446.00 UG/L	=	20
	Be 0.08 MG/KG	U		Be 0.90 UG/L	U	none
	Ca 334000.00 MG/KG	J		Ca 16900.00 UG/L	=	19763
	Cd 0.81 MG/KG	J		Cd 0.30 UG/L	UJ	5400
	Co 5.50 MG/KG	=		Co 0.50 UG/L	J	11000
	Cr 8.30 MG/KG	J		Cr 8.20 UG/L	J	1012
	Cu 26.00 MG/KG	=		Cu 10.60 UG/L	J	2453
	Fe 4300.00 MG/KG	=		Fe 4150.00 UG/L	J	1036
	Hg 0.04 MG/KG	U		Hg 0.40 UG/L	U	none
	K 1580.00 MG/KG	J		K 825.00 UG/L	J	1915
	Mg 3440.00 MG/KG	J		Mg 1190.00 UG/L	J	2891
	Mn 318.00 MG/KG	=		Mn 18.70 UG/L	=	17005
	Na 681.00 MG/KG	=		Na 1200.00 UG/L	J	568
	Ni 17.10 MG/KG	=		Ni 6.20 UG/L	J	2758
	Pb 18.10 MG/KG	=		Pb 6.20 UG/L	J	2919
	Sb 0.45 MG/KG	J		Sb 2.40 UG/L	U	375
	Se 0.15 MG/KG	U		Se 1.70 UG/L	U	none
	Sn 6.20 MG/KG	J		Sn 2.70 UG/L	U	4593
	Tl 2.10 MG/KG	R		Tl 2.40 UG/L	U	0
	V 8.40 MG/KG	=		V 12.20 UG/L	J	689
	Zn 56.40 MG/KG	J		Zn 134.00 UG/L	J	421
109SB004T2 subsurface	Ag 0.05 MG/KG	U	109SB004S2 subsurface	Ag 0.50 UG/L	UJ	none
	Al 4130.00 MG/KG	=		Al 475.00 UG/L	=	8695
	As 2.10 MG/KG	J		As 2.00 UG/L	U	2100
	Ba 10.60 MG/KG	J		Ba 194.00 UG/L	J	55
	Be 0.40 MG/KG	J		Be 0.90 UG/L	U	889
	Ca 6270.00 MG/KG	J		Ca 12400.00 UG/L	=	506
	Cd 0.03 MG/KG	UJ		Cd 0.30 UG/L	UJ	none
	Co 2.30 MG/KG	J		Co 0.50 UG/L	U	9200
	Cr 10.90 MG/KG	J		Cr 1.30 UG/L	J	8385
	Cu 3.60 MG/KG	=		Cu 1.40 UG/L	J	2571
	Fe 4270.00 MG/KG	=		Fe 700.00 UG/L	J	6100
	Hg 0.18 MG/KG	=		Hg 0.40 UG/L	U	900
	K 496.00 MG/KG	J		K 1070.00 UG/L	J	464
	Mg 795.00 MG/KG	J		Mg 807.00 UG/L	J	985
	Mn 30.60 MG/KG	=		Mn 10.70 UG/L	J	2860
	Na 86.40 MG/KG	J		Na 854.00 UG/L	J	101
	Ni 3.90 MG/KG	J		Ni 1.10 UG/L	U	7091
	Pb 4.90 MG/KG	=		Pb 3.50 UG/L	J	1400
	Sb 0.24 MG/KG	UJ		Sb 5.30 UG/L	J	45
	Se 0.75 MG/KG	J		Se 3.30 UG/L	J	227
	Sn 2.90 MG/KG	J		Sn 6.20 UG/L	J	468
	Tl 0.24 MG/KG	R		Tl 2.40 UG/L	U	0
	V 10.80 MG/KG	=		V 6.50 UG/L	J	1662
	Zn 15.40 MG/KG	J		Zn 31.90 UG/L	J	483

SWMU 109

Location F109SB001

Sample no.	conc.			SPLP		Kd, L/KG
109SB005T1 surface	Ag 0.05 MG/KG	U	109SB005S1 surface	Ag 0.50 UG/L	U	none
	Al 6810.00 MG/KG	=		Al 27900.00 UG/L	J	244
	As 14.10 MG/KG	J		As 14.80 UG/L	=	953
	Ba 37.80 MG/KG	=		Ba 1330.00 UG/L	=	28
	Be 0.32 MG/KG	J		Be 0.90 UG/L	U	711
	Ca 252000.00 MG/KG	J		Ca 10300.00 UG/L	=	24466
	Cd 1.20 MG/KG	=		Cd 3.00 UG/L	J	400
	Co 5.50 MG/KG	=		Co 7.00 UG/L	J	786
	Cr 41.40 MG/KG	J		Cr 41.90 UG/L	=	988
	Cu 84.20 MG/KG	=		Cu 33.50 UG/L	=	2513
	Fe 10300.00 MG/KG	=		Fe 22900.00 UG/L	J	450
	Hg 0.38 MG/KG	=		Hg 0.40 UG/L	U	1900
	K 1450.00 MG/KG	J		K 8560.00 UG/L	J	169
	Mg 2910.00 MG/KG	J		Mg 5230.00 UG/L	=	556
	Mn 331.00 MG/KG	=		Mn 84.20 UG/L	=	3931
	Na 574.00 MG/KG	=		Na 28200.00 UG/L	=	20
	Ni 23.90 MG/KG	=		Ni 13.80 UG/L	J	1732
	Pb 793.00 MG/KG	=		Pb 48.10 UG/L	=	16486
	Sb 3.90 MG/KG	J		Sb 2.40 UG/L	U	3250
	Se 0.31 MG/KG	J		Se 4.40 UG/L	U	141
	Sn 8.80 MG/KG	J		Sn 5.40 UG/L	J	1630
	Tl 2.60 MG/KG	R		Tl 2.40 UG/L	UJ	0
	V 20.80 MG/KG	=		V 59.20 UG/L	=	351
	Zn 326.00 MG/KG	J		Zn 696.00 UG/L	=	468
109SB005T2 subsurface	Ag 0.06 MG/KG	U	109SB005S2 subsurface	Ag 0.50 UG/L	U	none
	Al 7380.00 MG/KG	=		Al 20200.00 UG/L	J	365
	As 3.30 MG/KG	J		As 7.80 UG/L	J	423
	Ba 25.90 MG/KG	=		Ba 1010.00 UG/L	=	26
	Be 0.37 MG/KG	J		Be 0.90 UG/L	U	822
	Ca 4930.00 MG/KG	J		Ca 7930.00 UG/L	=	622
	Cd 0.03 MG/KG	UJ		Cd 0.30 UG/L	U	none
	Co 2.70 MG/KG	J		Co 2.10 UG/L	J	1286
	Cr 13.00 MG/KG	J		Cr 26.10 UG/L	=	498
	Cu 9.80 MG/KG	=		Cu 15.60 UG/L	J	628
	Fe 6760.00 MG/KG	=		Fe 12700.00 UG/L	J	532
	Hg 0.06 MG/KG	=		Hg 0.40 UG/L	U	300
	K 561.00 MG/KG	J		K 14500.00 UG/L	J	39
	Mg 849.00 MG/KG	J		Mg 5760.00 UG/L	=	147
	Mn 46.70 MG/KG	=		Mn 83.40 UG/L	=	560
	Na 134.00 MG/KG	J		Na 76300.00 UG/L	=	2
	Ni 5.10 MG/KG	=		Ni 12.60 UG/L	J	405
	Pb 29.10 MG/KG	=		Pb 14.90 UG/L	=	1953
	Sb 0.40 MG/KG	J		Sb 2.40 UG/L	U	333
	Se 0.97 MG/KG	J		Se 2.60 UG/L	U	746
	Sn 6.10 MG/KG	J		Sn 3.00 UG/L	J	2033
	Tl 0.28 MG/KG	R		Tl 2.40 UG/L	UJ	0
	V 14.90 MG/KG	=		V 35.40 UG/L	J	421
	Zn 35.30 MG/KG	J		Zn 389.00 UG/L	=	91

AOC 607 SPLP COMPARISONS

Location F607SB008

Sample no.	conc.			SPLP	Kd, L/KG
607SB008T1 surface	Ag 0.050 MG/KG	U	607SB008S1 surface	Ag 0.50 UG/L	UJ none
	Al 6840.000 MG/KG	=		Al 90.70 UG/L	J 75413
	As 5.300 MG/KG	J		As 2.00 UG/L	U 5300
	Ba 16.100 MG/KG	J		Ba 53.80 UG/L	J 299
	Be 0.100 MG/KG	J		Be 0.90 UG/L	U 222
	Ca 196000.000 MG/KG	J		Ca 86300.00 UG/L	= 2271
	Cd 0.390 MG/KG	J		Cd 0.30 UG/L	U 2600
	Co 2.300 MG/KG	J		Co 0.50 UG/L	UJ 9200
	Cr 15.500 MG/KG	J		Cr 0.60 UG/L	U 51667
	Cu 4.800 MG/KG	=		Cu 1.40 UG/L	J 3429
	Fe 9730.000 MG/KG	=		Fe 68.40 UG/L	U 284503
	Hg 0.050 MG/KG	U		Hg 0.40 UG/L	R
	K 1210.000 MG/KG	J		K 1480.00 UG/L	J 818
	Mg 2460.000 MG/KG	J		Mg 4000.00 UG/L	J 615
	Mn 128.000 MG/KG	=		Mn 1.90 UG/L	J 67368
	Na 504.000 MG/KG	J		Na 3260.00 UG/L	J 155
	Ni 7.700 MG/KG	=		Ni 1.10 UG/L	U 14000
	Pb 14.100 MG/KG	=		Pb 2.20 UG/L	U 12818
	Sb 1.000 MG/KG	J		Sb 4.50 UG/L	J 222
	Se 0.410 MG/KG	J		Se 1.70 UG/L	U 482
	Sn 5.100 MG/KG	J		Sn 2.70 UG/L	U 3778
	Tl 2.500 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 17.400 MG/KG	=		V 0.90 UG/L	J 19333
	Zn 30.400 MG/KG	J		Zn 23.30 UG/L	U 2609

607SB008T2 subsurface	Ag 0.050 MG/KG	U	607SB008S2 subsurface	Ag 0.50 UG/L	UJ none
	Al 10300.000 MG/KG	=		Al 146000.00 UG/L	= 71
	As 2.600 MG/KG	J		As 35.40 UG/L	= 73
	Ba 23.000 MG/KG	=		Ba 1440.00 UG/L	= 16
	Be 0.470 MG/KG	J		Be 3.20 UG/L	J 147
	Ca 1700.000 MG/KG	J		Ca 9370.00 UG/L	= 181
	Cd 0.030 MG/KG	UJ		Cd 0.30 UG/L	U none
	Co 1.300 MG/KG	J		Co 14.30 UG/L	J 91
	Cr 15.400 MG/KG	J		Cr 203.00 UG/L	= 76
	Cu 0.840 MG/KG	J		Cu 12.60 UG/L	J 67
	Fe 10700.000 MG/KG	=		Fe 130000.00 UG/L	= 82
	Hg 0.050 MG/KG	U		Hg 0.40 UG/L	R
	K 528.000 MG/KG	J		K 9290.00 UG/L	= 57
	Mg 1050.000 MG/KG	J		Mg 12900.00 UG/L	= 81
	Mn 18.600 MG/KG	=		Mn 137.00 UG/L	= 136
	Na 231.000 MG/KG	J		Na 8540.00 UG/L	= 27
	Ni 2.900 MG/KG	J		Ni 34.80 UG/L	J 83
	Pb 8.000 MG/KG	=		Pb 78.50 UG/L	= 102
	Sb 0.510 MG/KG	J		Sb 3.90 UG/L	J 131
	Se 1.100 MG/KG	=		Se 12.30 UG/L	J 89
	Sn 4.400 MG/KG	J		Sn 8.70 UG/L	J 506
	Tl 0.260 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 21.000 MG/KG	=		V 272.00 UG/L	= 77
	Zn 9.400 MG/KG	J		Zn 394.00 UG/L	= 24

AOC 607 SPLP COMPARISONS

Location F607SB008

Sample no.	conc.				SPLP			Kd, L/KG
607SB010T1 surface	Ag	0.110 MG/KG	J	607SB010S1 surface	Ag	0.50 UG/L	U	440
	Al	8140.000 MG/KG	=		Al	2050.00 UG/L	=	3971
	As	3.300 MG/KG	=		As	2.30 UG/L	J	1435
	Ba	27.600 MG/KG	=		Ba	175.00 UG/L	J	158
	Be	0.320 MG/KG	J		Be	0.90 UG/L	U	711
	Ca	10900.000 MG/KG	J		Ca	13000.00 UG/L	=	838
	Cd	0.220 MG/KG	J		Cd	0.30 UG/L	U	1467
	Co	1.800 MG/KG	J		Co	0.50 UG/L	U	7200
	Cr	11.700 MG/KG	J		Cr	2.50 UG/L	J	4680
	Cu	20.500 MG/KG	J		Cu	2.60 UG/L	J	7885
	Fe	6310.000 MG/KG	J		Fe	1490.00 UG/L	=	4235
	Hg	0.200 MG/KG	=		Hg	0.40 UG/L	U	1000
	K	362.000 MG/KG	J		K	297.00 UG/L	J	1219
	Mg	703.000 MG/KG	J		Mg	503.00 UG/L	J	1398
	Mn	80.200 MG/KG	J		Mn	6.60 UG/L	J	12152
	Na	137.000 MG/KG	J		Na	797.00 UG/L	J	172
	Ni	8.200 MG/KG	J		Ni	1.60 UG/L	J	5125
	Pb	29.800 MG/KG	J		Pb	4.80 UG/L	J	6208
	Sb	1.400 MG/KG	J		Sb	2.40 UG/L	U	1167
	Se	0.780 MG/KG	J		Se	1.70 UG/L	U	918
	Sn	12.200 MG/KG	=		Sn	3.20 UG/L	U	7625
	Tl	0.260 MG/KG	U		Tl	2.40 UG/L	U	none
	V	18.400 MG/KG	=		V	11.20 UG/L	J	1643
	Zn	144.000 MG/KG	J		Zn	33.70 UG/L	J	4273

607SB010T2 subsurface	Ag	0.050 MG/KG	U	607SB010S2 subsurface	Ag	0.60 UG/L	J	83
	Al	4680.000 MG/KG	=		Al	27600.00 UG/L	=	170
	As	3.000 MG/KG	=		As	8.80 UG/L	J	341
	Ba	14.300 MG/KG	J		Ba	656.00 UG/L	=	22
	Be	0.250 MG/KG	J		Be	0.90 UG/L	U	556
	Ca	728.000 MG/KG	J		Ca	7180.00 UG/L	=	101
	Cd	0.030 MG/KG	U		Cd	0.30 UG/L	U	none
	Co	0.890 MG/KG	J		Co	2.50 UG/L	J	356
	Cr	8.000 MG/KG	J		Cr	40.50 UG/L	=	198
	Cu	0.780 MG/KG	J		Cu	2.50 UG/L	J	312
	Fe	7440.000 MG/KG	J		Fe	29200.00 UG/L	=	255
	Hg	0.050 MG/KG	U		Hg	0.40 UG/L	U	none
	K	146.000 MG/KG	J		K	930.00 UG/L	J	157
	Mg	241.000 MG/KG	J		Mg	1770.00 UG/L	J	136
	Mn	31.800 MG/KG	J		Mn	27.80 UG/L	=	1144
	Na	69.500 MG/KG	J		Na	2180.00 UG/L	J	32
	Ni	1.900 MG/KG	J		Ni	8.40 UG/L	J	226
	Pb	5.900 MG/KG	J		Pb	12.40 UG/L	=	476
	Sb	0.720 MG/KG	J		Sb	4.80 UG/L	U	300
	Se	0.820 MG/KG	J		Se	5.30 UG/L	J	155
	Sn	4.600 MG/KG	U		Sn	5.70 UG/L	U	none
	Tl	0.220 MG/KG	U		Tl	2.40 UG/L	U	none
	V	16.300 MG/KG	=		V	59.10 UG/L	=	276
	Zn	7.300 MG/KG	J		Zn	150.00 UG/L	J	49

AOC 607 SPLP COMPARISONS

Location F607SB008

Sample no.	conc.			SPLP			Kd, L/KG
607SB016T1 surface	Ag	0.050 MG/KG	U	607SB016S1 surface	Ag	0.50 UG/L	UJ none
	Al	8370.000 MG/KG	=		Al	13000.00 UG/L	= 644
	As	2.400 MG/KG	J		As	6.50 UG/L	J 369
	Ba	30.600 MG/KG	=		Ba	1930.00 UG/L	= 16
	Be	0.370 MG/KG	J		Be	0.90 UG/L	U 822
	Ca	4600.000 MG/KG	J		Ca	9390.00 UG/L	= 490
	Cd	0.030 MG/KG	UJ		Cd	0.30 UG/L	UJ none
	Co	8.000 MG/KG	=		Co	1.10 UG/L	J 7273
	Cr	12.600 MG/KG	J		Cr	22.70 UG/L	J 555
	Cu	9.000 MG/KG	=		Cu	11.00 UG/L	J 818
	Fe	9770.000 MG/KG	=		Fe	9770.00 UG/L	J 1000
	Hg	0.050 MG/KG	=		Hg	0.40 UG/L	U 250
	K	1340.000 MG/KG	J		K	4960.00 UG/L	J 270
	Mg	1650.000 MG/KG	J		Mg	1000.00 UG/L	J 1650
	Mn	159.000 MG/KG	=		Mn	24.70 UG/L	= 6437
	Na	137.000 MG/KG	J		Na	9450.00 UG/L	= 14
	Ni	3.300 MG/KG	J		Ni	4.50 UG/L	J 733
	Pb	14.800 MG/KG	=		Pb	17.40 UG/L	= 851
	Sb	0.450 MG/KG	J		Sb	3.20 UG/L	J 141
	Se	0.790 MG/KG	J		Se	2.20 UG/L	J 359
	Sn	5.100 MG/KG	J		Sn	4.20 UG/L	J 1214
	Tl	0.240 MG/KG	R		Tl	2.40 UG/L	U
	V	17.500 MG/KG	=		V	28.90 UG/L	J 606
	Zn	40.300 MG/KG	J		Zn	1520.00 UG/L	J 27

607SB016T2 subsurface	Ag	0.050 MG/KG	U	607SB016S2 subsurface	Ag	0.50 UG/L	UJ none
	Al	9120.000 MG/KG	=		Al	11000.00 UG/L	= 829
	As	2.000 MG/KG	J		As	2.60 UG/L	J 769
	Ba	22.400 MG/KG	=		Ba	424.00 UG/L	= 53
	Be	0.500 MG/KG	J		Be	0.90 UG/L	U 1111
	Ca	1180.000 MG/KG	J		Ca	12800.00 UG/L	= 92
	Cd	0.030 MG/KG	UJ		Cd	0.30 UG/L	U none
	Co	4.800 MG/KG	J		Co	5.60 UG/L	J 857
	Cr	12.200 MG/KG	J		Cr	14.80 UG/L	= 824
	Cu	0.620 MG/KG	J		Cu	2.60 UG/L	J 238
	Fe	7620.000 MG/KG	=		Fe	10200.00 UG/L	= 747
	Hg	0.060 MG/KG	=		Hg	0.40 UG/L	R
	K	327.000 MG/KG	J		K	1850.00 UG/L	J 177
	Mg	633.000 MG/KG	J		Mg	2270.00 UG/L	J 279
	Mn	25.600 MG/KG	=		Mn	21.80 UG/L	= 1174
	Na	86.900 MG/KG	J		Na	1160.00 UG/L	J 75
	Ni	3.100 MG/KG	J		Ni	4.40 UG/L	J 705
	Pb	6.800 MG/KG	=		Pb	8.50 UG/L	U 1600
	Sb	0.470 MG/KG	J		Sb	2.40 UG/L	U 392
	Se	0.950 MG/KG	J		Se	1.90 UG/L	U 1000
	Sn	4.100 MG/KG	J		Sn	4.70 UG/L	J 872
	Tl	0.250 MG/KG	UJ		Tl	2.40 UG/L	UJ none
	V	17.600 MG/KG	=		V	21.00 UG/L	J 838
	Zn	9.400 MG/KG	J		Zn	179.00 UG/L	= 53

AOC 609 SPLP COMPARISONS

Location 609SB001

sample no.

sample no.	surface	conc.		sample no.	surface	SPLP		Kd, L/KG
609SB001T1	Ag	0.29 MG/KG	J	609SB001S1	Ag	0.50 UG/L	UJ	1160
	Al	4080.00 MG/KG	=		Al	11200.00 UG/L	=	364
	As	30.80 MG/KG	J		As	12.40 UG/L	=	2484
	Ba	116.00 MG/KG	=		Ba	709.00 UG/L	=	164
	Be	0.57 MG/KG	J		Be	0.90 UG/L	U	1267
	Ca	2390.00 MG/KG	J		Ca	5340.00 UG/L	=	448
	Cd	0.32 MG/KG	J		Cd	0.30 UG/L	U	2133
	Co	22.40 MG/KG	=		Co	14.70 UG/L	J	1524
	Cr	20.30 MG/KG	J		Cr	17.20 UG/L	=	1180
	Cu	65.00 MG/KG	=		Cu	27.70 UG/L	=	2347
	Fe	11500.00 MG/KG	=		Fe	9120.00 UG/L	=	1261
	Hg	1.30 MG/KG	=		Hg	0.40 UG/L	R	
	K	336.00 MG/KG	J		K	1930.00 UG/L	J	174
	Mg	425.00 MG/KG	J		Mg	1990.00 UG/L	J	214
	Mn	122.00 MG/KG	=		Mn	128.00 UG/L	=	953
	Na	194.00 MG/KG	J		Na	2900.00 UG/L	J	67
	Ni	17.70 MG/KG	=		Ni	8.20 UG/L	J	2159
	Pb	184.00 MG/KG	=		Pb	65.10 UG/L	=	2826
	Sb	2.80 MG/KG	J		Sb	7.50 UG/L	J	373
	Se	2.00 MG/KG	=		Se	2.40 UG/L	U	1667
	Sn	7.60 MG/KG	J		Sn	4.10 UG/L	J	1854
	Tl	0.29 MG/KG	UJ		Tl	2.40 UG/L	UJ	none
	V	21.40 MG/KG	=		V	23.20 UG/L	J	922
	Zn	338.00 MG/KG	J		Zn	241.00 UG/L	=	1402
609SB001T2	subsurface			609SB001S2	subsurface			
	Ag	0.05 MG/KG	U		Ag	0.50 UG/L	UJ	none
	Al	5740.00 MG/KG	=		Al	15100.00 UG/L	=	380
	As	3.40 MG/KG	J		As	16.00 UG/L	=	213
	Ba	19.30 MG/KG	J		Ba	1200.00 UG/L	=	16
	Be	0.52 MG/KG	J		Be	0.90 UG/L	U	1156
	Ca	640.00 MG/KG	J		Ca	1840.00 UG/L	J	348
	Cd	0.03 MG/KG	UJ		Cd	0.30 UG/L	U	none
	Co	1.70 MG/KG	J		Co	2.30 UG/L	J	739
	Cr	6.70 MG/KG	J		Cr	20.60 UG/L	=	325
	Cu	13.70 MG/KG	=		Cu	23.20 UG/L	J	591
	Fe	3680.00 MG/KG	=		Fe	10800.00 UG/L	=	341
	Hg	0.06 MG/KG	=		Hg	0.40 UG/L	R	
	K	223.00 MG/KG	J		K	2180.00 UG/L	J	102
	Mg	430.00 MG/KG	J		Mg	1840.00 UG/L	J	234
	Mn	55.10 MG/KG	=		Mn	120.00 UG/L	=	459
	Na	41.30 MG/KG	U		Na	3340.00 UG/L	J	12
	Ni	2.70 MG/KG	J		Ni	7.10 UG/L	J	380
	Pb	17.70 MG/KG	=		Pb	22.40 UG/L	=	790
	Sb	0.30 MG/KG	J		Sb	2.40 UG/L	U	250
	Se	0.49 MG/KG	J		Se	1.70 UG/L	U	576
	Sn	4.30 MG/KG	J		Sn	2.70 UG/L	U	3185
	Tl	0.26 MG/KG	UJ		Tl	2.40 UG/L	UJ	none
	V	9.30 MG/KG	=		V	34.90 UG/L	J	266
	Zn	11.40 MG/KG	J		Zn	264.00 UG/L	=	43

AOC 609 SPLP COMPARISONS

Location 609SB001

sample no.

609SB002T1	surface	conc.		609SB002S1	surface	SPLP	Kd, L/KG
	surface				surface		
	Ag	0.06 MG/KG	U		Ag	0.50 UG/L	UJ none
	Al	36000.00 MG/KG	=		Al	17200.00 UG/L	= 2093
	As	18.70 MG/KG	J		As	13.00 UG/L	= 1438
	Ba	50.30 MG/KG	=		Ba	1050.00 UG/L	= 48
	Be	1.60 MG/KG	=		Be	0.90 UG/L	U 3556
	Ca	4400.00 MG/KG	J		Ca	6500.00 UG/L	= 677
	Cd	0.04 MG/KG	UJ		Cd	0.30 UG/L	U none
	Co	11.90 MG/KG	=		Co	4.20 UG/L	J 2833
	Cr	54.70 MG/KG	J		Cr	24.00 UG/L	= 2279
	Cu	42.00 MG/KG	=		Cu	20.30 UG/L	J 2069
	Fe	38800.00 MG/KG	=		Fe	15700.00 UG/L	= 2471
	Hg	0.81 MG/KG	=		Hg	0.40 UG/L	R
	K	2930.00 MG/KG	J		K	4620.00 UG/L	J 634
	Mg	4560.00 MG/KG	J		Mg	3460.00 UG/L	J 1318
	Mn	389.00 MG/KG	=		Mn	291.00 UG/L	= 1337
	Na	377.00 MG/KG	J		Na	4660.00 UG/L	J 81
	Ni	20.60 MG/KG	=		Ni	9.70 UG/L	J 2124
	Pb	62.90 MG/KG	=		Pb	24.50 UG/L	= 2567
	Sb	1.40 MG/KG	J		Sb	2.40 UG/L	U 1167
	Se	2.60 MG/KG	=		Se	3.50 UG/L	U 1486
	Sn	7.80 MG/KG	J		Sn	4.60 UG/L	J 1696
	Tl	0.31 MG/KG	UJ		Tl	2.40 UG/L	UJ none
	V	88.70 MG/KG	=		V	39.30 UG/L	J 2257
	Zn	172.00 MG/KG	J		Zn	306.00 UG/L	= 562

609SB002T2 subsurface

609SB002S2 subsurface

	Ag	0.06 MG/KG	U		Ag	0.50 UG/L	UJ none
	Al	13900.00 MG/KG	=		Al	200000.00 UG/L	= 70
	As	5.70 MG/KG	J		As	62.50 UG/L	= 91
	Ba	23.40 MG/KG	=		Ba	3080.00 UG/L	= 8
	Be	0.29 MG/KG	J		Be	2.70 UG/L	J 107
	Ca	1190.00 MG/KG	J		Ca	17100.00 UG/L	= 70
	Cd	0.03 MG/KG	UJ		Cd	0.30 UG/L	U none
	Co	2.20 MG/KG	J		Co	26.40 UG/L	J 83
	Cr	26.70 MG/KG	J		Cr	274.00 UG/L	= 97
	Cu	1.30 MG/KG	J		Cu	22.80 UG/L	J 57
	Fe	19000.00 MG/KG	=		Fe	177000.00 UG/L	= 107
	Hg	0.05 MG/KG	U		Hg	0.40 UG/L	J 125
	K	763.00 MG/KG	J		K	15500.00 UG/L	= 49
	Mg	1110.00 MG/KG	J		Mg	13000.00 UG/L	= 85
	Mn	51.20 MG/KG	=		Mn	341.00 UG/L	= 150
	Na	264.00 MG/KG	J		Na	16500.00 UG/L	= 16
	Ni	4.30 MG/KG	J		Ni	66.00 UG/L	= 65
	Pb	8.10 MG/KG	=		Pb	87.60 UG/L	= 92
	Sb	0.88 MG/KG	J		Sb	2.40 UG/L	U 733
	Se	1.80 MG/KG	=		Se	13.90 UG/L	J 129
	Sn	5.30 MG/KG	J		Sn	13.90 UG/L	J 381
	Tl	0.27 MG/KG	UJ		Tl	2.40 UG/L	UJ none
	V	36.30 MG/KG	=		V	372.00 UG/L	= 98
	Zn	13.50 MG/KG	J		Zn	1940.00 UG/L	= 7

AOC 611 SPLP COMPARISONS

Location 611SB001

sample no.

sample no.	surface	conc.		sample no.	surface	SPLP		Kd, L/KG
611SB001T1	Ag	0.04 MG/KG	U	611SB001S1	Ag	0.50 UG/L	U	none
	Al	2680.00 MG/KG	=		Al	698.00 UG/L	=	3840
	As	2.50 MG/KG	=		As	2.00 UG/L	U	2500
	Ba	8.50 MG/KG	J		Ba	154.00 UG/L	J	55
	Be	0.07 MG/KG	U		Be	0.90 UG/L	U	none
	Ca	4460.00 MG/KG	J		Ca	53200.00 UG/L	=	84
	Cd	0.02 MG/KG	U		Cd	0.30 UG/L	U	none
	Co	0.62 MG/KG	J		Co	0.50 UG/L	U	2480
	Cr	5.70 MG/KG	J		Cr	1.90 UG/L	J	3000
	Cu	0.68 MG/KG	J		Cu	0.60 UG/L	J	1133
	Fe	2350.00 MG/KG	J		Fe	524.00 UG/L	=	4485
	Hg	0.05 MG/KG	U		Hg	0.40 UG/L	U	none
	K	169.00 MG/KG	J		K	140.00 UG/L	J	1207
	Mg	286.00 MG/KG	J		Mg	974.00 UG/L	J	294
	Mn	14.20 MG/KG	J		Mn	1.40 UG/L	U	20286
	Na	89.30 MG/KG	J		Na	1380.00 UG/L	J	65
	Ni	1.00 MG/KG	J		Ni	1.80 UG/L	J	556
	Pb	2.80 MG/KG	J		Pb	2.10 UG/L	U	2667
	Sb	0.26 MG/KG	J		Sb	4.10 UG/L	U	127
	Se	0.30 MG/KG	J		Se	1.70 UG/L	U	353
	Sn	3.10 MG/KG	U		Sn	3.70 UG/L	U	none
	Tl	0.19 MG/KG	U		Tl	2.40 UG/L	U	none
	V	6.60 MG/KG	=		V	2.40 UG/L	J	2750
	Zn	4.50 MG/KG	J		Zn	38.30 UG/L	J	117
611SB001T2	subsurface			611SB001S2	subsurface			
	Ag	0.05 MG/KG	U		Ag	0.50 UG/L	U	none
	Al	15900.00 MG/KG	=		Al	58.70 UG/L	U	541738
	As	6.00 MG/KG	=		As	2.00 UG/L	U	6000
	Ba	24.30 MG/KG	=		Ba	202.00 UG/L	=	120
	Be	0.17 MG/KG	J		Be	0.90 UG/L	U	378
	Ca	695.00 MG/KG	J		Ca	1800.00 UG/L	J	386
	Cd	0.03 MG/KG	U		Cd	0.30 UG/L	U	none
	Co	2.20 MG/KG	J		Co	0.50 UG/L	U	8800
	Cr	26.90 MG/KG	J		Cr	0.80 UG/L	J	33625
	Cu	2.00 MG/KG	J		Cu	0.60 UG/L	U	6667
	Fe	19400.00 MG/KG	J		Fe	242.00 UG/L	U	160331
	Hg	0.05 MG/KG	U		Hg	0.40 UG/L	U	none
	K	566.00 MG/KG	J		K	85.60 UG/L	J	6612
	Mg	1110.00 MG/KG	J		Mg	521.00 UG/L	J	2131
	Mn	43.80 MG/KG	J		Mn	12.90 UG/L	J	3395
	Na	137.00 MG/KG	J		Na	777.00 UG/L	J	176
	Ni	4.90 MG/KG	J		Ni	1.10 UG/L	U	8909
	Pb	10.60 MG/KG	J		Pb	3.90 UG/L	J	2718
	Sb	0.94 MG/KG	J		Sb	3.50 UG/L	U	537
	Se	1.90 MG/KG	=		Se	1.70 UG/L	U	2235
	Sn	4.90 MG/KG	U		Sn	2.70 UG/L	U	none
	Tl	0.24 MG/KG	U		Tl	2.40 UG/L	U	none
	V	36.40 MG/KG	=		V	0.50 UG/L	U	145600
	Zn	17.00 MG/KG	J		Zn	39.00 UG/L	J	436

AOC 611 SPLP COMPARISONS

Location 611SB001

sample no.

sample no.	surface	conc.		611SB002S1	surface	SPLP		Kd, L/KG
611SB002T1	surface	conc.		611SB002S1	surface	SPLP		
	Ag	0.04 MG/KG	U		Ag	0.50 UG/L	U	none
	Al	2330.00 MG/KG	=		Al	1930.00 UG/L	=	1207
	As	2.80 MG/KG	=		As	2.00 UG/L	U	2800
	Ba	8.80 MG/KG	J		Ba	221.00 UG/L	=	40
	Be	0.07 MG/KG	J		Be	0.90 UG/L	U	156
	Ca	14300.00 MG/KG	J		Ca	40800.00 UG/L	=	350
	Cd	0.02 MG/KG	U		Cd	0.30 UG/L	U	none
	Co	0.87 MG/KG	J		Co	0.50 UG/L	U	3480
	Cr	5.30 MG/KG	J		Cr	8.50 UG/L	J	624
	Cu	0.66 MG/KG	J		Cu	0.70 UG/L	J	943
	Fe	3430.00 MG/KG	J		Fe	1610.00 UG/L	=	2130
	Hg	0.05 MG/KG	U		Hg	0.40 UG/L	U	none
	K	191.00 MG/KG	J		K	269.00 UG/L	J	710
	Mg	435.00 MG/KG	J		Mg	714.00 UG/L	J	609
	Mn	22.40 MG/KG	J		Mn	5.10 UG/L	J	4392
	Na	182.00 MG/KG	J		Na	1440.00 UG/L	J	126
	Ni	1.40 MG/KG	J		Ni	2.90 UG/L	J	483
	Pb	2.10 MG/KG	J		Pb	3.70 UG/L	J	568
	Sb	0.44 MG/KG	J		Sb	3.00 UG/L	U	293
	Se	0.40 MG/KG	J		Se	1.70 UG/L	U	471
	Sn	3.30 MG/KG	U		Sn	2.70 UG/L	U	none
	Tl	0.20 MG/KG	U		Tl	2.40 UG/L	U	none
	V	6.00 MG/KG	=		V	4.60 UG/L	J	1304
	Zn	5.30 MG/KG	J		Zn	68.30 UG/L	J	78
611SB002T2	subsurface			611SB002S2	subsurface			
	Ag	0.04 MG/KG	U		Ag	0.50 UG/L	U	none
	Al	16200.00 MG/KG	=		Al	58.70 UG/L	U	551959
	As	5.00 MG/KG	=		As	2.00 UG/L	U	5000
	Ba	22.80 MG/KG	=		Ba	88.30 UG/L	J	258
	Be	0.15 MG/KG	J		Be	0.90 UG/L	U	333
	Ca	1740.00 MG/KG	J		Ca	10400.00 UG/L	=	167
	Cd	0.03 MG/KG	U		Cd	0.30 UG/L	U	none
	Co	2.40 MG/KG	J		Co	0.50 UG/L	J	4800
	Cr	29.10 MG/KG	J		Cr	0.60 UG/L	U	97000
	Cu	2.20 MG/KG	J		Cu	0.60 UG/L	U	7333
	Fe	20500.00 MG/KG	J		Fe	26.00 UG/L	U	1576923
	Hg	0.11 MG/KG	=		Hg	0.40 UG/L	U	550
	K	612.00 MG/KG	J		K	157.00 UG/L	J	3898
	Mg	1250.00 MG/KG	J		Mg	1030.00 UG/L	J	1214
	Mn	62.40 MG/KG	J		Mn	222.00 UG/L	=	281
	Na	143.00 MG/KG	J		Na	982.00 UG/L	J	146
	Ni	4.70 MG/KG	J		Ni	1.10 UG/L	U	8545
	Pb	9.70 MG/KG	J		Pb	2.10 UG/L	U	9238
	Sb	0.95 MG/KG	J		Sb	2.40 UG/L	U	792
	Se	1.70 MG/KG	=		Se	1.70 UG/L	U	2000
	Sn	4.60 MG/KG	U		Sn	2.70 UG/L	U	none
	Tl	0.21 MG/KG	U		Tl	2.40 UG/L	U	none
	V	36.70 MG/KG	=		V	0.50 UG/L	U	146800
	Zn	17.20 MG/KG	J		Zn	136.00 UG/L	J	126

Location F613SP022

Sample no.	conc.			SPLP	Kd, L/KG
613SP022T1 surface	Ag 0.05 MG/KG	UJ	613SP022S1 surface	Ag 0.50 UG/L	J 100
	Al 5620.00 MG/KG	=		Al 71.20 UG/L	J 78933
	As 3.80 MG/KG	=		As 2.00 UG/L	U 3800
	Ba 14.20 MG/KG	J		Ba 206.00 UG/L	= 69
	Be 0.12 MG/KG	J		Be 0.90 UG/L	U 267
	Ca 142000.00 MG/KG	=		Ca 27900.00 UG/L	= 5090
	Cd 0.30 MG/KG	J		Cd 0.30 UG/L	UJ 2000
	Co 4.90 MG/KG	J		Co 0.50 UG/L	U 19600
	Cr 10.10 MG/KG	=		Cr 11.50 UG/L	J 878
	Cu 10.10 MG/KG	J		Cu 1.40 UG/L	J 7214
	Fe 5720.00 MG/KG	=		Fe 122.00 UG/L	J 46885
	Hg 0.06 MG/KG	=		Hg 0.40 UG/L	U 300
	K 839.00 MG/KG	J		K 663.00 UG/L	J 1265
	Mg 2320.00 MG/KG	=		Mg 1150.00 UG/L	J 2017
	Mn 153.00 MG/KG	=		Mn 2.10 UG/L	J 72857
	Na 318.00 MG/KG	J		Na 1320.00 UG/L	J 241
	Ni 9.30 MG/KG	=		Ni 5.10 UG/L	J 1824
	Pb 13.10 MG/KG	J		Pb 2.10 UG/L	U 12476
	Sb 0.31 MG/KG	J		Sb 2.60 UG/L	J 119
	Se 0.22 MG/KG	J		Se 1.70 UG/L	U 259
	Sn 3.90 MG/KG	U		Sn 2.70 UG/L	U none
	Tl 2.40 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 14.00 MG/KG	=		V 2.80 UG/L	J 5000
	Zn 34.90 MG/KG	J		Zn 42.60 UG/L	= 819
613SP022T2 subsurface	Ag 0.08 MG/KG	UJ	613SP022S2 subsurface	Ag 0.50 UG/L	UJ none
	Al 25100.00 MG/KG	=		Al 58.70 UG/L	U 855196
	As 31.50 MG/KG	=		As 2.00 UG/L	U 31500
	Ba 37.70 MG/KG	=		Ba 201.00 UG/L	= 188
	Be 1.20 MG/KG	=		Be 0.90 UG/L	U 2667
	Ca 15000.00 MG/KG	=		Ca 27400.00 UG/L	= 547
	Cd 0.05 MG/KG	U		Cd 0.30 UG/L	UJ none
	Co 9.00 MG/KG	J		Co 0.50 UG/L	U 36000
	Cr 40.90 MG/KG	=		Cr 7.10 UG/L	J 5761
	Cu 28.50 MG/KG	J		Cu 1.10 UG/L	J 25909
	Fe 35400.00 MG/KG	=		Fe 104.00 UG/L	J 340385
	Hg 0.46 MG/KG	=		Hg 0.40 UG/L	U 2300
	K 2410.00 MG/KG	J		K 614.00 UG/L	J 3925
	Mg 4240.00 MG/KG	=		Mg 1120.00 UG/L	J 3786
	Mn 799.00 MG/KG	=		Mn 1.80 UG/L	J 443889
	Na 997.00 MG/KG	=		Na 1180.00 UG/L	J 845
	Ni 14.20 MG/KG	=		Ni 3.70 UG/L	J 3838
	Pb 52.50 MG/KG	J		Pb 2.10 UG/L	U 50000
	Sb 0.88 MG/KG	J		Sb 3.20 UG/L	J 275
	Se 2.90 MG/KG	=		Se 1.70 UG/L	U 3412
	Sn 8.30 MG/KG	U		Sn 2.70 UG/L	U none
	Tl 1.90 MG/KG	UJ		Tl 2.40 UG/L	UJ none
	V 76.90 MG/KG	=		V 2.80 UG/L	J 27464
	Zn 110.00 MG/KG	J		Zn 38.40 UG/L	= 2865

Location F613SP022

Sample no.	conc.			SPLP	Kd, L/KG
613SP027T1 surface	Ag 0.12 MG/KG	J	613SP027S1 surface	Ag 0.50 UG/L	UJ 480
	Al 8780.00 MG/KG	=		Al 10900.00 UG/L	= 806
	As 69.90 MG/KG	J		As 76.10 UG/L	J 919
	Ba 60.90 MG/KG	=		Ba 490.00 UG/L	= 124
	Be 1.20 MG/KG	=		Be 0.90 UG/L	U 2667
	Ca 10900.00 MG/KG	J		Ca 14600.00 UG/L	= 747
	Cd 0.36 MG/KG	J		Cd 0.30 UG/L	UJ 2400
	Co 17.30 MG/KG	=		Co 2.10 UG/L	J 8238
	Cr 45.00 MG/KG	J		Cr 26.60 UG/L	J 1692
	Cu 325.00 MG/KG	=		Cu 90.90 UG/L	= 3575
	Fe 15400.00 MG/KG	=		Fe 11800.00 UG/L	J 1305
	Hg 1.10 MG/KG	=		Hg 0.40 UG/L	U 5500
	K 612.00 MG/KG	J		K 2230.00 UG/L	J 274
	Mg 909.00 MG/KG	J		Mg 1730.00 UG/L	J 525
	Mn 149.00 MG/KG	=		Mn 48.60 UG/L	= 3066
	Na 359.00 MG/KG	J		Na 1590.00 UG/L	J 226
	Ni 79.10 MG/KG	=		Ni 14.40 UG/L	J 5493
	Pb 395.00 MG/KG	=		Pb 108.00 UG/L	= 3657
	Sb 15.60 MG/KG	J		Sb 101.00 UG/L	= 154
	Se 1.60 MG/KG	=		Se 2.40 UG/L	J 667
	Sn 60.80 MG/KG	=		Sn 8.20 UG/L	J 7415
	Tl 1.00 MG/KG	R		Tl 2.40 UG/L	U 0
	V 24.10 MG/KG	=		V 25.40 UG/L	J 949
	Zn 1100.00 MG/KG	J		Zn 394.00 UG/L	J 2792
613SP027T2 subsurface	Ag 0.05 MG/KG	U	613SP027S2 subsurface	Ag 0.50 UG/L	UJ none
	Al 14300.00 MG/KG	=		Al 6870.00 UG/L	= 2082
	As 9.30 MG/KG	J		As 4.60 UG/L	J 2022
	Ba 25.60 MG/KG	=		Ba 1110.00 UG/L	= 23
	Be 0.56 MG/KG	=		Be 0.90 UG/L	U 1244
	Ca 8200.00 MG/KG	J		Ca 19000.00 UG/L	= 432
	Cd 0.03 MG/KG	UJ		Cd 0.30 UG/L	UJ none
	Co 4.80 MG/KG	J		Co 0.50 UG/L	U 19200
	Cr 28.10 MG/KG	J		Cr 10.90 UG/L	J 2578
	Cu 35.60 MG/KG	=		Cu 6.10 UG/L	J 5836
	Fe 16300.00 MG/KG	=		Fe 5310.00 UG/L	J 3070
	Hg 0.16 MG/KG	=		Hg 0.40 UG/L	U 800
	K 1080.00 MG/KG	J		K 5000.00 UG/L	J 216
	Mg 1730.00 MG/KG	J		Mg 3000.00 UG/L	J 577
	Mn 246.00 MG/KG	=		Mn 35.10 UG/L	= 7009
	Na 271.00 MG/KG	J		Na 7700.00 UG/L	= 35
	Ni 15.40 MG/KG	=		Ni 3.90 UG/L	J 3949
	Pb 42.70 MG/KG	=		Pb 10.10 UG/L	= 4228
	Sb 1.90 MG/KG	J		Sb 6.30 UG/L	J 302
	Se 1.70 MG/KG	=		Se 1.70 UG/L	U 2000
	Sn 10.80 MG/KG	=		Sn 4.30 UG/L	J 2512
	Tl 0.25 MG/KG	R		Tl 2.40 UG/L	U 0
	V 34.00 MG/KG	=		V 16.80 UG/L	J 2024
	Zn 179.00 MG/KG	J		Zn 157.00 UG/L	J 1140

Location F613SP022

Sample no.	conc.			SPLP		Kd, L/KG
613SP051T1 surface	Ag 0.06 MG/KG	U	613SP051S1 surface	Ag 0.50 UG/L	U	none
	Al 22600.00 MG/KG	=		Al 27900.00 UG/L	J	810
	As 16.20 MG/KG	=		As 14.80 UG/L	=	1095
	Ba 36.30 MG/KG	=		Ba 1330.00 UG/L	=	27
	Be 0.69 MG/KG	=		Be 0.90 UG/L	U	1533
	Ca 15000.00 MG/KG	J		Ca 10300.00 UG/L	=	1456
	Cd 0.04 MG/KG	U		Cd 3.00 UG/L	J	13
	Co 8.00 MG/KG	=		Co 7.00 UG/L	J	1143
	Cr 34.70 MG/KG	J		Cr 41.90 UG/L	=	828
	Cu 22.50 MG/KG	J		Cu 33.50 UG/L	=	672
	Fe 21900.00 MG/KG	J		Fe 22900.00 UG/L	J	956
	Hg 0.09 MG/KG	=		Hg 0.40 UG/L	U	450
	K 2260.00 MG/KG	J		K 8560.00 UG/L	J	264
	Mg 3440.00 MG/KG	J		Mg 5230.00 UG/L	=	658
	Mn 206.00 MG/KG	J		Mn 84.20 UG/L	=	2447
	Na 1750.00 MG/KG	=		Na 28200.00 UG/L	=	62
	Ni 13.40 MG/KG	J		Ni 13.80 UG/L	J	971
	Pb 33.80 MG/KG	J		Pb 48.10 UG/L	=	703
	Sb 1.30 MG/KG	UJ		Sb 2.40 UG/L	U	none
	Se 2.00 MG/KG	=		Se 4.40 UG/L	U	909
	Sn 6.40 MG/KG	U		Sn 5.40 UG/L	J	1185
	Tl 0.29 MG/KG	UJ		Tl 2.40 UG/L	UJ	none
	V 52.20 MG/KG	=		V 59.20 UG/L	=	882
	Zn 82.90 MG/KG	J		Zn 696.00 UG/L	=	119
613SP051T2 subsurface	Ag 0.09 MG/KG	U	613SP051S2 subsurface	Ag 0.50 UG/L	U	none
	Al 35700.00 MG/KG	=		Al 20200.00 UG/L	J	1767
	As 20.10 MG/KG	=		As 7.80 UG/L	J	2577
	Ba 50.70 MG/KG	=		Ba 1010.00 UG/L	=	50
	Be 1.20 MG/KG	=		Be 0.90 UG/L	U	2667
	Ca 30800.00 MG/KG	J		Ca 7930.00 UG/L	=	3884
	Cd 0.05 MG/KG	U		Cd 0.30 UG/L	U	none
	Co 13.50 MG/KG	=		Co 2.10 UG/L	J	6429
	Cr 52.60 MG/KG	J		Cr 26.10 UG/L	=	2015
	Cu 35.10 MG/KG	J		Cu 15.60 UG/L	J	2250
	Fe 40200.00 MG/KG	J		Fe 12700.00 UG/L	J	3165
	Hg 0.37 MG/KG	=		Hg 0.40 UG/L	U	1850
	K 4030.00 MG/KG	J		K 14500.00 UG/L	J	278
	Mg 6230.00 MG/KG	J		Mg 5760.00 UG/L	=	1082
	Mn 594.00 MG/KG	J		Mn 83.40 UG/L	=	7122
	Na 4110.00 MG/KG	=		Na 76300.00 UG/L	=	54
	Ni 19.70 MG/KG	J		Ni 12.60 UG/L	J	1563
	Pb 68.60 MG/KG	J		Pb 14.90 UG/L	=	4604
	Sb 1.80 MG/KG	J		Sb 2.40 UG/L	U	1500
	Se 3.00 MG/KG	=		Se 2.60 UG/L	U	2308
	Sn 10.00 MG/KG	J		Sn 3.00 UG/L	J	3333
	Tl 0.41 MG/KG	UJ		Tl 2.40 UG/L	UJ	none
	V 80.10 MG/KG	=		V 35.40 UG/L	J	2263
	Zn 143.00 MG/KG	J		Zn 389.00 UG/L	=	368

AOC 616 SPLP COMPARISONS

Location 616SB002

sample no.

616SB002T1	surface	conc.		616SB002S1	surface	SPLP		Kd, L/KG
	CN	0.50000 MG/KG	U		CN	10.00000 UG/L	=	50
	Ag	0.05000 MG/KG	U		Ag	0.50000 UG/L	UJ	none
	Al	1630.00000 MG/KG	=		Al	58.70000 UG/L	U	55537
	As	1.30000 MG/KG	J		As	2.00000 UG/L	U	1300
	Ba	11.50000 MG/KG	J		Ba	88.60000 UG/L	J	130
	Be	0.08000 MG/KG	U		Be	0.90000 UG/L	U	none
	Ca	322000.00000 MG/KG	J		Ca	52300.00000 UG/L	=	6157
	Cd	0.62000 MG/KG	J		Cd	0.30000 UG/L	UJ	4133
	Co	7.20000 MG/KG	=		Co	0.50000 UG/L	U	28800
	Cr	8.70000 MG/KG	J		Cr	13.20000 UG/L	J	659
	Cu	2.70000 MG/KG	=		Cu	0.60000 UG/L	UJ	9000
	Fe	3030.00000 MG/KG	=		Fe	69.40000 UG/L	J	43660
	Hg	0.05000 MG/KG	U		Hg	0.40000 UG/L	U	none
	K	1770.00000 MG/KG	J		K	395.00000 UG/L	J	4481
	Mg	6110.00000 MG/KG	J		Mg	2280.00000 UG/L	J	2680
	Mn	227.00000 MG/KG	=		Mn	3.00000 UG/L	J	75667
	Na	630.00000 MG/KG	=		Na	1950.00000 UG/L	J	323
	Ni	11.30000 MG/KG	=		Ni	4.90000 UG/L	J	2306
	Pb	1.60000 MG/KG	=		Pb	2.30000 UG/L	J	696
	Sb	0.35000 MG/KG	J		Sb	3.50000 UG/L	J	100
	Se	0.16000 MG/KG	U		Se	1.70000 UG/L	U	none
	Sn	4.30000 MG/KG	J		Sn	4.10000 UG/L	J	1049
	Tl	2.20000 MG/KG	R		Tl	2.40000 UG/L	U	0
	V	6.80000 MG/KG	=		V	0.50000 UG/L	U	27200
	Zn	23.10000 MG/KG	J		Zn	16.20000 UG/L	J	1426
616SB002T2	subsurface			616SB002S2	subsurface			
	Ag	0.05000 MG/KG	U		Ag	0.50000 UG/L	UJ	none
	Al	8460.00000 MG/KG	=		Al	304.00000 UG/L	=	27829
	As	6.70000 MG/KG	J		As	2.00000 UG/L	U	6700
	Ba	13.20000 MG/KG	J		Ba	202.00000 UG/L	=	65
	Be	0.35000 MG/KG	J		Be	0.90000 UG/L	U	778
	Ca	9890.00000 MG/KG	J		Ca	18200.00000 UG/L	=	543
	Cd	0.03000 MG/KG	UJ		Cd	0.30000 UG/L	UJ	none
	Co	2.90000 MG/KG	J		Co	0.50000 UG/L	U	11600
	Cr	12.70000 MG/KG	J		Cr	0.80000 UG/L	J	15875
	Cu	6.70000 MG/KG	=		Cu	0.90000 UG/L	J	7444
	Fe	9070.00000 MG/KG	=		Fe	276.00000 UG/L	J	32862
	Hg	0.06000 MG/KG	=		Hg	0.40000 UG/L	U	300
	K	625.00000 MG/KG	J		K	3450.00000 UG/L	J	181
	Mg	1170.00000 MG/KG	J		Mg	3330.00000 UG/L	J	351
	Mn	78.80000 MG/KG	=		Mn	1.80000 UG/L	J	43778
	Na	192.00000 MG/KG	J		Na	3640.00000 UG/L	J	53
	Ni	4.30000 MG/KG	=		Ni	1.60000 UG/L	J	2668
	Pb	18.10000 MG/KG	=		Pb	2.10000 UG/L	U	17238
	Sb	0.34000 MG/KG	J		Sb	2.80000 UG/L	J	121
	Se	0.85000 MG/KG	J		Se	1.70000 UG/L	U	1000
	Sn	4.10000 MG/KG	J		Sn	3.20000 UG/L	J	1281
	Tl	0.26000 MG/KG	R		Tl	2.40000 UG/L	U	0
	V	20.20000 MG/KG	=		V	5.10000 UG/L	J	3961
	Zn	42.30000 MG/KG	J		Zn	53.50000 UG/L	J	791

AOC 617 SPLP COMPARISONS

Location 617SB003

sample no.

sample no.	surface	conc.		617SB003S1	surface	SPLP		Kd, L/KG
617SB003T1	Ag	0.57000 MG/KG	J	617SB003S1	Ag	0.50 UG/L	UJ	2280
	Al	1560.00000 MG/KG	=		Al	58.70 UG/L	U	53152
	As	3.20000 MG/KG	J		As	2.00 UG/L	U	3200
	Ba	12.40000 MG/KG	J		Ba	83.70 UG/L	J	148
	Be	0.09000 MG/KG	U		Be	0.90 UG/L	U	none
	Ca	340000.00000 MG/KG	J		Ca	69000.00 UG/L	=	4928
	Cd	0.66000 MG/KG	J		Cd	0.30 UG/L	UJ	4400
	Co	4.90000 MG/KG	=		Co	0.50 UG/L	U	19600
	Cr	7.70000 MG/KG	J		Cr	0.60 UG/L	U	25667
	Cu	3.30000 MG/KG	=		Cu	0.60 UG/L	UJ	11000
	Fe	3390.00000 MG/KG	=		Fe	103.00 UG/L	J	32913
	Hg	0.05000 MG/KG	U		Hg	0.40 UG/L	U	none
	K	1660.00000 MG/KG	J		K	922.00 UG/L	J	1800
	Mg	5460.00000 MG/KG	J		Mg	1840.00 UG/L	J	2967
	Mn	230.00000 MG/KG	=		Mn	3.10 UG/L	J	74194
	Na	718.00000 MG/KG	=		Na	1680.00 UG/L	J	427
	Ni	9.80000 MG/KG	=		Ni	1.10 UG/L	U	17818
	Pb	2.50000 MG/KG	=		Pb	3.00 UG/L	J	833
	Sb	0.36000 MG/KG	J		Sb	2.60 UG/L	J	138
	Se	0.16000 MG/KG	U		Se	1.70 UG/L	U	none
	Sn	4.40000 MG/KG	J		Sn	3.10 UG/L	J	1419
	Tl	2.30000 MG/KG	R		Tl	2.40 UG/L	U	0
	V	5.90000 MG/KG	=		V	0.50 UG/L	U	23600
	Zn	31.10000 MG/KG	J		Zn	8.50 UG/L	J	3659
617SB003T2	subsurface			617SB003S2	subsurface			
	Ag	0.05000 MG/KG	U		Ag	0.50 UG/L	UJ	none
	Al	7780.00000 MG/KG	=		Al	309.00 UG/L	=	25178
	As	3.60000 MG/KG	J		As	2.00 UG/L	U	3600
	Ba	18.00000 MG/KG	J		Ba	221.00 UG/L	=	81
	Be	0.23000 MG/KG	J		Be	0.90 UG/L	U	511
	Ca	17300.00000 MG/KG	J		Ca	142000.00 UG/L	=	122
	Cd	0.50000 MG/KG	J		Cd	0.30 UG/L	UJ	3333
	Co	1.90000 MG/KG	J		Co	0.50 UG/L	U	7600
	Cr	14.30000 MG/KG	J		Cr	0.80 UG/L	J	17875
	Cu	11.40000 MG/KG	=		Cu	1.90 UG/L	J	6000
	Fe	6630.00000 MG/KG	=		Fe	68.50 UG/L	J	96788
	Hg	0.18000 MG/KG	=		Hg	0.40 UG/L	U	900
	K	461.00000 MG/KG	J		K	2140.00 UG/L	J	215
	Mg	857.00000 MG/KG	J		Mg	3680.00 UG/L	J	233
	Mn	60.90000 MG/KG	=		Mn	35.50 UG/L	=	1715
	Na	232.00000 MG/KG	J		Na	3250.00 UG/L	J	71
	Ni	5.30000 MG/KG	=		Ni	1.10 UG/L	J	4818
	Pb	50.10000 MG/KG	=		Pb	2.10 UG/L	J	23857
	Sb	1.20000 MG/KG	J		Sb	3.90 UG/L	J	308
	Se	0.80000 MG/KG	J		Se	1.70 UG/L	U	941
	Sn	10.00000 MG/KG	=		Sn	2.70 UG/L	U	7407
	Tl	1.20000 MG/KG	R		Tl	2.40 UG/L	U	0
	V	14.60000 MG/KG	=		V	3.60 UG/L	J	4056
	Zn	1200.00000 MG/KG	J		Zn	173.00 UG/L	J	6936

AOC 617 SPLP COMPARISONS

Location 617SB003

sample no.

617SB004T1	surface	conc.		617SB004S1	surface	SPLP		Kd, L/KG
	Ag	0.16000 MG/KG	J		Ag	0.50 UG/L	J	320
	Al	1520.00000 MG/KG	=		Al	58.70 UG/L	U	51789
	As	2.50000 MG/KG	J		As	2.00 UG/L	U	2500
	Ba	15.60000 MG/KG	J		Ba	75.20 UG/L	J	207
	Be	7.90000 MG/KG	U		Be	0.90 UG/L	U	none
	Ca	328000.00000 MG/KG	J		Ca	77700.00 UG/L	=	4221
	Cd	0.68000 MG/KG	J		Cd	0.30 UG/L	UJ	4400
	Co	8.10000 MG/KG	=		Co	0.50 UG/L	U	32400
	Cr	7.90000 MG/KG	J		Cr	0.60 UG/L	U	26333
	Cu	2.70000 MG/KG	=		Cu	0.70 UG/L	J	3857
	Fe	3470.00000 MG/KG	=		Fe	39.20 UG/L	J	88520
	Hg	0.05000 MG/KG	U		Hg	0.40 UG/L	U	none
	K	2010.00000 MG/KG	J		K	3110.00 UG/L	J	646
	Mg	5730.00000 MG/KG	J		Mg	2150.00 UG/L	J	2665
	Mn	248.00000 MG/KG	=		Mn	2.50 UG/L	J	99200
	Na	729.00000 MG/KG	=		Na	3090.00 UG/L	J	236
	Ni	11.20000 MG/KG	=		Ni	1.70 UG/L	J	6588
	Pb	1.60000 MG/KG	=		Pb	4.30 UG/L	J	372
	Sb	0.39000 MG/KG	J		Sb	4.40 UG/L	J	89
	Se	0.17000 MG/KG	U		Se	1.90 UG/L	J	89
	Sn	4.60000 MG/KG	J		Sn	4.70 UG/L	J	979
	Tl	2.40000 MG/KG	R		Tl	2.40 UG/L	U	0
	V	6.90000 MG/KG	=		V	0.50 UG/L	U	27600
	Zn	21.50000 MG/KG	J		Zn	45.80 UG/L	J	469

617SB004T2

subsurface

Ag	0.05000 MG/KG	U
Al	5750.00000 MG/KG	=
As	2.20000 MG/KG	J
Ba	18.00000 MG/KG	J
Be	0.09000 MG/KG	J
Ca	17000.00000 MG/KG	J
Cd	0.32000 MG/KG	J
Co	1.70000 MG/KG	J
Cr	11.30000 MG/KG	J
Cu	8.60000 MG/KG	=
Fe	4490.00000 MG/KG	=
Hg	0.19000 MG/KG	=
K	263.00000 MG/KG	J
Mg	576.00000 MG/KG	J
Mn	31.90000 MG/KG	=
Na	170.00000 MG/KG	J
Ni	5.00000 MG/KG	=
Pb	48.20000 MG/KG	=
Sb	1.10000 MG/KG	J
Se	0.63000 MG/KG	J
Sn	6.00000 MG/KG	J
Tl	0.23000 MG/KG	R
V	9.50000 MG/KG	=
Zn	437.00000 MG/KG	J

617SB004S2

subsurface

Ag	0.50 UG/L	J	100
Al	58.70 UG/L	U	195911
As	2.00 UG/L	U	2200
Ba	58.60 UG/L	J	307
Be	0.90 UG/L	U	200
Ca	200000.00 UG/L	=	85
Cd	0.30 UG/L	UJ	2133
Co	0.50 UG/L	U	6800
Cr	0.80 UG/L	J	14125
Cu	2.70 UG/L	J	3185
Fe	97.60 UG/L	J	46004
Hg	0.40 UG/L	U	950
K	1270.00 UG/L	J	207
Mg	1750.00 UG/L	J	329
Mn	4.40 UG/L	J	7250
Na	3870.00 UG/L	J	44
Ni	4.00 UG/L	J	1250
Pb	2.70 UG/L	J	17852
Sb	7.80 UG/L	J	141
Se	2.10 UG/L	J	300
Sn	5.40 UG/L	J	1111
Tl	2.40 UG/L	U	0
V	2.00 UG/L	J	4750
Zn	87.80 UG/L	J	4977

AOC619 METALS

Location 619SB001

Sample no.	conc.			SPLP	Kd, L/KG
619SB001T1 surface	Ag 0.05 MG/KG	U	619SB001S1 surface	Ag 1.00 UG/L	J 50
	Al 9100.00 MG/KG	=		Al 7760.00 UG/L	= 1173
	As 9.60 MG/KG	J		As 6.50 UG/L	J 1477
	Ba 33.40 MG/KG	=		Ba 765.00 UG/L	= 44
	Be 0.36 MG/KG	J		Be 0.90 UG/L	U 800
	Ca 5010.00 MG/KG	J		Ca 10800.00 UG/L	= 464
	Cd 0.03 MG/KG	UJ		Cd 0.30 UG/L	UJ none
	Co 3.50 MG/KG	J		Co 0.70 UG/L	J 5000
	Cr 17.20 MG/KG	J		Cr 13.30 UG/L	J 1293
	Cu 21.60 MG/KG	=		Cu 6.80 UG/L	J 3176
	Fe 11900.00 MG/KG	=		Fe 7420.00 UG/L	J 1604
	Hg 0.16 MG/KG	=		Hg 0.40 UG/L	U 800
	K 731.00 MG/KG	J		K 2220.00 UG/L	J 329
	Mg 1230.00 MG/KG	J		Mg 2710.00 UG/L	J 454
	Mn 167.00 MG/KG	=		Mn 19.50 UG/L	= 8564
	Na 353.00 MG/KG	J		Na 11400.00 UG/L	= 31
	Ni 9.20 MG/KG	=		Ni 5.50 UG/L	J 1673
	Pb 58.30 MG/KG	=		Pb 17.70 UG/L	= 3294
	Sb 0.55 MG/KG	J		Sb 3.40 UG/L	J 162
	Se 1.30 MG/KG	=		Se 2.50 UG/L	J 520
	Sn 6.00 MG/KG	J		Sn 3.70 UG/L	J 1622
	Tl 0.25 MG/KG	R		Tl 2.40 UG/L	U 0
	V 22.40 MG/KG	=		V 19.90 UG/L	J 1126
	Zn 82.90 MG/KG	J		Zn 129.00 UG/L	J 643

619SB001S2 subsurface	Ag 0.04 MG/KG	U	619SB001S2 subsurface	Ag 0.50 UG/L	UJ none
	Al 2840.00 MG/KG	=		Al 415.00 UG/L	= 6843
	As 1.30 MG/KG	J		As 2.00 UG/L	U 1300
	Ba 10.20 MG/KG	J		Ba 481.00 UG/L	= 21
	Be 0.18 MG/KG	J		Be 1.00 UG/L	J 180
	Ca 490.00 MG/KG	J		Ca 2330.00 UG/L	J 210
	Cd 0.02 MG/KG	UJ		Cd 0.30 UG/L	UJ none
	Co 0.78 MG/KG	J		Co 0.50 UG/L	U 3120
	Cr 4.50 MG/KG	J		Cr 3.80 UG/L	J 1184
	Cu 1.40 MG/KG	J		Cu 2.80 UG/L	J 500
	Fe 2330.00 MG/KG	=		Fe 378.00 UG/L	J 6164
	Hg 0.05 MG/KG	U		Hg 0.40 UG/L	U none
	K 135.00 MG/KG	J		K 430.00 UG/L	J 314
	Mg 248.00 MG/KG	J		Mg 622.00 UG/L	J 399
	Mn 15.80 MG/KG	=		Mn 6.30 UG/L	J 2508
	Na 96.80 MG/KG	J		Na 3370.00 UG/L	J 29
	Ni 1.70 MG/KG	J		Ni 2.50 UG/L	J 680
	Pb 4.90 MG/KG	=		Pb 3.10 UG/L	J 1581
	Sb 0.18 MG/KG	UJ		Sb 5.30 UG/L	J 34
	Se 0.40 MG/KG	J		Se 1.70 UG/L	U 471
	Sn 3.20 MG/KG	J		Sn 3.20 UG/L	J 1000
	Tl 0.18 MG/KG	R		Tl 2.40 UG/L	U 0
	V 6.00 MG/KG	=		V 3.70 UG/L	J 1622
	Zn 6.60 MG/KG	J		Zn 31.10 UG/L	J 212

AOC619 METALS

Location 619SB001

Sample no.	conc.			SPLP	Kd, L/KG
619SB004T1 surface	Ag 0.05 MG/KG	U	619SB004S1 surface	Ag 0.50 UG/L	UJ none
	Al 5200.00 MG/KG	=		Al 3950.00 UG/L	= 1316
	As 2.30 MG/KG	J		As 5.20 UG/L	J 442
	Ba 16.30 MG/KG	J		Ba 306.00 UG/L	= 53
	Be 0.09 MG/KG	U		Be 0.90 UG/L	U none
	Ca 30100.00 MG/KG	J		Ca 16000.00 UG/L	= 1881
	Cd 0.03 MG/KG	J		Cd 0.30 UG/L	UJ 200
	Co 1.50 MG/KG	J		Co 0.50 UG/L	U 6000
	Cr 11.00 MG/KG	J		Cr 9.40 UG/L	J 1170
	Cu 11.20 MG/KG	=		Cu 15.00 UG/L	J 747
	Fe 4790.00 MG/KG	=		Fe 3840.00 UG/L	J 1247
	Hg 0.05 MG/KG	=		Hg 0.40 UG/L	U 250
	K 323.00 MG/KG	J		K 449.00 UG/L	J 719
	Mg 915.00 MG/KG	J		Mg 978.00 UG/L	J 936
	Mn 83.30 MG/KG	=		Mn 28.40 UG/L	= 2933
	Na 276.00 MG/KG	J		Na 1600.00 UG/L	J 173
	Ni 4.50 MG/KG	=		Ni 3.40 UG/L	J 1324
	Pb 17.00 MG/KG	=		Pb 17.80 UG/L	= 955
	Sb 0.50 MG/KG	J		Sb 4.10 UG/L	J 122
	Se 0.52 MG/KG	J		Se 1.70 UG/L	U 612
	Sn 4.50 MG/KG	J		Sn 4.40 UG/L	J 1023
	Tl 0.23 MG/KG	R		Tl 2.40 UG/L	U 0
	V 9.40 MG/KG	=		V 12.10 UG/L	J 777
	Zn 98.70 MG/KG	J		Zn 134.00 UG/L	J 737
619SB004T2 subsurface	Ag 0.06 MG/KG	U	619SB004S2 subsurface	Ag 0.50 UG/L	UJ none
	Al 21700.00 MG/KG	=		Al 1790.00 UG/L	= 12123
	As 17.70 MG/KG	J		As 2.00 UG/L	U 17700
	Ba 157.00 MG/KG	=		Ba 1000.00 UG/L	= 157
	Be 1.40 MG/KG	=		Be 0.90 UG/L	U 3111
	Ca 16800.00 MG/KG	J		Ca 12600.00 UG/L	= 1333
	Cd 0.04 MG/KG	UJ		Cd 0.30 UG/L	UJ none
	Co 5.80 MG/KG	J		Co 0.50 UG/L	U 23200
	Cr 32.10 MG/KG	J		Cr 4.00 UG/L	J 8025
	Cu 28.40 MG/KG	=		Cu 4.10 UG/L	J 6927
	Fe 26100.00 MG/KG	=		Fe 1590.00 UG/L	J 16415
	Hg 0.62 MG/KG	=		Hg 0.40 UG/L	U 3100
	K 2330.00 MG/KG	J		K 4190.00 UG/L	J 556
	Mg 3790.00 MG/KG	J		Mg 2440.00 UG/L	J 1553
	Mn 722.00 MG/KG	=		Mn 9.60 UG/L	J 75208
	Na 2100.00 MG/KG	=		Na 15500.00 UG/L	= 135
	Ni 11.10 MG/KG	=		Ni 2.50 UG/L	J 4440
	Pb 106.00 MG/KG	=		Pb 2.20 UG/L	J 48182
	Sb 0.60 MG/KG	J		Sb 2.40 UG/L	U 500
	Se 1.90 MG/KG	=		Se 1.70 UG/L	U 2235
	Sn 5.30 MG/KG	J		Sn 2.70 UG/L	U 3926
	Tl 1.40 MG/KG	R		Tl 2.40 UG/L	U 0
	V 48.40 MG/KG	=		V 6.60 UG/L	J 7333
	Zn 255.00 MG/KG	J		Zn 127.00 UG/L	J 2008

AOC619 METALS

Location 619SB001

Sample no.	conc.		SPLP	Kd, L/KG
619SB015T1 surface	Ag 0.05 MG/KG	U	619SB015S1 Ag 0.50 UG/L	UJ none
	Al 6700.00 MG/KG	=	Al 3950.00 UG/L	= 1696
	As 5.30 MG/KG	J	As 5.20 UG/L	J 1019
	Ba 23.40 MG/KG	=	Ba 306.00 UG/L	= 76
	Be 0.19 MG/KG	J	Be 0.90 UG/L	U 422
	Ca 38400.00 MG/KG	J	Ca 16000.00 UG/L	= 2400
	Cd 0.15 MG/KG	J	Cd 0.30 UG/L	UJ 1000
	Co 2.70 MG/KG	J	Co 0.50 UG/L	U 10800
	Cr 18.00 MG/KG	J	Cr 9.40 UG/L	J 1915
	Cu 45.40 MG/KG	=	Cu 15.00 UG/L	J 3027
	Fe 8570.00 MG/KG	=	Fe 3840.00 UG/L	J 2232
	Hg 0.09 MG/KG	=	Hg 0.40 UG/L	U 450
	K 536.00 MG/KG	J	K 449.00 UG/L	J 1194
	Mg 1270.00 MG/KG	J	Mg 978.00 UG/L	J 1299
	Mn 110.00 MG/KG	=	Mn 28.40 UG/L	= 3873
	Na 270.00 MG/KG	J	Na 1600.00 UG/L	J 169
	Ni 8.30 MG/KG	=	Ni 3.40 UG/L	J 2441
	Pb 56.00 MG/KG	=	Pb 17.80 UG/L	= 3146
	Sb 0.70 MG/KG	J	Sb 4.10 UG/L	J 171
	Se 0.70 MG/KG	J	Se 1.70 UG/L	U 824
	Sn 17.20 MG/KG	=	Sn 4.40 UG/L	J 3909
	Tl 1.30 MG/KG	R	Tl 2.40 UG/L	U 0
	V 14.20 MG/KG	=	V 12.10 UG/L	J 1174
	Zn 128.00 MG/KG	J	Zn 134.00 UG/L	J 955
619SB015T2 subsurface	Ag 0.07 MG/KG	U	619SB015S2 Ag 0.50 UG/L	UJ none
	Al 18300.00 MG/KG	=	Al 1790.00 UG/L	= 10223
	As 10.60 MG/KG	J	As 2.00 UG/L	U 10600
	Ba 30.80 MG/KG	=	Ba 1000.00 UG/L	= 31
	Be 0.67 MG/KG	=	Be 0.90 UG/L	U 1489
	Ca 12800.00 MG/KG	J	Ca 12600.00 UG/L	= 1016
	Cd 0.04 MG/KG	UJ	Cd 0.30 UG/L	UJ none
	Co 5.40 MG/KG	J	Co 0.50 UG/L	U 21600
	Cr 28.40 MG/KG	J	Cr 4.00 UG/L	J 7100
	Cu 25.30 MG/KG	=	Cu 4.10 UG/L	J 6171
	Fe 18900.00 MG/KG	=	Fe 1590.00 UG/L	J 11887
	Hg 0.30 MG/KG	=	Hg 0.40 UG/L	U 1500
	K 1460.00 MG/KG	J	K 4190.00 UG/L	J 348
	Mg 2620.00 MG/KG	J	Mg 2440.00 UG/L	J 1074
	Mn 236.00 MG/KG	=	Mn 9.60 UG/L	J 24583
	Na 483.00 MG/KG	J	Na 15500.00 UG/L	= 31
	Ni 11.00 MG/KG	=	Ni 2.50 UG/L	J 4400
	Pb 39.10 MG/KG	=	Pb 2.20 UG/L	J 17773
	Sb 0.98 MG/KG	J	Sb 2.40 UG/L	U 817
	Se 1.70 MG/KG	=	Se 1.70 UG/L	U 2000
	Sn 7.10 MG/KG	J	Sn 2.70 UG/L	U 5259
	Tl 1.60 MG/KG	R	Tl 2.40 UG/L	U 0
	V 39.60 MG/KG	=	V 6.60 UG/L	J 6000
	Zn 91.10 MG/KG	J	Zn 127.00 UG/L	J 717

AOC 620 SPLP COMPARISONS - METALS

Location 620SB008

sample no.

sample no.	surface	conc.		620SB008S1	surface	SPLP		Kd, L/KG
620SB008T1	Ag	0.050 MG/KG	U	Ag	0.500 UG/L		UJ	none
	Al	6750.000 MG/KG	=	Al	749.000 UG/L		=	9012
	As	15.100 MG/KG	J	As	27.400 UG/L		=	551
	Ba	27.200 MG/KG	=	Ba	128.000 UG/L		J	213
	Be	0.310 MG/KG	J	Be	0.900 UG/L		U	689
	Ca	39600.000 MG/KG	J	Ca	10500.000 UG/L		=	3771
	Cd	0.290 MG/KG	J	Cd	0.300 UG/L		U	1933
	Co	3.200 MG/KG	J	Co	0.500 UG/L		UJ	12800
	Cr	32.800 MG/KG	J	Cr	4.100 UG/L		J	8000
	Cu	46.300 MG/KG	=	Cu	5.600 UG/L		J	8268
	Fe	8790.000 MG/KG	=	Fe	992.000 UG/L		=	8861
	Hg	0.380 MG/KG	=	Hg	0.400 UG/L		R	950
	K	698.000 MG/KG	J	K	751.000 UG/L		J	929
	Mg	1310.000 MG/KG	J	Mg	594.000 UG/L		J	2205
	Mn	110.000 MG/KG	=	Mn	6.600 UG/L		J	16667
	Na	270.000 MG/KG	J	Na	963.000 UG/L		J	280
	Ni	11.400 MG/KG	=	Ni	2.500 UG/L		J	4560
	Pb	89.000 MG/KG	=	Pb	8.900 UG/L		U	20000
	Sb	1.700 MG/KG	J	Sb	2.400 UG/L		U	1417
	Se	0.800 MG/KG	J	Se	1.700 UG/L		U	941
	Sn	7.300 MG/KG	J	Sn	4.000 UG/L		J	1825
	Tl	0.240 MG/KG	UJ	Tl	2.400 UG/L		UJ	none
	V	17.500 MG/KG	=	V	9.400 UG/L		J	1862
	Zn	145.000 MG/KG	J	Zn	40.900 UG/L		=	3545
620SB008T2	subsurface			620SB008S2	subsurface			
	Ag	0.050 MG/KG	U	Ag	0.500 UG/L		U	none
	Al	16000.000 MG/KG	=	Al	5990.000 UG/L		J	2671
	As	18.900 MG/KG	=	As	4.200 UG/L		J	4500
	Ba	139.000 MG/KG	=	Ba	422.000 UG/L		=	329
	Be	0.470 MG/KG	J	Be	0.900 UG/L		U	1044
	Ca	14000.000 MG/KG	J	Ca	23800.000 UG/L		=	588
	Cd	0.430 MG/KG	J	Cd	0.500 UG/L		U	1720
	Co	4.800 MG/KG	J	Co	0.500 UG/L		UJ	19200
	Cr	269.000 MG/KG	J	Cr	16.700 UG/L		=	16108
	Cu	66.800 MG/KG	J	Cu	8.000 UG/L		J	8350
	Fe	19200.000 MG/KG	J	Fe	3890.000 UG/L		J	4936
	Hg	0.700 MG/KG	=	Hg	0.400 UG/L		U	3500
	K	1390.000 MG/KG	J	K	4040.000 UG/L		J	344
	Mg	2220.000 MG/KG	J	Mg	3240.000 UG/L		J	685
	Mn	401.000 MG/KG	J	Mn	21.000 UG/L		=	19095
	Na	325.000 MG/KG	J	Na	2130.000 UG/L		J	153
	Ni	9.900 MG/KG	J	Ni	3.400 UG/L		J	2912
	Pb	105.000 MG/KG	J	Pb	11.800 UG/L		U	17797
	Sb	2.500 MG/KG	J	Sb	2.400 UG/L		U	2083
	Se	1.700 MG/KG	=	Se	3.200 UG/L		U	1063
	Sn	5.900 MG/KG	U	Sn	4.000 UG/L		J	1475
	Tl	1.300 MG/KG	UJ	Tl	12.000 UG/L		UJ	none
	V	36.400 MG/KG	=	V	13.100 UG/L		J	2779
	Zn	422.000 MG/KG	J	Zn	174.000 UG/L		=	2425

APPENDIX C

Work Plan Addendum, Revision 0, Comments

Comment 1:

The work plan addendum is, as submitted, does not provide the current and complete characterization of Zone F SWMUs and AOCs. The work plan refers to the Draft RFI Report to present the known extent of contamination. The Draft RFI Report does not present this information in a comprehensive manner. Also, the soil exceedances in the Draft RFI Report were based upon a SSL-DAF of 20 which has since been changed to a site-specific SSL. It is not known how the revision of SSL will change the known extent of contamination from the Draft RFI Report. Furthermore, analytical data from subsequent RFI assessments, previous and ongoing Petroleum UST assessments, Sanitary and Storm Water Sewer assessments was not evaluated in this work plan. All this additional data is reportedly being re-evaluated during the end of November 1999. This addendum sampling effort is intended to complete the characterization of contamination. Only a comprehensive review of all data will tell if this effort was successful.

EnSafe Response 1:

The extensive data evaluation described in this comment was performed as part of the development of the work plan addendum. A formal presentation of this effort was not prepared because the Navy and EnSafe feel that level of effort should be reserved for the revised RFI report. The intended purpose of the work plan addendum was to provide a summary of the data with respect to where data gaps were identified and describe the work required to fill the data gaps. The revised RFI report will provide the documentation necessary to measure the successfulness of the addendum sampling effort. Attached are the figures and tables that reflect the agreements reached at the meeting.

CH2M-Jones Response Clarification:

Data and sample locations are provided in the project EGIS and are described in Revision 1 of the Work Plan Addendum. Figures are provided in areas where delineation is not complete, based on scoping meetings with SCDHEC and CH2M-Jones.

Comment 2:

Figures in this work plan describe COC exceedances with generic symbols such as VOC, SVOC or METALS. This method of presentation of the nature and extent of contamination fails to relay the known levels of contamination.

EnSafe Response 2:

The figures provided were modeled after the summary map that was part of an example set of figures provided to the team when the Navy and EnSafe were attempting to get "buy in" on an acceptable graphical presentation of the data. This method of presentation conveys all the information that is needed in a work plan with respect to a quick, visual representation on one map of where screening levels were exceeded and whether or not that location was adequately surrounded by data points where they were not exceeded. The text accompanying the figures explained that, where the generic symbols were displayed, one or more constituents of that particular family of compounds exceeded it's respective screening level. At points without a generic symbol, the concentrations for all constituents were either below screening concentrations or not detected at all. The presentation of data for individual constituents is not required using this method of identifying data gaps since the analysis for a generic parameter such as

VOCs will include reporting of all of the individual constituents on the Method 8260 analyte list.

CH2M-Jones Response Clarification:

Work Plan Addendum Revision 1 provides mapped concentrations for applicable constituents that need further delineation.

Comment 3:

In an RFI investigation where the release mechanism is not known, analytical data to define the nature and extent of contamination should be presented on maps or figures before comparing the data to screening values. This is significant when multiple contaminant detections below screening values may provide cumulative evidence of a release. Screening values are not based upon their cumulative effect. The Navy must adequately define the nature and extent of contamination.

EnSafe Response 3:

The screening process that has been used since the beginning of the RFI provides a specific means to with the potential cumulative effect for non-carcinogens. The RBCs are multiplied by a factor of 0.1 for screening purposes for non-carcinogens. This was not done for carcinogens because the use of RBCs as a screening tool takes into account the conservative nature in which the values are calculated and the fact that it is highly improbable that multiple detections below the RBC would result in a cumulative risk for the site that would exceed the risk range of 1E-06 to 1E-04 that is generally acceptable to EPA. The Navy acknowledges that SCDHEC is primarily interested anything that exceeds 1E-06 and that it is possibly that multiple detections slightly under the RBC could result in a cumulative site risk greater than 1E-06 using the default assumptions for a residential exposure scenario. If these situations are identified they will be dealt with appropriately in the baseline risk assessment.

The other issue brought out by this comments is whether or not the nature and extent can be adequately defined when using screening values to determine when to stop sampling if the release mechanism is poorly understood. In the case where compounds are detected below their respective screening levels which are at or below the practical quantitation limits, it is extremely unlikely that they can be attributed to a release from a SWMU/AOC or if a definitive source of any kind will ever be identified. The Navy and EnSafe do not see the value in continuing to sample for these compounds until non-detect results are achieved nor do we see the value in attempting to map these constituents when they are inconsequential with respect to risk/hazard at a site. On the other hand, there may be constituents such as some of those found in petroleum which are useful in mapping the extent of an release because of their elevated concentrations but, because they don't contribute significantly to risk have very high screening values. The Navy and EnSafe agree that it may still be beneficial to map these compounds for purposes of describing the nature and extent of an obvious release.

CH2M-Jones Response Clarification:

No clarification.

Comment 4:

The Figures in this work plan represent groundwater flow with an arrow. It is not clear if the representation of groundwater flow in this document is from a single seasonal sample

event or an average. This representation of groundwater flow is often at odds with other data previously presented by the Navy. In a work plan such as this, the variability of the seasonal or average groundwater flow can influence proposed monitoring well locations. The Navy must indicate how the groundwater flow was determined.

EnSafe Response 4:

The arrows are intended as an indication of the general horizontal flow direction over several measured events. Prior to installation of the new monitoring wells (613007, 613008) proposed in the work plan addendum, the flow was again determined from water level measurements and compared to previously measured patterns representative of different seasons. The final location of the well was determined by this comparison. The revised report will provide groundwater flow maps from various time periods to document variations (or the lack of) over time.

CH2M-Jones Response Clarification:

Groundwater flow maps will be prepared only if they provide assistance in understanding the site.

Comment 5:

Figures of buildings should include pertinent information as it relates to the nature of the SWMU or AOC. An example of this is SWMU 4, Pest Control. *"SWMU 4 consists of Building 381 which was built in 1980 to store various insecticides and rodenticides. Building 381 has a formulation and mixing room, equipment wash area, and sink and floor drains connected to the base sanitary sewer system. Pesticide storage at the facility was discontinued after 1985, and after this date the building was used for miscellaneous storage."* Upon close inspection of the work plan, it is apparent that only two soil samples have been taken close to the building. There is one side gradient monitoring well. Providing figures showing the layout of the building, the connection to the sanitary sewer system, where mixing and washing occurred, etc., is critical to understanding the assessment to date and the adequacy of the proposed assessment. The Navy should include pertinent information as it relates to the nature of each SWMU or AOC.

EnSafe Response 5:

This information will be presented in the final Zone F RFI report so the reviewers can determine the adequacy of the data collected.

CH2M-Jones Response Clarification:

Samples collected at each AOC or SWMU provide sufficient coverage of potential release areas within the site. If site samples indicate a release has occurred, further investigation of specific drain lines and other features is warranted.

Comment 6:

Building 1824 is described in the 29 April 1994 Draft EBS as being the Flammable and Hazardous Waste Storage Facility. There is no evidence that Building 1824 has been listed as a SWMU or an AOC. The Navy should address the status of this facility.

EnSafe Response 6:

During the 4/11/00 meeting, the Project Team reached consensus to include Building 1824 as a part of AOC 619.

CH2M-Jones Response Clarification:

Potential releases from Building 1824 have been sufficiently investigated in the AOC 619 RFI.

Comment 7:

There appears to be a break in the Sewer line near the Zone F boundary along side SWMU 4/AOC 619 and SWMU 36/AOC 620. The Navy should anticipate the effect of Sewer line repairs on groundwater flow in this area.

EnSafe Response 7:

The Navy agrees that this could affect future decisions regarding these sites but it does not change the interpretation of the data currently being used to characterize these sites.

CH2M-Jones Response Clarification:

No clarification.

Comment 8:

An Interim Measure was conducted at AOC 611 (former Hobby Shop). There are several issues regarding this IM that will need to be addressed before a final determination can be made.

- A. Confirmation sample analysis was only for PAH and RCRA Metals and not for the full range of potential contamination. This limited suite of analysis will complicate the use of the IM data in the RFI Report.
- B. PCB was determined to be a COC in the Draft RFI Report, however there were no reports of PCB analysis during the IM confirmation samples or in the waste characterization.
- C. PAH Confirmation samples 1, 2 and 3 were diluted (10x, 40x and 10x) as a result of matrix interference. How these elevated detection levels may compare with the RBC was not addressed in the Report.
- D. Confirmation sample location 2 (611-004) reported strong petroleum odor and the TPH analysis confirmed 28,500 ppm at the site.
- E. Maps and figures from the IM Report and the Work plan Addendum of the excavated area do not agree.

EnSafe Response 8:

The Navy agrees that the lack of PCB analyses may limit the usefulness of the IM data with respect to completing the RFI characterization. The Navy proposes that this issue be discussed at the February 2000 Project Team meeting where all of the nature and extent data currently available for this site will be presented in detail.

- A. This appears to be a deficiency in the IM work that was completed and it may have an impact on the RFI. As mentioned above, this issue should be discussed and a resolution agreed upon at the next Project Team meeting.
- B. The elevated TPH concentrations mentioned in Part D of this comment provide an indication that the matrix interference was most likely a result of one or more of the numerous constituents of which TPH is comprised that are not included on a standard Method 8270 analyte list. Situations such as this where an obvious petroleum release has occurred, yet no constituents are identified which drive risk requires a risk management decision from the team with respect to how the site should be addressed. The report will be revised to include a discussion of the data usefulness based on the conditions causing the matrix interference and the elevated reporting limits.
- C. This site is one of several where the remedial goals were based on the petroleum "indicator" compounds for which risk based cleanup goals have been established, not TPH. The Navy addressed these situations in detail in Appendix A of the *Zone C CMS Work Plan (EnSafe, June 23, 1998)*. The Project Team has yet to collectively decide how to deal with these situations. This matter should be resolved prior to attempting to submit the revised RFI report.
- D. The only figure in the work plan addendum that shows AOC 611 is Figure 6. The site boundary presented on this map represents the footprint of the former building, not the area of the IM excavation. The Project Team has agreed that the term "site boundary" should refer to the boundary of the site as it was described in the RFA which is going to be different from the boundary associated with the extent of contamination at a site. A map showing the extent of the IM excavation will be included as part of the revised RFI report.

As discussed during the April Project Team meeting, Dean Williamson drafted this definition of a site boundary:

The boundary of a site (SWMU or AOC) will be the larger of either:

- 1) the originally identified footprint in the RFA or
- 2) the extent of contamination linked to the activities conducted at the site

The "extent of contamination" is considered to "unrestricted land use" outside of Zone and for "restricted use" outside Zone E.

In cases where contamination is identified that may not be linked to the site, the team will make a case-by-case decision on how to delineate the site boundaries.

CH2M-Jones Response Clarification:

- A. *Additional samples are proposed to complete the delineation of contaminants identified during the initial phase of RFI sampling. IM data will also be used for this delineation.*
- B. *PCB samples are proposed within the native soil at the depth of the base of the IM.*
- C. *The reporting limits constitute the maximum potential concentrations of non-detected compound. If the BEQ is calculated using these elevated reporting limits as if they were actual detected concentrations, the BEQ concentration would be below the basewide background value, and is therefore not discernable from background conditions.*
- D. *Please refer to EnSafe's discussion in Response 8C.*
- E. *The IM area is shown in the Work Plan Addendum, Revision 1. Industrial "restricted" land use is considered for sites east of Hobson Avenue.*

Comment 9:

The work plan stated that Tetra Tech NUS will be performing a "Rapid Assessment" under supervision of the UST Program. UST programs typically work with virgin petroleum products. The Navy and contractor must be aware of the hazardous constituents present and conduct an adequate analytical assessment. Incomplete or partial analysis during the "Rapid Assessment" will require additional assessment.

EnSafe Response 9:

The Navy agrees with this comment. In most instances, additional samples analyzed for a broader range of parameters are collected under the RFI from the UST wells rather than simply relying on the data from those assessments. The intent of pointing out the UST wells is also to acknowledge there is a nearby source for petroleum that is likely unrelated to the site and should not be attributed to the site.

CH2M-Jones Response Clarification:

No clarification.

Comment 10:

The status and environmental conditions of all Oil Water Separators in this Zone must be considered. OWS have typically been assessed assuming virgin petroleum contaminants. The Navy must conduct an adequate analytical assessment of all OWS. Incomplete or partial analysis will require additional assessment.

EnSafe Response 10:

The Navy and EnSafe believe the revised RFI report will document the fact that the OWS have been adequately assessed.

CH2M-Jones Response Clarification:

OWS will be considered in the RFI report only if they are associated with an AOC or SWMU. Other means will be taken to assess OWS in other portions of Zone F.

Comment 11:

Data collected as part of the assessment of SWMU 37, AOC 699 and AOC 709 should be included in the data presentation.

EnSafe Response 11:

Site specific discussions in the revised RFI report are being revised to include all relevant data that contributes to the complete characterization of a site.

CH2M-Jones Response Clarification:

No clarification.

General Comments:

The Zone F RFI Work plan Addendum document addressed additional work needed to address nature and extent for the following sites:

- SWMU 4 and AOC 619
- SWMU 36 and AOC 620
- SWMU 109
- AOC 609
- AOC 611
- AOC 613, AOC 615, and SWMU 175

Comment 1:

Throughout the text of the document there are references to data that was used to determine the need for additional sampling locations to fill data gaps. A range of sampling result data was given instead of providing a table of all results. All data should have been included in the text.

EnSafe Response 1:

Please refer to the response to Bergstrand's comment #1.

CH2M-Jones Response Clarification:

It is not practical to present all data in the Work Plan Addendum. Data is provided to the project team in the EGIS.

Comment 2:

It is proposed that the soil data be reevaluated with respect to site specific SSL which may indicate that there are additional soil data gaps. This should have been evaluated prior to this document being finalized.

EnSafe Response 2:

The Navy and EnSafe informed SCDHEC of the decision to calculate site specific SSLs and discussions were held with the Department regarding methodology. We were told by SCDHEC that collection of samples necessary to calculate the site-specific SSLs did not need to be described in the work plan addendum. Because of this field work was started concurrently with the development of the work plan addendum. This information was not available by the time the work plan addendum was completed and the Navy does not intend to revise the work plan addendum to show the outcome of that evaluation with respect to identifying data gaps simply because the revised report will be submitted in a couple of weeks and it will thoroughly document that process.

CH2M-Jones Response Clarification:

Data gaps described in the Work Plan Addendum Revision 1 have been evaluated with respect to screening criteria, including site-specific SSLs

Comment 3:

The document indicates that additional screening results should be completed by mid-November. This information should have been completed and incorporated into this document in order that a final determination of appropriate sampling could be more closely achieved.

EnSafe Response 3:

Please refer to the response to comment #2 above.

CH2M-Jones Response Clarification:

No clarification.

Site Specific Comments:

SWMU 36 and AOC 620

The location of the proposed soil sampling location 620SB010 is not shown on the map. This is one of the proposed eastern sampling points from 620SB004.

EnSafe Response:

This sample location, as well as others required to complete the investigation, will be included on figures in the Final Zone F RFI report. After sample collection the locations will be surveyed, this is the actual location which will be shown on the Final Zone F RFI report figures.

CH2M-Jones Response Clarification:

All existing or proposed RFI sampling locations are provided on applicable maps in the Work Plan Addendum Revision I.

SWMU 109

Some of the contaminants exceeded RBC and/or background by very marginal amounts. Therefore, it is proposed that no additional sampling be done. No sampling data was provided. It is felt that further sampling should be made at these locations based upon the information as presented.

EnSafe Response:

The revised RFI report will delineate or provide the appropriate justification for not collecting additional samples.

CH2M-Jones Response Clarification:

The Work Plan Addendum provides appropriate justification for the decision of whether to collect additional samples.

AOC 609

As previously mentioned, the document states that soil sampling results would be reevaluated with respect to site-specific SSL's. This should have been done prior to the submittal of the document.

EnSafe Response:

Please refer to the response to comment #2 above.

CH2M-Jones Response Clarification:

No clarification

AOC 611

There was PCB contamination present at 611SB007. There is no further mention of this contamination. Did the interim removal address this and was this confirmed through sampling? The area of interim removal should have been indicated on the map.

EnSafe Response:

The Aroclor-1260 detected in the surface soil was from the 0-1 foot bgs interval. The IM soil removal included this location and removed soil to a depth of at least 1 foot bgs to remove PAHs and arsenic. The depth of the sample collection and of the excavation suggest that the PCBs should have been removed, although this was not confirmed. Confirmation samples were not analyzed for PCBs. The risk associated with the unexcavated sample was 1.7X-06.

CH2M-Jones Response Clarification:

The PCB was identified in a duplicate sample. Additional samples are proposed to evaluate if the IM adequately removed PCB-contaminated soil.

AOC 613:

There were slight exceedances of contaminant levels at 613SP008 and 613SP0036. The work plan does not propose additional sampling at these locations. Based on the information as presented, additional sampling is needed at these locations and any others in a similar situation.

EnSafe Response:

Limited additional sampling was performed in the area of 613SP008 and the results will be included in the Final Zone F RFI. The focus of the investigation is the facilities and activities associated with the former Building 1169 (service pits and oil water separator) and the crane painting area. The areas described as requiring additional sampling are removed from these potential sources and most likely represent anthropogenic background conditions so additional delineation sampling was not performed. Data to support this belief will be presented in the revised report.

CH2M-Jones Response Clarification:

With the exception of arsenic, the contaminant levels identified at 613SP008 were below industrial (restricted) land use RBCs or were less than Zone F background values. Arsenic was detected at 20.2 mg/kg (within 2 percent of the Zone F background level, and below the adjacent Zone E background level). Arsenic occurrences at AOC 613/615/175 are sporadic and not indicative of a release from the AOC.

Sample LF037SP027 effectively delineated any contaminants identified at 613SP036.

APPENDIX D

**SCDHEC No Further Action
Correspondence for Site 24 (AOC 609)**



9 March 2000

2600 Bull Street
Columbia, SC 29201-1708

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Larry R. Cheaning, Jr., DMD

Department of the Navy
Southern Division NFEC*
P.O. Box 190010
North Charleston, SC 29419-9010
Attention: Mr. Gabriel Magwood

Re: Final Assessment Report dated 07 February 2000
Zone F/Site 24-Building NS 1346 (Site Identification # 01782)
Charleston Naval Complex/Charleston Naval Base
Charleston, SC
Charleston County

Dear Mr. Magwood:

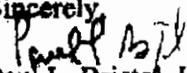
The author has completed technical review of the referenced document. As submitted, the report provides a narrative describing previous assessment activities and analytical results from additional sampling conducted to determine the environmental fate of suspected contamination at the subject property. The analytical results provided indicate that reportable concentrations of BTEX, PAH and metal compounds were detected above established method detection limits in soil and/or groundwater samples obtained at the subject site. The reported compounds are at a concentration(s) which is at or below the RBSL (Risk-Based Screening Levels, SCDHEC *Risk-Based Corrective Action for Petroleum Releases*, 5 January 1998), proposed RBC (Risk-Based Concentrations for Residential Soils, EPA Region III Risk-Based Concentrations Table, 12 April 1999) and established groundwater MCLs (maximum contaminant levels). Based on the analytical results presented and description of site specific geology/hydrogeology, potential releases, if any, from previous activities at the subject site do not appear to present a significant threat to human health and/or the environment at the present time. In this regard, the employed assessment activities and sampling results appear to indicate that no additional endeavors for remedial actions and/or contaminant characterization is warranted for the Zone F/Site 24-Building NS 1346 area at this time.

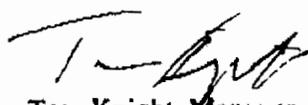
With consideration to the above comments, the Department has reviewed the referenced environmental data. Based on the information and analytical data submitted, the Department recognizes that the Department of the Navy and Charleston Naval Complex has adequately addressed the known environmental contamination identified on the property to date in accordance with the approved scope of work. Please note, this statement pertains only to the portion of the site addressed in the referenced report and does not apply to other areas of the site and/or any other potential regulatory violations. Further, the Department retains the right to request further investigation if deemed necessary.

Charleston Naval Complex/Charleston Naval Base
9 March 2000
page 2

Should you have any questions please contact me at (803) 898-3559.

Sincerely,


Paul L. Bristol, Hydrogeologist
Groundwater Quality Section
Bureau of Water


Tom Knight, Manager
Groundwater Quality Section
Bureau of Water

cc: Trident District EQC