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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT  
ADDENDUM AREA OF CONCERN 580 (AOC 508) ZONE E CNC CHARLESTON SC  
6/4/2002  
CH2M HILL

# RFI REPORT ADDENDUM

## Area of Concern 580, Zone E



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

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

*CH2M-Jones*

*May 2002*

Contract N62467-99-C-0960

CH2M HILL

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**CH2MHILL**

June 4, 2002

Mr. David Scaturro  
South Carolina Department of Health and  
Environmental Control  
Bureau of Land and Waste Management  
2600 Bull Street  
Columbia, SC 29201

Re: RFI Report Addendum (Revision 1) – AOC 580, Zone E

Dear Mr. Scaturro:

Enclosed please find two sets of replacement pages which serve as Revision 1 of the RFI Report Addendum for AOC 580 in Zone E of the Charleston Naval Complex (CNC). Below is a summary of the material enclosed with this letter:

- Revision 1 text and table to replace text and table in the Revision 0 RFI Report Addendum for AOC 580, Zone E, submitted by CH2M-Jones in April 2002.
- New Appendix D divider page and material to be inserted in the back of the original Revision 0 RFI Report Addendum 3-ring binder.
- Revision 1 covers/spines and flysheets to replace those in the original Revision 0 RFI Report Addendum 3-ring binder.

This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Kris Garcia. Please contact her at 770/604-9182, extension 476, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Rob Harrell/Navy, w/att  
Gary Foster/CH2M HILL, w/att  
Tim Frederick/Gannett-Fleming, Inc.



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April 24, 2002

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South Carolina Department of Health and  
Environmental Control  
Bureau of Land and Waste Management  
2600 Bull Street  
Columbia, SC 29201

Re: RFI Report Addendum (Revision 0) – AOC 580, Zone E

Dear Mr. Scaturo:

Enclosed are two copies of the RFI Report Addendum (Revision 0) for AOC 580 in Zone E of 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.

The principal author of this document is Kris Garcia. Please contact her at 770/604-9182, extension 476, should you have any questions or comments.

Sincerely,

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Rob Harrell/Navy, w/att  
Gary Foster/CH2M HILL, w/att

RFI REPORT ADDENDUM

**Area of Concern 580, Zone E**



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

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

PREPARED BY  
***CH2M-Jones***

*May 2002*

Revision 1  
Contract N62467-99-C-0960  
158814.ZE.PR.12

## Certification Page for RFI Report Addendum (Revision 0) – AOC 580, Zone E

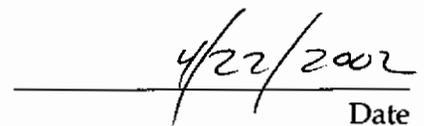
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.



Date

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# 1 **Acronyms and Abbreviations**

---

2	AOC	Area of concern
3	AST	Aboveground storage tank
4	BCT	BRAC Cleanup Team
5	BEQ	Benzo(a)pyrene equivalent
6	BRAC	Base Realignment and Closure Act
7	BRC	Background reference concentration
8	CA	Corrective action
9	CCA	Copper-chromium-arsenic
10	CNC	Charleston Naval Complex
11	CNS	Central nervous system
12	COC	Chemical of concern
13	COPC	Chemical of potential concern
14	DAF	Dilution attenuation factor
15	EnSafe	EnSafe Inc.
16	EPA	U.S. Environmental Protection Agency
17	ft bls	Feet below land surface
18	GI	Gastrointestinal
19	HHRA	Human health risk assessment
20	HI	Hazard index
21	IM	Interim measure
22	LUC	Land use control
23	MCL	Maximum contaminant level
24	µg/L	Micrograms per liter
25	mg/kg	Milligrams per kilogram
26	NAVBASE	Naval Base
27	NFA	No further action
28	OWS	Oil/water separator
29	RBC	Risk-based concentration
30	RCRA	Resource Conservation and Recovery Act

# 1 **Acronyms and Abbreviations, Continued**

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2	RFI	RCRA Facility Investigation
3	SCDHEC	South Carolina Department of Health and Environmental Control
4	SSL	Soil screening level
5	SVOC	Semivolatile organic compound
6	SWMU	Solid waste management unit
7	TDS	Total dissolved solids
8	VOC	Volatile organic compound
9	UST	Underground storage tank



# 1 1.0 Introduction

---

2 In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for  
3 closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates  
4 closure and transition of property to the community. The Charleston Naval Complex (CNC)  
5 was formed as a result of the dis-establishment of the Charleston Naval Shipyard and  
6 NAVBASE on April 1, 1996.

7 Corrective Action (CA) activities are being conducted under the Resource Conservation and  
8 Recovery Act (RCRA) with the South Carolina Department of Health and Environmental  
9 Control (SCDHEC) as the lead agency for CA activities at the CNC. All RCRA CA activities  
10 are performed in accordance with the Final Permit (Permit No. SC0 170 022 560).

11 In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation  
12 and remediation services at the CNC. This submittal has been prepared by CH2M-Jones to  
13 complete the RCRA Facility Investigation (RFI) for Area of Concern (AOC) 580 in Zone E of  
14 the CNC. The site is recommended for No Further Action (NFA) for soils and groundwater.  
15 Figures 1-1 and 1-2 illustrate the location of Zone E and the site in the CNC.

## 16 1.1 Background

17 AOC 580, a former pattern and electric shop, was historically located in Building 10. Built in  
18 1918, it was used until 1935 as a pattern and storage shop. From 1935 until 1955, this unit  
19 was used as a pattern and electric shop. In the early 1980s the building became the office for  
20 the Nuclear Engineering Department. No information could be found regarding the  
21 operating practices of this facility. In November 2001, a site inspection revealed that the  
22 building is currently out of use and has been closed and locked.

23 Based on review of historical public works maps, railroad lines historically passed along the  
24 north sides of Building 10 (see Figure 1-3). In addition, one railroad line extended into the  
25 building through the western wall and was present at least until 1935, but is no longer  
26 present in the 1937 public works map. The exterior railroad lines appear to have remained  
27 in service at least until 1955, but were no longer present in the 1962 public works maps.

28 Little information could be found regarding the design, operating practices, and waste  
29 disposal methods associated with the facility.

1 Materials of concern identified in the *Final Zone E RFI Work Plan* (EnSafe Inc. [EnSafe],  
2 1995b) include degreasers and solvents. Potential receptors that may be exposed to site  
3 contaminants include current and future building users and any site workers this area may  
4 support.

5 This site is zoned M-2, for industrial land use, and will likely be used for non-residential  
6 purposes.

## 7 **1.2 Purpose of the RFI Report Addendum**

8 This report addendum provides information about AOC 580, including the conclusions  
9 from the *Zone E RFI Report, Revision 0* (EnSafe, 1997), and provides the results of additional  
10 sampling performed after the *Zone E RFI Report, Revision 0* was issued. The results of an  
11 additional investigation are presented herein to further assess specific chemicals of  
12 potential concern (COPCs). AOC 580 is recommended for NFA.

13 Prior to changing the status of any site in the CNC RCRA CA permit, the BRAC Cleanup  
14 Team (BCT) agreed that the following issues should be considered:

- 15 • Status of the RFI
- 16 • Presence of metals (inorganics) in groundwater
- 17 • Potential linkage to Solid Waste Management Unit (SWMU) 37, Investigated Sanitary  
18 Sewers at the CNC
- 19 • Potential linkage to AOC 699, Investigated Storm Sewers at the CNC
- 20 • Potential linkage of AOC 504, Investigated Railroad Lines at the CNC
- 21 • Potential linkage to surface water bodies (Zone J)
- 22 • Potential contamination associated with oil/water separators (OWSs)
- 23 • Relevance or need for land use controls (LUCs) at the site

24 Information regarding these issues is provided in Section 6.0 of this report addendum to  
25 expedite evaluation of closure of the site.

## 26 **1.3 Report Organization**

27 This RFI Report Addendum consists of the following sections, including this introductory  
28 section:

29 **1.0 Introduction** – Presents the purpose of the report and background information relating  
30 to the RFI Report Addendum.

1 **2.0 Summary of RFI Conclusions for AOC 580** – Summarizes the conclusions from the RFI  
2 field investigations and risk evaluations for AOC 580.

3 **3.0 Interim Measures and UST/AST Removals** – Provides information regarding any  
4 interim measures (IMs) or any underground storage tank (UST) or aboveground storage  
5 tank (AST) removal activities performed at the site.

6 **4.0 Summary of Additional Investigations** – Summarizes information collected after  
7 completion of the *Zone E RFI Report, Revision 0*.

8 **5.0 COPC/COC Refinement** – Provides further evaluation of COPCs based on the RFI  
9 Report and additional data to assess them as chemicals of concern (COCs).

10 **6.0 Summary of Information Related to Site Closeout Issues** – Discusses the various site  
11 closeout issues that the BCT agreed to evaluate prior to site closeout.

12 **7.0 Conclusions and Recommendations** – Provides recommendations for proceeding with  
13 closeout of AOC 580.

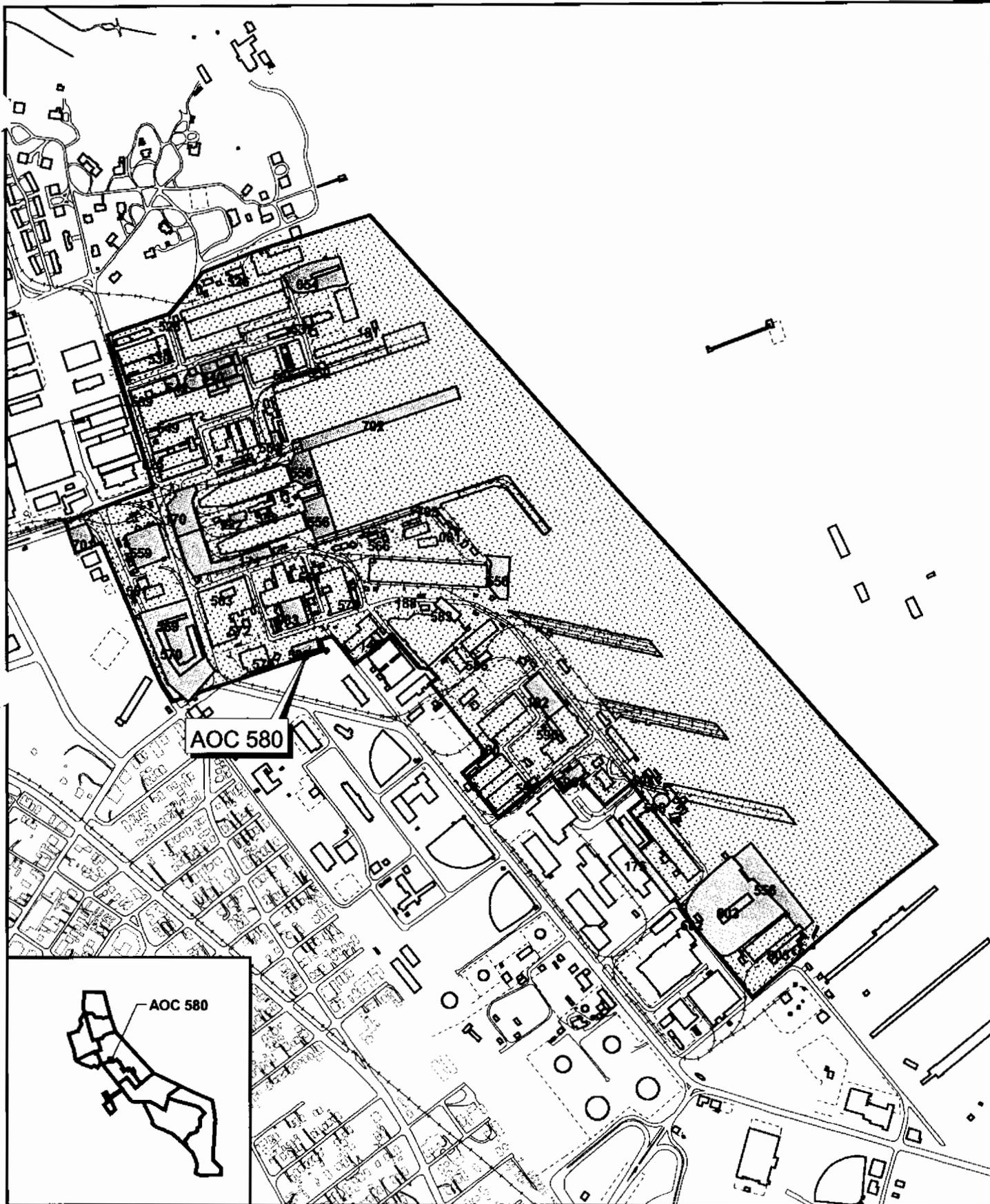
14 **8.0 References** – Lists the references used in this document.

15 **Appendix A** contains analytical data from *Zone E RFI Report, Revision 0*.

16 **Appendix B** contains the analytical results and data validation report for the additional  
17 sampling performed at AOC 580 in January 2002.

18 **Appendix C** contains responses to comments on the *Zone E RFI Report, Revision 0*.

19 All tables and figures appear at the end of their respective sections.



AOC 580

AOC 580

-  Zone E Boundary
-  SWMU/AOC Within Zone E Boundary

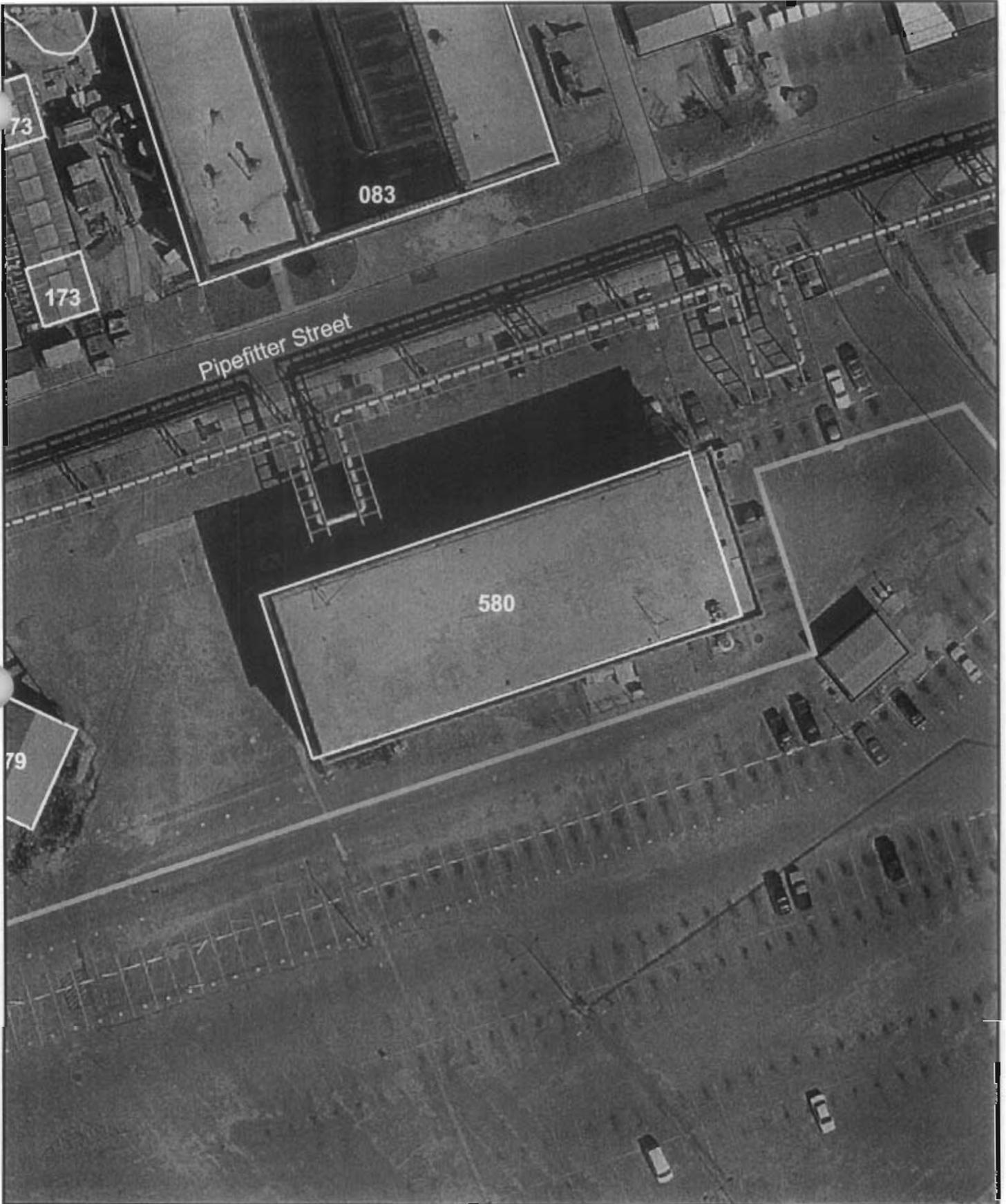


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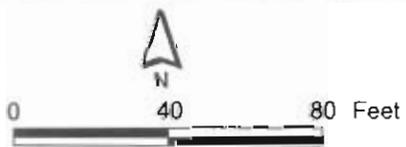


1 inch = 800 feet

**Figure 1-1**  
 Zone E Within CNC  
 AOC 580, Zone E  
 Charleston Naval Complex



-  AOC/SWMU Boundary
-  Zone Boundary



1 inch = 50 feet

**Figure 1-2**  
 Site Map  
 AOC 580, Zone E  
 Charleston Naval Complex





## 1 **2.0 Summary of RFI Conclusions for AOC 580**

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2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted at AOC 580, which were reported in the *Zone E RFI Report,*  
4 *Revision 0*, (EnSafe, 1997). Figure 2-1 presents the site features and RFI soil sample locations.  
5 Figure 2-2 shows monitoring well locations.

6 The *Zone E RFI Report, Revision 0* conclusions related to soils are summarized in Section 2.1;  
7 conclusions related to groundwater are summarized in Section 2.2. Further evaluation of  
8 soil and groundwater COPCs is provided in Section 5.0.

### 9 **2.1 Soil Sampling and Analysis**

10 Two soil sampling events were conducted in September 1995 and September 1996. In the  
11 first event, a total of six surface (0 to 1 feet below land surface [ft bls]) soil samples  
12 (E580SB001 through E580SB006) and six subsurface (3 to 5 ft bls) soil samples (E580SB001  
13 through E580SB006) were collected. During this first sampling event, all surface and  
14 subsurface soil samples were analyzed for volatile organic compounds (VOCs), semivolatile  
15 organic compounds (SVOCs), and metals.

16 During the second sampling event, three surface and three subsurface soil samples were  
17 collected at locations E580SB007 through E580SB009. These samples were analyzed for  
18 SVOCs and metals. In the *Zone E RFI Report, Revision 0*, the results of surface soil analyses  
19 were compared to U.S. Environmental Protection Agency (EPA) Region III residential and  
20 industrial risk-based concentrations (RBCs) and generic soil-to-groundwater migration soil  
21 screening levels (SSLs) with dilution attenuation factors (DAF) of 10 and 1. The soil data  
22 were also evaluated to assess the potential of soil contamination to migrate into surface  
23 water and air.

24 The evaluation also included a comparison of inorganic constituents to Zone E background  
25 reference concentrations (BRCs) for surface and subsurface soil.

26 Analytes that exceeded the screening criteria were considered to be COPCs in the RFI and  
27 were retained for further evaluation in the risk assessment to determine which were  
28 considered COCs. Analytical results from all constituents detected soil and groundwater  
29 samples collected during the RFI are included in Appendix A of this RFI Report  
30 Addendum.

### 1 **2.1.1 Surface Soil Results**

2 The *Zone E RFI Report, Revision 0* (Section 10.40.7) presented the following conclusions  
3 regarding the surface soil samples collected and analyzed at AOC 580:

- 4 • Benzo(a)pyrene equivalents (BEQs), arsenic, antimony, copper, lead manganese and  
5 vanadium were identified as COCs in the surface soils.

### 6 **2.1.2 Subsurface Soil Results**

7 The RFI Report (Sections 10.40.5.1 and 10.40.5.2) evaluated the analytical results for the soil  
8 to groundwater pathway and the soil to groundwater to surface pathways for subsurface  
9 soil using BRCs, SSLs, and, as needed, surface water dilution factors. Based on this  
10 evaluation, no COPCs were identified in subsurface soil.

## 11 **2.2 Groundwater**

12 Two shallow (approximately 13 ft bls) and one deep (approximately 27 to 30 ft bls)  
13 groundwater monitoring wells were installed during the RFI and sampled in four sampling  
14 events. The monitoring wells were formerly designated as NBCE580001, NBCE580001D,  
15 and NBCE580002 and are currently designated as E580GW001, E580GW001D, and  
16 E580GW002 (see Figure 2-2). Analytes detected in both the shallow wells and the deep well  
17 for the four sampling events are presented in Appendix A.

18 Shallow groundwater in the vicinity of AOC 580 generally flows northeast toward Dry  
19 Dock 5 (see Figure 2-3). There is a small localized groundwater depression beneath Building  
20 10, but groundwater ultimately flows regionally toward the Cooper River.

21 Four groundwater sampling events were conducted between April 1996 and January 1997.  
22 The groundwater samples were analyzed for VOCs, SVOCs, metals, chlorides, sulfates, and  
23 total dissolved solids (TDS) during the first sampling event and for metals, only, during  
24 subsequent sampling events. The first sampling event (April 1996) is reported and  
25 discussed in the groundwater nature and extent section (Section 10.40.3) of the *Zone E RFI*  
26 *Report, Revision 0*. Data from subsequent sampling events (July 1996, November 1996, and  
27 January 1997) were not included in the nature and extent section of the RFI Report, but were  
28 reviewed and incorporated into the risk assessment. These results are evaluated in the RFI  
29 Report Fate and Transport and Risk sections (Sections 10.40.5 and 10.40.6 of the RFI Report,  
30 respectively).

31 The screening criteria for groundwater included EPA Region III tap water RBCs and  
32 maximum contaminant levels (MCLs), plus, for inorganics, Zone E groundwater BRCs. The

1 discussion on the nature and extent of contamination in groundwater (*Zone E RFI Report,*  
2 *Revision 0, Section 10.40.4*), based on the results of the first groundwater sampling event,  
3 indicated that several VOCs, SVOCs, and metals were detected in groundwater samples.

#### 4 **2.2.1 Shallow Groundwater**

5 The results of the screening of the shallow groundwater analytical results from the first  
6 sampling event were presented in the RFI Report in Tables 10.40.4.1 and 10.40.4.2.

7 Constituents detected from all four sampling events are included in Appendix A of this  
8 report.

9 Only one VOC, methyl ethyl ketone (2-butanone), was detected in the first sampling event,  
10 at a concentration of 4 micrograms per liter ( $\mu\text{g/L}$ ), which did not exceed any of the  
11 screening criteria. No SVOCs were detected in shallow groundwater samples.

12 Fourteen metals were detected in shallow groundwater, but none exceeded their respective  
13 screening criteria.

14 The human health risk assessment (HHRA) did not identify any COCs in shallow  
15 groundwater (*Zone E RFI Report, Revision 0, Section 10.40.7*).

#### 16 **2.2.2 Deep Groundwater**

17 Screening of deep groundwater from the first sampling event was presented in the RFI  
18 Report Table 10.40.4.3. Constituents detected from all four sampling events are included in  
19 Appendix A of this report. No VOCs or SVOCs were detected in deep groundwater  
20 samples.

21 Twelve metals were detected in deep groundwater, and arsenic, iron and manganese  
22 exceeded their respective screening criteria. Based on the human health risk assessment,  
23 arsenic and manganese were identified as COCs in deep groundwater at AOC 580 (*Zone E*  
24 *RFI Report, Revision 0, Section 10.40.7*).

### 25 **2.3 COPC/COC Summary**

#### 26 **2.3.1 Soils**

27 The *Zone E RFI Report, Revision 0* concluded that, based on the analytical results and the  
28 human health risk assessment, the following COCs were identified for surface soils at AOC  
29 580, based on a future unrestricted (residential) land use scenario:

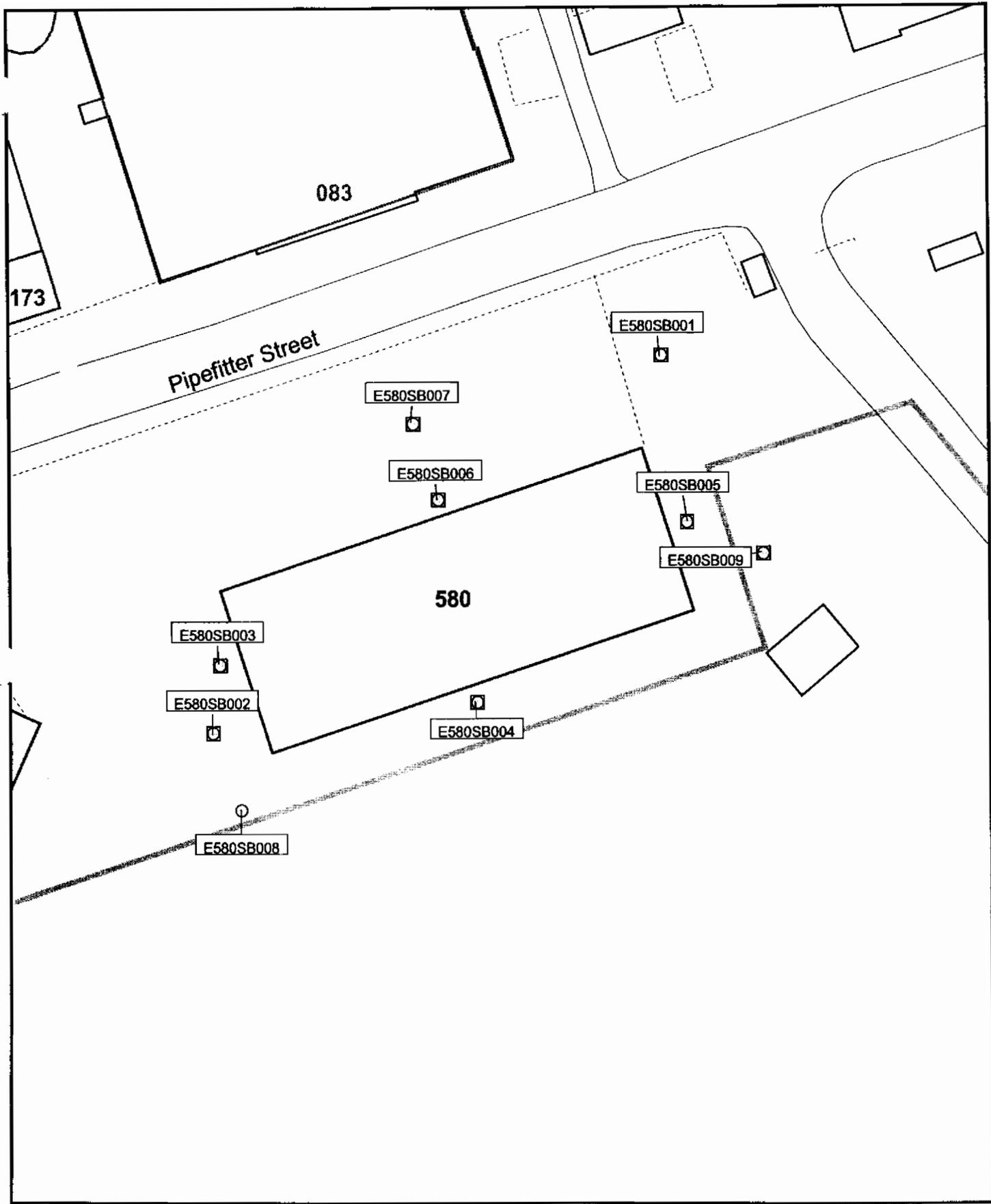
- 30 • Antimony

- 1 • Arsenic
- 2 • Copper
- 3 • Lead
- 4 • Manganese
- 5 • Vanadium
- 6 • BEQs

7 No constituents were identified as COCs under an industrial land use (site worker)  
8 scenario. No COCs were identified for subsurface soils at AOC 580.

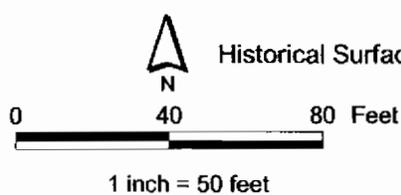
### 9 **2.3.2 Groundwater**

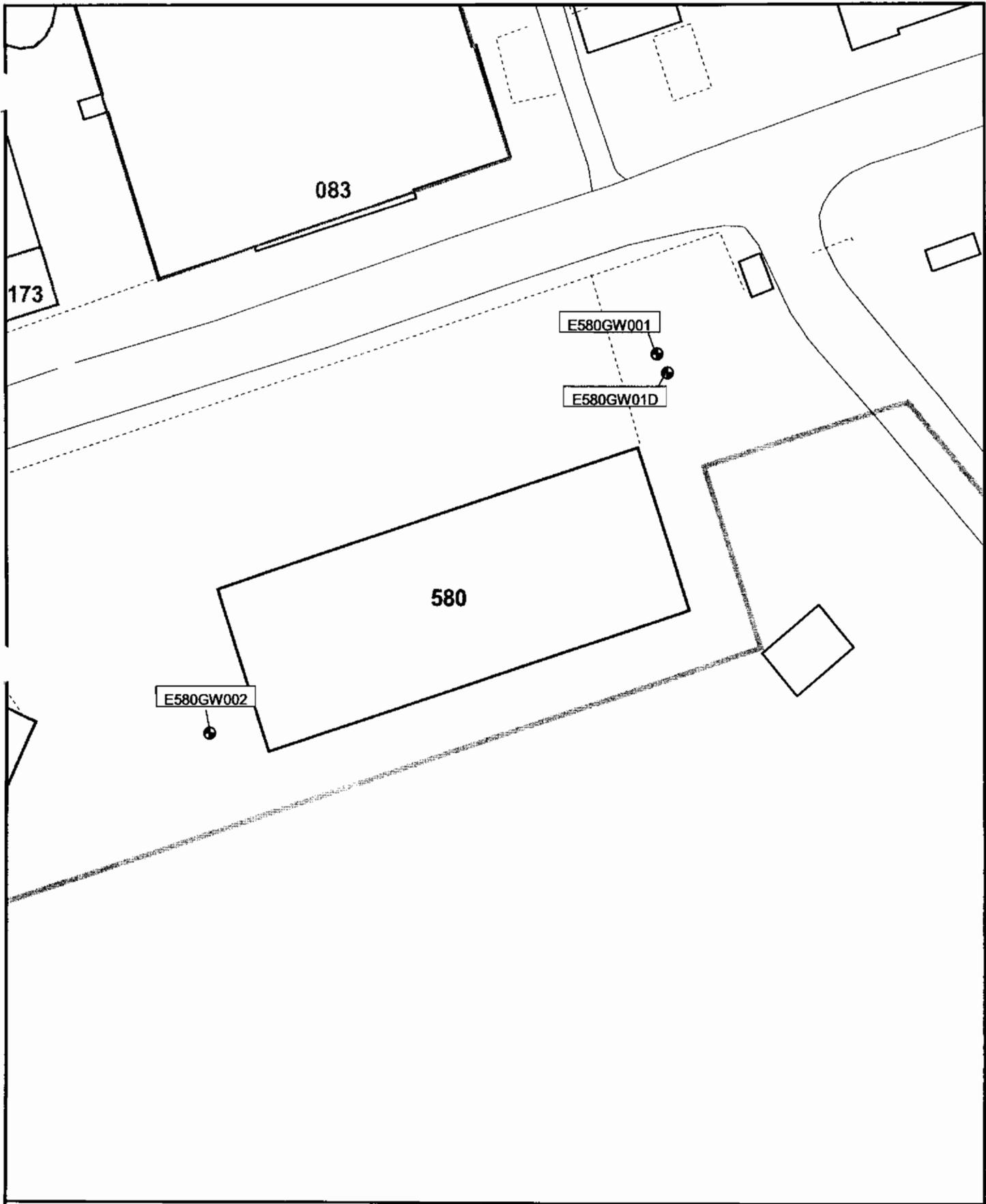
10 No COCs were identified for shallow groundwater. Arsenic and manganese were identified  
11 as COCs for deep groundwater during the RFI.



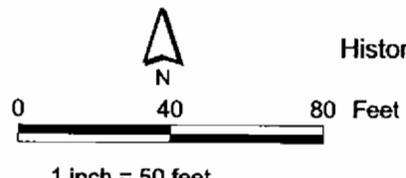
**Figure 2-1**  
 Historical Surface and Subsurface Soil Sample Location Map  
 AOC 580, Zone E  
 Charleston Naval Complex

- Surface Soil Sample
- Subsurface Soil Sample
- - - Fence
- Roads
- AOC Boundary
- Buildings
- ⋯ SWMU Boundary
- ▨ Zone Boundary

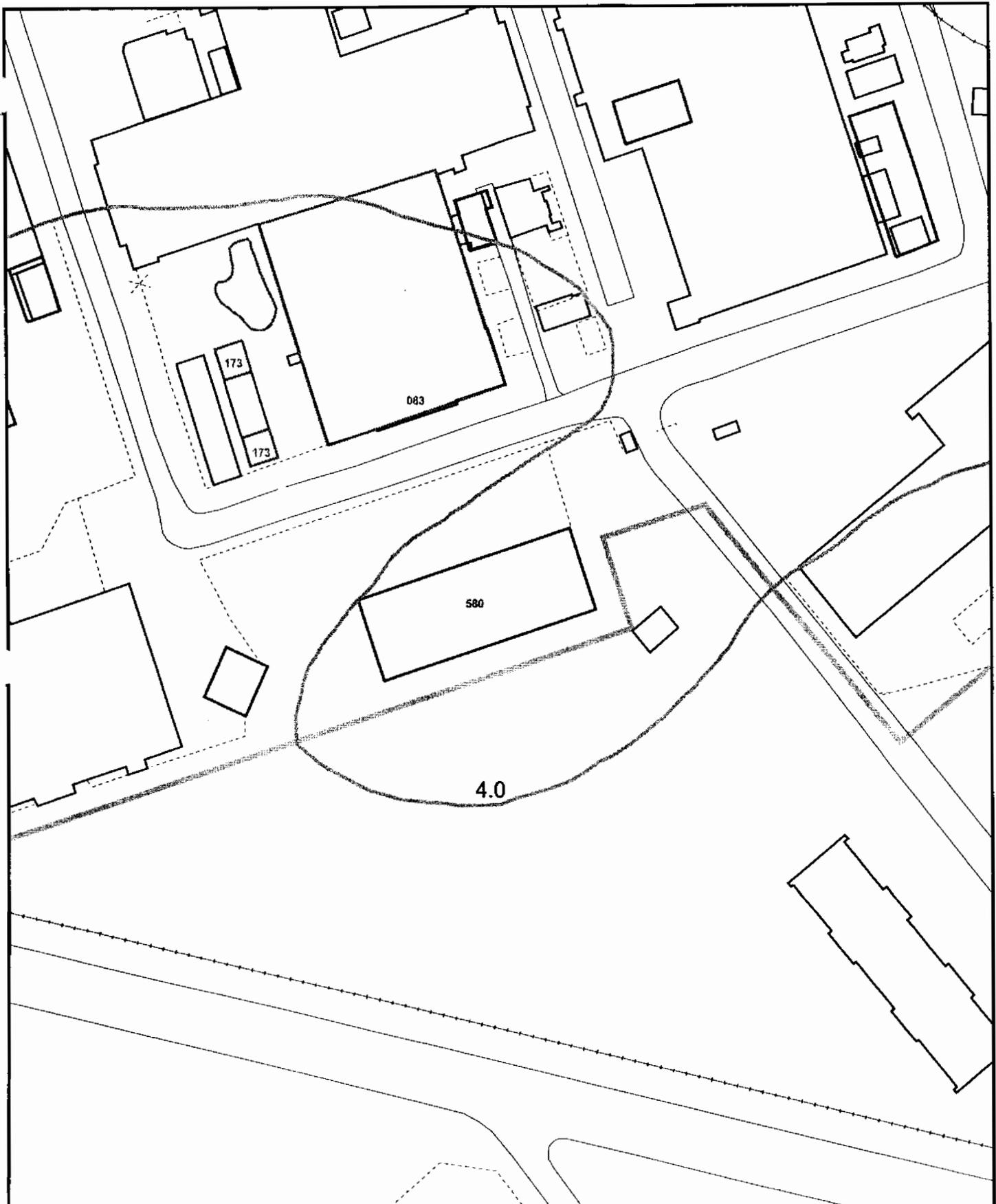




- Groundwater Sample
- - - Fence
- ≡ Roads
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings
- - - Zone Boundary

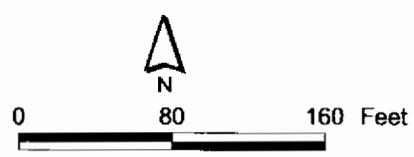


**Figure 2-2**  
 Historical Groundwater Sample Location Map  
 AOC 580, Zone E  
 Charleston Naval Complex



**Figure 2-3**  
 Shallow Groundwater Contours  
 AOC 580, Zone E  
 Charleston Naval Complex

- known
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary





## 1 **3.0 Interim Measures and UST/AST Removals**

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- 2 There are no known USTs or ASTs associated with AOC 580. No IMs have been conducted
- 3 at AOC 580 to date.



## 1 **4.0 Summary of Additional Investigations**

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2 In January 2002, additional field activities were conducted in the vicinity of AOC 580 by the  
3 CH2M-Jones team to complete the delineation of the nature and extent of specific  
4 constituents detected in the surface and subsurface soils. The field activities were conducted  
5 in accordance with the *Areas of Concern 579 and 580 Sampling and Analysis Plan, Revision 0*  
6 (CH2M-Jones, 2001).

7 As part of this effort, a total of seven additional surface soil and subsurface soil samples  
8 were collected and analyzed. Four pairs of surface/subsurface soil samples were analyzed  
9 for arsenic, two pairs were analyzed for antimony and five pairs were analyzed for lead (see  
10 Table 4-1). The locations of the additional samples are shown in Figure 4-1. The analytical  
11 data and data validation summary report for these samples are presented in Appendix B of  
12 this RFI Report Addendum.

13 Although soil samples collected from the 0 to 1 ft bls interval are referred to as surface soil  
14 samples, most of the surrounding area is paved with asphalt, with the exposed soil limited  
15 to a small overgrown landscaped grass strip located along the southwestern corner of  
16 Building 10. All surface soil sample locations were sited in paved areas. Thus, surface soils  
17 are primarily representative of the soils beneath the asphalt pavement. There is very limited  
18 direct access for contact (ingestion and dermal) or leachability potential for the constituents  
19 reported around AOC 580 at the present time. The screening criteria used to identify COPCs  
20 represent a conservative analysis for future human health protection in the event that the  
21 asphalt cover is removed.

22 Surface soil sampling results were screened against EPA Region III residential RBCs (using  
23 a hazard index [HI]=0.1 for non-carcinogens) and the generic soil-to-groundwater SSLs  
24 (DAF=1 for VOCs, DAF=10 for all other parameters). Results for inorganic constituents  
25 were also compared to the range of these chemical concentrations detected in surface soil  
26 samples collected at grid locations in Zone E.

27 Similarly, subsurface soil results were compared to SSLs and the range of detections for  
28 inorganic constituents detected in subsurface soil samples collected at grid locations in  
29 Zone E.

## 1 **4.1 Surface Soil Results**

2 The analytical results for the surface soil samples collected in January 2002 are presented in  
3 Table 4-2. Values that exceed the COPC screening criteria are in bold text and outlined in  
4 the table. Each of these COPCs is discussed briefly below and in more detail in Section 5.0.

### 5 **4.1.1 Antimony in Surface Soil**

6 Antimony was not present at detectable concentrations in either of the surface soil samples  
7 collected at AOC 580.

### 8 **4.1.2 Arsenic in Surface Soil**

9 Arsenic was detected in all four surface soil samples at concentrations ranging from  
10 17.6 milligrams per kilogram (mg/kg) to 24.2 mg/kg. Arsenic concentrations in all four of  
11 these samples were within the Zone E background range of 0.95 to 68 mg/kg.

### 12 **4.1.3 Lead in Surface Soil**

13 Lead was detected in all five of the surface soil samples collected at AOC 580 in  
14 concentrations ranging from 102 to 1,240 mg/kg. Only the lead concentration reported at  
15 E580SB016 (1,240 J mg/kg) exceeded the EPA screening level for residential land use of 400  
16 mg/kg. The estimated concentration of lead in E580SB016 is approximately equal to the  
17 industrial worker exposure value of 1,218 mg/kg developed for the CNC project (CH2M-  
18 Jones, 2001).

## 19 **4.2 Subsurface Soil Results**

20 The analytical results for the additional subsurface soil samples collected in 2002 are  
21 presented in Table 4-3. Values that exceed the COPC screening criteria are in bold text and  
22 outlined in the table.

### 23 **4.2.1 Antimony in Subsurface Soil**

24 Antimony was not present at detectable concentrations in either of the subsurface soil  
25 samples collected at AOC 580.

### 26 **4.2.2 Arsenic in Subsurface Soil**

27 Arsenic was detected in all four subsurface soil samples at concentrations ranging from  
28 17.6 to 24.2 mg/kg. Arsenic concentrations in all four of these samples were within the  
29 Zone E background range of 0.83 to 26 mg/kg.

1 **4.2.3 Lead in Subsurface Soil**

2 Lead was detected in all five subsurface soil samples at concentrations ranging from 48.7 J  
3 to 2,530 mg/kg. Lead concentrations in only one sample exceeded the Zone E background  
4 range of 1.8 to 322 mg/kg. This same sample also exceeded the SSL value of 400 mg/kg.

5 Each of these metals, as well as other COCs identified in the *Zone E RFI Report, Revision 0*  
6 are discussed in Section 5.0 of this RFI Report Addendum.

**TABLE 4-1**  
Additional Sample Summary  
*RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex*

<b>Sample Location</b>	<b>Analytes</b>
E580SB010	Arsenic
E580SB011	Arsenic
E580SB012	Antimony Arsenic Lead
E580SB013	Antimony Arsenic Lead
E580SB014	Lead
E580SB015	Lead
E580SB016	Lead

**TABLE 4-2**  
 Surface Soil Analytical Results - Additional Investigation, 2002  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Antimony		Arsenic		Lead	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			<b>Res RBC</b>	3.1	0.43		400	
			<b>Ind RBC</b>	82	3.8		1,218	
			<b>SSL</b>	2.5	14.5		400	
			<b>Bkgd-SS</b>	7.4	68		400	
E580SB010	580SB01001	01/14/2002		NS	5.6	=	NS	
E580SB011	580SB01101	01/14/2002		NS	7.78	=	NS	
E580SB012	580SB01201	01/14/2002		0.799	UJ	=	102	J
E580SB013	580SB01301	01/14/2002		0.671	UJ	=	136	J
E580SB014	580SB01401	01/14/2002		NS	NS		348	J
E580SB015	580SB01501	01/14/2002		NS	NS		140	J
E580SB016	580SB01601	01/14/2002		NS	NS		<b>1,240</b>	J

Concentrations in bold and outlined with the table indicate an exceedance of the screening criteria.

mg/kg = Milligrams per kilogram

NA = Not Applicable

NS = Not Sampled

J = Indicates that the concentration reported is estimated.

UJ = Indicates that samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL), the concentration reported is estimated.

**TABLE 4-3**  
 Subsurface Soil Analytical Results - Additional Investigation, 2002  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Antimony		Arsenic		Lead		
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	
			<b>SSL</b>	2.5		14.5		400	
			<b>Bkgd - SB</b>	1.6		26		322	
E580SB010	580SB01002	01/14/2002		NS		24.2	=	NS	
E580SB011	580SB01102	01/14/2002		NS		22.6	=	NS	
E580SB012	580SB01202	01/14/2002		0.95	UJ	17.6	=	59.8	J
E580SB013	580SB01302	01/14/2002		0.08	UJ	19	=	67.3	J
E580SB014	580SB01402	01/14/2002		NS		NS		2,530	J
E580SB015	580SB01502	01/14/2002		NS		NS		49.3	J
E580SB016	580SB01602	01/14/2002		NS		NS		48.7	J

Concentrations in bold and outlined with the table indicate an exceedance of the screening criteria.

mg/kg = Milligrams per kilogram

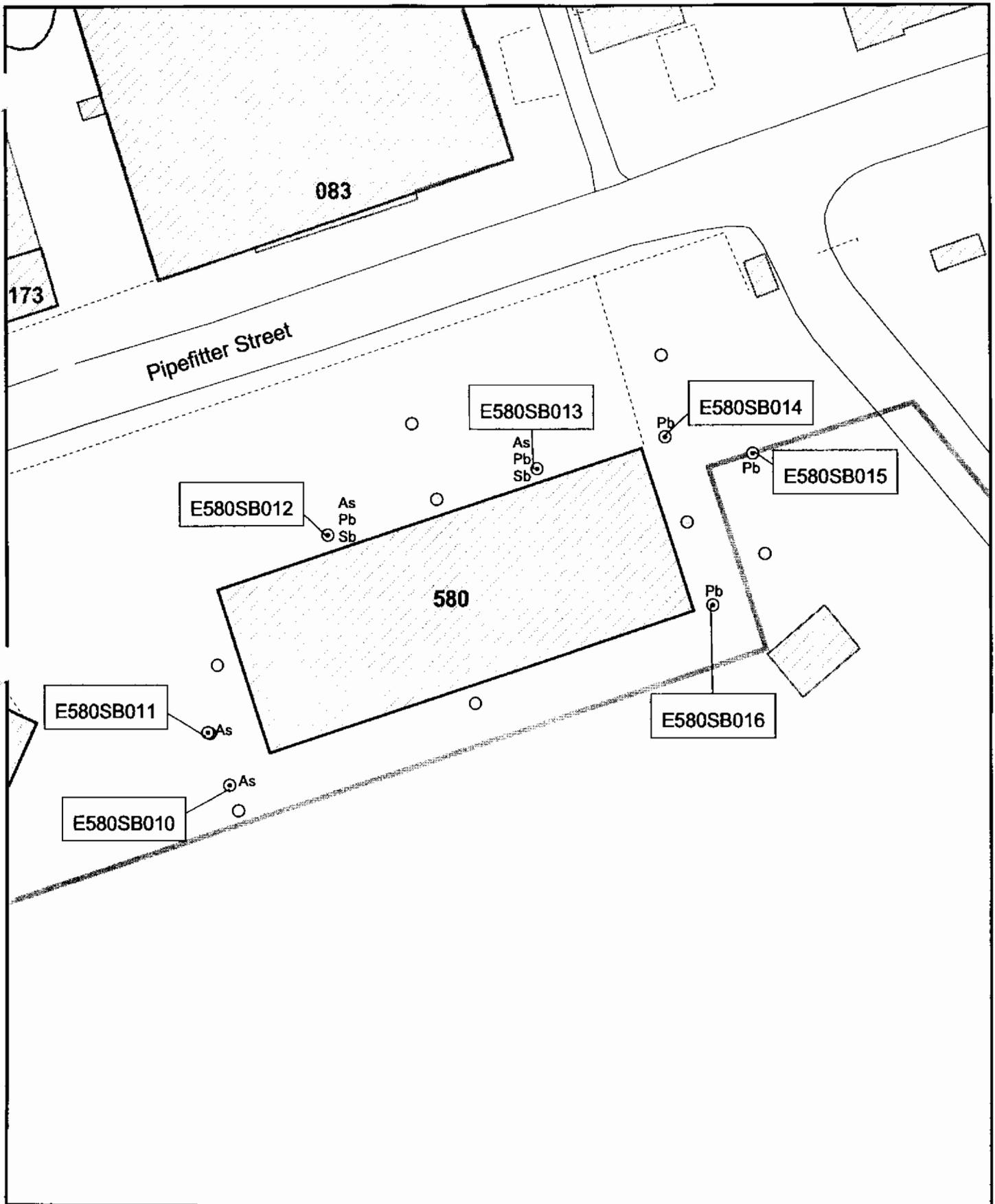
NA = Not Applicable

NS = Not Sampled

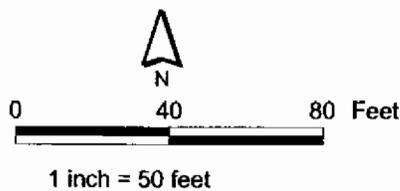
= Indicates that the analyte was detected at the concentration shown.

J = Indicates that the concentration reported is estimated.

UJ = Indicates that the analyte was not detected, the concentration reported is estimated.



- ⊙ Additional Soil Sample
- Soil Sample
- - - Fence
- ≡ Roads
- ▭ AOC Boundary
- ▭ Buildings
- ▭ SWMU Boundary
- ▭ Zone Boundary



**Figure 4-1**  
 Additional Soil Sample Locations  
 AOC 580, Zone E  
 Charleston Naval Complex



## 1 **5.0 COPC/COC Refinement**

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2 This section discusses compounds that were identified as COCs for AOC 580 in the *Zone E*  
3 *RFI Report, Revision 0*, (EnSafe, 1997), as well as compounds identified as COPCs based on  
4 additional sampling in 2002. Also, VOC data from the *Zone E RFI Report, Revision 0*, are re-  
5 screened using current screening criteria.

6 The COCs identified in surface soil for AOC 580 in the *Zone E RFI Report, Revision 0*  
7 included:

- 8 • Antimony
- 9 • Arsenic
- 10 • Copper
- 11 • Lead
- 12 • Manganese
- 13 • Vanadium
- 14 • BEQs

15 Each of these constituents is discussed in detail below.

### 16 **5.1 Re-screening of Surface Soil VOC Data Based on SSL** 17 **(DAF=1)**

18 The *Zone E RFI Report, Revision 0* evaluated VOC leachability to groundwater using an SSL  
19 based on a DAF=10. The BCT has agreed to re-screen these soil VOC data using more SSL  
20 values based on a DAF=1.0.

21 A total of five VOCs were detected in surface soil at the site: acetone, chloroform, methyl  
22 ethyl ketone, methylene chloride and naphthalene (see Table 5-1).

23 Methylene chloride was the only VOC which had reported concentrations exceeding its SSL  
24 of 0.001 mg/kg, with two exceedances (0.003 mg/kg in E580SB001 and 0.004 mg/kg in  
25 E580SB005). Methylene chloride was not detected in subsurface soils samples or in  
26 groundwater samples obtained from either of the two shallow wells located at AOC 580,  
27 indicating that significant transport from soil to groundwater has not occurred. Methylene  
28 chloride is a common laboratory contaminant and the concentrations detected in soils at

1 AOC 580 are likely to be the result of laboratory contamination, and do not appear to be  
2 associated with site operations. Methylene chloride is not considered a COC at AOC 580.

3 The only VOC detected in subsurface soil at AOC 580 was acetone, which was detected in  
4 three subsurface soil samples at concentrations of 0.027 mg/kg, 0.22 mg/kg and 0.05 mg/kg  
5 in samples E580SB001, E580SB003, and E580SB006, respectively (see Table 5-2). The detected  
6 values of acetone are well below its SSL value of 0.8 mg/kg (DAF=1). In addition, acetone is  
7 a common sampling artifact and the concentrations detected in soils at AOC 580 are not  
8 likely to be the result of historical operations at AOC 580. For these reasons, acetone is not  
9 considered a COC at AOC 580.

10 The soil VOC re-screening did not identify any new COCs in surface or subsurface soil at  
11 AOC 580.

## 12 **5.2 Soil COPC/COC Refinement**

### 13 **5.2.1 Antimony in Soil**

14 Antimony was detected in five of the nine surface soil samples collected during the RFI  
15 field investigation at concentrations ranging from 1.2 J mg/kg (E580SB00801 and  
16 E580SB00901) to 9.1 J mg/kg (E580SB006), but not in either of the two additional samples  
17 collected in January 2002. Only one value (9.1 J mg/kg in E580SB006) slightly exceeded the  
18 Zone E background surface soil range for antimony of 0.5 mg/kg to 7.4 mg/kg (see Table 5-  
19 3 and Figure 5-1).

20 Antimony is a naturally occurring metal detected in soils throughout Zone E and the  
21 observed concentrations are within background levels, with the exception of one sample.  
22 This one sample with the maximum detected concentration slightly exceeded the  
23 background range and is also above the EPA Region III residential RBC at HI=0.1 (3.1  
24 mg/kg). However, the maximum antimony concentration in surface soil (9.1 mg/kg) is  
25 below the EPA Region III residential RBC of 31 mg/kg (HI=1.0). The target organs for  
26 antimony are the blood and whole body effects. None of the other COPCs discussed below  
27 have the same target organs. The maximum detected concentration of antimony does not  
28 exceed the EPA Region III industrial RBC at HI=0.1 of 82 mg/kg. Based on the above  
29 considerations, antimony is not considered a COC in surface soil.

30 In subsurface soil, antimony was detected in three of the eight samples collected during the  
31 original RFI, but was not detected in either of the two subsurface soil samples collected as  
32 part of the additional investigation conducted in January 2002. Concentrations of antimony  
33 in the subsurface soil ranged from 0.43 J mg/kg (E580SB007) to 1.6 J mg/kg (E580SB002)

1 (see Table 5-4). None of the detected values exceeded either the Zone E subsurface soil  
2 background range of 0.52 mg/kg to 1.6 mg/kg or the SSL of 2.5 mg/kg. Antimony was not  
3 identified as COC for subsurface soil in the *Zone E RFI Report, Revision 0*. Antimony is not  
4 considered at COC in subsurface soil at AOC 580.

## 5 **5.2.2 Arsenic in Soil**

6 Arsenic was identified as a COC in the *Zone E RFI Report, Revision 0*. Only one of the  
7 original nine RFI samples had an arsenic concentration that exceeded the Zone E arsenic  
8 background range of 0.95 to 68 mg/kg (maximum of 102 mg/kg at E580SB006). Arsenic  
9 concentrations in the four additional samples collected in January 2002 did not exceed the  
10 range of arsenic detected in Zone E surface soil grid samples.

11 Although arsenic in surface soil at boring E580SB006 is above the Zone E background range,  
12 the location where this sample was collected is within the bed of an abandoned railroad line  
13 that was located adjacent to the northern side of Building 10 (see Figure 1-3). An additional  
14 background study conducted as part of the PAHs background study along railroad lines  
15 indicated the presence of arsenic in surface soil at concentrations ranging between 2 to  
16 92 mg/kg (CH2M-Jones, 2001), which is thought to be due to pesticide applications along  
17 railroad lines, paved area, and buildings across CNC. Additionally, the maximum arsenic  
18 concentration of 102 mg/kg at E580SB00601 also had elevated copper at 739 mg/kg (see  
19 Table 5-4), indicating that the detected arsenic might be related to a copper-chromium-  
20 arsenic (CCA)-type of pesticide application.

21 Surface soil in this area is covered with asphalt, with the exception of the small area  
22 adjacent to the southwestern corner of Building 10, so direct contact-related exposures are  
23 likely to be limited. The average arsenic concentration in surface soil is 24.8 mg/kg, well  
24 within the range of arsenic detected in Zone E surface soil background samples.

25 In subsurface soil, arsenic was detected in the eight samples collected during the original  
26 RFI field investigation and in the five samples collected in January 2002 (see Table 5-4). The  
27 Zone E background range for arsenic in subsurface soils is 0.83 to 26 mg/kg and the SSL  
28 value is 14.5 mg/kg (DAF=10). Thus, the COPC screening criteria governing the  
29 determination of whether or not an environmental impact has occurred is the background  
30 concentration range. Only one subsurface soil sample (49.9 mg/kg at E580SB002) had an  
31 arsenic concentration that exceeded the Zone E arsenic background range. This sample was  
32 collected on the western side of Building 10, where the railroad line used to enter the  
33 building. The detected concentration is thought to be related to the application of arsenic-  
34 containing pesticides for weed control, as discussed above.

1 The average arsenic levels in subsurface soil are estimated at 18 mg/kg (see Table 5-4),  
2 which is well within the Zone E background range for arsenic in subsurface soils.

3 In addition, arsenic concentrations in all groundwater samples collected from shallow  
4 monitoring well E580GW002, which is collocated with sample location E580SB002, as well  
5 as the other shallow well at the site (E580GW001) were below the arsenic MCL of 50 µg/L,  
6 indicating that arsenic is not leaching into the groundwater.

7 Overall, with the exception of one of 16 surface soil samples and one twelve subsurface soil  
8 samples, no other arsenic concentrations exceeded the background levels in either surface  
9 or subsurface soil. The site average concentrations are well within their respective Zone  
10 background ranges for surface and subsurface soils. The surface soil sample with elevated  
11 arsenic was in a sample located immediately adjacent to Building 10 under pavement at a  
12 location where a former railroad line was present. The detected arsenic is likely from CCA-  
13 type of pesticide applications. Arsenic does not appear to be leaching since groundwater  
14 does not have elevated arsenic levels. Based on these reasons, arsenic is not selected as a  
15 COC for soils (surface or subsurface) at AOC 580.

### 16 **5.2.3 Copper in Soil**

17 Copper was detected in all nine surface soil samples collected during the original RFI field  
18 investigation at concentrations ranging from 14.6 mg/kg (E580SB002) to 768 mg/kg  
19 (E580SB008) (see Table 5-3). Copper was identified as a COC in the RFI Report because two  
20 copper values (739 mg/kg in E580SB007 and 768 mg/kg in E580SB008 exceeded the EPA  
21 Region III residential RBC of 310 mg/kg (HI =0.1). The maximum detected copper  
22 concentration occurred in the same sample as the maximum detected arsenic concentration  
23 (see Table 5-3). When compared to the Zone E background range for copper of 0.47 mg/kg  
24 to 866 mg/kg, the maximum observed concentration of 768 mg/kg falls within the  
25 background range. Copper concentrations at the site are well below the residential RBC of  
26 3,100 mg/kg (HI=1.0). The target organ for copper is gastrointestinal (GI) tract; no other  
27 COPCs at AOC 580 have the same target organ. Thus, the comparison of copper to the  
28 residential RBC, based on an HI=1.0, is appropriate.

29 The occurrence of copper may be associated with the routine historical application of a  
30 CCA-type of pesticide across the base, as similar concentrations were detected across Zone  
31 E and in the background sampling conducted along the railroad lines.

32 In subsurface soil, copper was detected in all eight samples collected during the RFI field  
33 investigation at concentrations ranging from 0.94 J mg/kg (E580SB001) to 32.5 mg/kg  
34 (E580SB004) (see Table 5-4). None of the concentrations exceeded the Zone E background

1 range for copper of 1.3 mg/kg to 192 mg/kg. Copper was not identified as subsurface soil  
2 COPC in the *Zone E RFI Report, Revision 0*.

3 Based on these considerations, copper is not considered a COC for surface or subsurface soil  
4 at AOC 580.

#### 5 **5.2.4 Lead in Soil**

6 Lead was detected in all nine of the surface soil samples collected during the original RFI  
7 field investigation at concentrations ranging from 40.6 J mg/kg (E580SB002) to 1,180  
8 J mg/kg (E580SB007). Two of these 9 samples exceeded the Zone E background range of  
9 1 mg/kg to 400 mg/kg (712 J mg/kg at E580SB005 and 1,180 J mg/kg at E580SB006) and the  
10 residential screening value of 400 mg/kg. (See Table 5-3 and Figure 5-3).

11 Based on analysis of the additional samples collected in January 2002, lead was detected in  
12 all five samples at concentrations ranging from 102 mg/kg (E580SB012) to 1,240 mg/kg  
13 (E580SB016). One of these samples (E580SB016) exceeded the SSL value of 400 mg/kg  
14 (DAF=10) and the Zone E background range for lead in surface soils (see Table 5-3). This  
15 value is consistent with the industrial worker-based value of 1,218 mg/kg developed for the  
16 CNC project.

17 The average lead concentration across the site in surface is estimated at 341 mg/kg, which is  
18 well below the residential screening RBC value of 400 mg/kg, as well as the SSL of 400  
19 mg/kg. The locations where lead exceeded the residential screening level of 400 mg/kg is  
20 limited and does not present a significant exposure area. For these reasons, lead in the  
21 surface soil is not considered a COC.

22 Lead was detected in all eight subsurface soil samples collected during the original RFI field  
23 investigation at concentrations ranging from 4.7 to 108 mg/kg and was not identified a  
24 COC for subsurface soils in the *Zone E RFI Report, Revision 0*. Based on analysis of the  
25 additional samples collected in January 2002, lead was detected in all five samples at  
26 concentrations ranging from 48.7 J to 2,530 mg/kg in boring E580SB014 (see Table 5-4).  
27 Only one value exceeded the Zone E subsurface soil background range for lead of 1.8 to  
28 322 mg/kg and the SSL value of 400 mg/kg (DAF=10).

29 The average lead concentration in subsurface soil is estimated at 268 mg/kg, which is well  
30 below the SSL. The area in which lead exceeds the SSL is limited in size and delineated.  
31 Lead was not detected in any groundwater samples from site wells, thus does not appear to  
32 be leaching or impacting groundwater. Based on these considerations, lead is not  
33 considered to be a COC for subsurface soil at AOC 580.

## 5.2.5 Manganese in Soil

Manganese was detected in all nine surface samples collected during the RFI field investigation at concentrations ranging from 68.1 mg/kg (E580SB008) to 775 mg/kg (E580SB003) (see Table 5-3). Manganese was identified as a COC in the *Zone E RFI Report, Revision 0* due to exceedances of the EPA Region III residential RBC of 160 mg/kg (HI =0.1). Manganese occurs naturally in the soils at the CNC, and only two values (736 mg/kg in E580SB003 and 775 mg/kg in E580SB007) exceeded the Zone E background range for manganese of 0.93 to 508 mg/kg (see Table 5-3). None of the detected concentrations exceeded the EPA Region III industrial RBC of 4,100 (HI=0.1). (See Table 5-3 and Figure 5-4). The detected manganese levels are all below a residential RBC value of 1600 mg/kg, at an HI of 1.0. The target organ for manganese is the central nervous system (CNS), and no other COC was identified with this target organ at AOC 580.

The EPA Region III SSL for manganese is 475 mg/kg (DAF=10). Again the same two surface soil samples (E580SB002 and E580SB007) exceed the SSL, but this screening value is below the Zone E background maximum concentration of 508 mg/kg. Also, the corresponding subsurface soil samples had manganese concentrations that were within the Zone E background range for subsurface soils (4.9 mg/kg to 625 mg/kg), indicating that manganese is not readily leachable. For these reasons, manganese is not considered a COC for surface soil at AOC 580.

Manganese concentrations in subsurface soils ranged from 15 J to 452 J mg/kg (see Table 5-4) in samples collected during the original RFI field investigation. None of these concentrations exceeded the Zone E background range for manganese of 4.9 to 625 mg/kg, and are below the EPA Region III SSL of 475 mg/kg (DAF=10). For these reasons, manganese is not considered a subsurface soil COC.

## 5.2.6 Vanadium in Surface Soil

Vanadium was detected in all nine samples collected during the RFI field investigation at concentrations ranging from 16 mg/kg (E580SB002) to 97.1 mg/kg (E580SB007) (see Table 5-3). Vanadium was identified as a COC in the *Zone E RFI Report, Revision 0*, because one value exceeded the EPA Region III residential RBC of 55 mg/kg (HI =0.1). Vanadium occurs naturally in the soils at the CNC. The maximum detected concentration (97 mg/kg) exceeded the Zone E surface soil background range of 1.1 to 60 mg/kg. (See Table 5-3 and Figure 5-5).

However, this value does not exceed either the SSL of 3,000 mg/kg for vanadium of 3,000 mg/kg (DAF=10) or the EPA Region III industrial RBC of 140 mg/kg (HI=0.1). The EPA

1 Region III residential RBC of 550 mg/kg at an HI=1.0 also not exceeded by the maximum  
2 detected vanadium concentration. No specific target organ was identified for vanadium  
3 toxicity. The site average vanadium concentration for surface soil is estimated at 35.7  
4 mg/kg, which is well below any of the screening criteria listed above. No site-related uses  
5 of vanadium are known to have occurred at this site. Also, the highest detected site  
6 concentration of 97 mg/kg is below the highest vanadium concentration detected in surface  
7 soil background samples (101 mg/kg in Zone B) at the CNC. For these reasons, vanadium is  
8 not considered a surface soil COC at AOC 580.

9 Vanadium was detected in all eight subsurface soil samples collected during the original  
10 RFI field investigation at concentrations ranging from 11.6 mg/kg to 51.8 mg/kg (see Table  
11 5-4). None of these samples had vanadium concentrations that exceeded the Zone E  
12 subsurface soil background range of 1.6 to 71 mg/kg, and are below the SSL of 3,000 mg/kg  
13 (DAF=10). For these reasons, vanadium is not considered a COC for subsurface soil at AOC  
14 580.

### 15 **5.2.7 BEQs in Soil**

16 BEQs were detected in all of the nine surface soil samples collected during the RFI field  
17 investigation at concentrations ranging from 0.405 mg/kg (E580SB003) to 1.107 mg/kg  
18 (E580SB005) (see Table 5-3). BEQs were identified as a COC in the RFI Report, because the  
19 BEQ values observed at AOC 580 exceeded the EPA Region III residential RBC of 0.088  
20 mg/kg. When compared to the site-wide reference concentration of 1.304 mg/kg for BEQs  
21 in surface soil developed for the CNC, there are no exceedances.

22 BEQs were detected in one of the of the eight subsurface soil samples collected during the  
23 RFI field investigation at a concentration of 0.477 mg/kg (E580SB007) (see Table 5-4). BEQs  
24 were identified in the *Zone E RFI Report, Revision 0*, report as COCs for subsurface soil. The  
25 BEQ value in subsurface soils did not exceeded the BEQ site-wide reference concentration  
26 for subsurface soil of 1.4 mg/kg developed for the CNC. BEQs are not considered COCs for  
27 surface or subsurface soil at AOC 580.

## 28 **5.3 Groundwater**

29 No COCs were identified in the *Zone E RFI Report, Revision 0*, for shallow groundwater.  
30 Arsenic and manganese were identified as COCs for deep groundwater.

### 5.3.1 Arsenic in Deep Groundwater

Arsenic was detected in all four groundwater samples collected from the deep well at AOC 580 (E580GW001D). The detected values of arsenic in groundwater ranged from 84.4  $\mu\text{g}/\text{L}$  (first sampling event) to 110  $\mu\text{g}/\text{L}$  (third sampling event), and all four arsenic values exceed the MCL of 50  $\mu\text{g}/\text{L}$  (see Table 5-5). Shallow groundwater at the site did not have elevated arsenic levels, suggesting that the observed arsenic levels could be naturally occurring in the area for this deeper aquifer zone.

Table 5-6 presents a summary of arsenic, iron, and manganese groundwater data for all three wells at AOC 580. The data indicated that iron concentrations are elevated and in the range that suggests natural iron-reduction is occurring. Manganese concentrations in the deep well also suggest that some natural manganese reduction may be occurring. These conditions create an environment in which arsenic may be naturally released into the groundwater. Arsenic concentrations in Zone E grid wells range from 3 to 132  $\mu\text{g}/\text{L}$ . The arsenic concentrations in the deep well at AOC 580 all fall within this range.

Arsenic was determined not to represent a COC for soils, it is not known to have been used for site-related purposes, and is present at concentrations within the background concentration range for Zone E grid wells. For these reasons, it is believed to be naturally occurring and thus is not considered to be a COC in deep groundwater at AOC 580.

### 5.3.2 Manganese in Deep Groundwater

Manganese was detected in all four groundwater samples from the deep well at AOC 580 (E580GW001). The detected values of manganese in groundwater ranged from 924  $\mu\text{g}/\text{L}$  (fourth sampling event) to 1,040  $\mu\text{g}/\text{L}$  (first sampling event), and all four manganese values exceed the EPA Region III tap water RBC of 730  $\mu\text{g}/\text{L}$  (see Table 5-5). All concentrations fall within the Zone E background deep groundwater range of 1.3 to 1,660  $\mu\text{g}/\text{L}$ . Also, the presence of elevated manganese, along with iron, suggest naturally reductive geochemical processes are occurring in this zone of the aquifer (see Table 5-6). Manganese is a naturally occurring element that is widely present in groundwater in the vicinity of the CNC. For these reasons, manganese is not considered to be a COC in deep groundwater at AOC 580.

## 5.4 COC Summary

After evaluation of data collected during the original RFI field investigation and the additional sampling conducted in January 2002, no COCs were identified for surface or subsurface soils or for groundwater at AOC 580 under the residential or industrial land use scenario or for groundwater.

**TABLE 5-1**  
 VOCs Detected in Surface Soils  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Acetone		Chloroform		Methyl ethyl ketone (2-Butanone)		Methylene Chloride		Naphthalene	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			<b>Res RBC<sup>a</sup></b>									
			<b>Ind RBC<sup>b</sup></b>									
			<b>SSL<sup>c</sup></b>									
580SB00101	580SB00101	09/14/1995	0.16	=	0.006	U	0.01	U	<b>0.003</b>	J	NA	
580SB00201	580SB00201	09/14/1995	0.12	=	0.006	U	0.013	U	0.006	U	NA	
580SB00301	580SB00301	09/14/1995	0.18	=	0.002	J	0.017	U	0.008	U	NA	
580SB00501	580SB00501	09/14/1995	0.038	=	0.008	U	0.01	J	<b>0.004</b>	J	NA	
580SB00601	580SB00601	09/14/1995	0.058	=	0.006	U	0.012	U	0.021	U	0.15	J

Concentrations in bold and outlined with the table indicate an exceedance of the screening criteria.

<sup>a</sup> EPA Region III RBC Table, October 5, 2002. Residential RBCs with HI=1.0 for carcinogens and HI=0.1 for non-carcinogens.

<sup>b</sup> EPA Region III RBC Table, October 5, 2002. Industrial RBCs with HI=1.0 for carcinogens and HI=0.1 for non-carcinogens.

<sup>c</sup> U.S. EPA. *EPA Soil Screening Guidance: Technical Background Document* (Table A-1), EPA540/R95/128. May 1996.

NA Not Analyzed

-- No applicable criteria

= Indicates that the analyte is detected at the concentration shown

J Indicates that the concentration is an estimated value

mg/kg Milligrams per kilogram

U Indicates that the analyte was not detected

**TABLE 5-2**  
 VOCs Detected in Subsurface Soils  
*RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex*

Sample Location	Sample ID	Date Collected	Acetone		
			SSL <sup>a</sup>	Result (mg/kg)	Qualifier
			Bkgd SB	--	
E580SB003	580SB00302	09/14/1995		0.22	=
E580SB001	580SB00102	09/14/1995		0.027	=
E580SB004	580SB00402	09/15/1995		0.014	U
E580SB005	580SB00502	09/14/1995		0.016	U
E580SB006	580SB00602	09/14/1995		0.051	=
E580SB002	580SB00202	09/14/1995		0.018	U

<sup>a</sup> U.S. EPA. EPA Soil Screening Guidance: Technical Background Document (Table A-1), EPA540/R95/128. May 1996.

-- No applicable criteria

NA Not Analyzed

= Indicates that the analyte is detected at the concentration shown

U Indicates that samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL)

mg/kg Milligrams per kilogram

TABLE 5-3  
 COPCs in Surface Soils  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Antimony		Arsenic		Copper		Lead		Manganese		Vanadium		BEQs		
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	
			Res RBC <sup>a</sup>	3.1		0.43		31		400		16		55		--	
			Ind RBC <sup>b</sup>	82		3.8		820		1,200		4,100		140		--	
			SSL <sup>c</sup>	2.5		14.5		--		400		480		3,000		--	
			Bkgd-SS <sup>d</sup>	7.4		68		866		400		508		60		1.306	
E580SB001	580SB00101	09/14/1995		3.8	UJ	16.9	=	102	=	140	J	163	J	16.5	=	0.736	=
E580SB002	580SB00201	09/14/1995		3.7	UJ	10.5	=	14.6	=	40.6	J	77.8	J	16	=	0.656	=
E580SB003	580SB00301	09/14/1995		4.7	UJ	20.5	=	122	=	125	J	736	J	49.9	=	0.405	=
E580SB004	580SB00401	09/15/1995		1.9	J	16.5	=	61.1	J	113	J	311	J	36.4	J	0.443	=
E580SB005	580SB00501	09/14/1995		4.9	UJ	19	=	50	=	712	J	416	J	40.3	=	1.107	=
E580SB006	580SB00601	09/14/1995		9.1	J	102	=	739	=	1180	J	185	J	17.3	=	0.419	=
E580SB007	580SB00701	09/15/1996		2.4	J	13.3	=	768	=	85.4	=	775	=	97.1	=	0.552	=
E580SB008	580SB00801	09/15/1996		1.2	J	9.8	=	80.8	=	45.6	=	68.1	=	20.1	=	0.445	=
E580SB009	580SB00901	09/15/1996		1.2	J	12	=	136	=	376	=	224	=	27.7	=	0.597	=
E580SB010	580SB01001	01/14/2002		NA		5.6	=	NA		NA		NA		NA		NA	
E580SB011	580SB01101	01/14/2002		NA		7.78	=	NA		NA		NA		NA		NA	
E580SB012	580SB01201	01/14/2002		0.799	UJ	50.3	=	NA		102	J	NA		NA		NA	
E580SB013	580SB01301	01/14/2002		0.671	UJ	37.8	=	NA		136	J	NA		NA		NA	
E580SB014	580SB01401	01/14/2002		NA		NA		NA		348	J	NA		NA		NA	
E580SB015	580SB01501	01/14/2002		NA		NA		NA		140	J	NA		NA		NA	
E580SB016	580SB01601	01/14/2002		NA		NA		NA		1,240	J	NA		NA		NA	

<sup>a</sup> EPA Region III RBC Table, October 5, 2002. Residential RBCs with HI=1.0 for carcinogens and HI=0.1 for non-carcinogens.

<sup>b</sup> EPA Region III RBC Table, October 5, 2002. Industrial RBCs with HI=1.0 for carcinogens and HI=0.1 for non-carcinogens.

<sup>c</sup> U.S. EPA. EPA Soil Screening Guidance: Technical Background Document (Table A-1), EPA540/R95/128. May 1996.

<sup>d</sup> The screening value reported is the uppermost end of the Zone E background range for surface soils.

-- No applicable criteria

NA Not Analyzed

= Chemical is detected at the concentration shown

J Estimated value

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL)

UJ Not detected; analytical detection limit is estimated

mg/kg Milligrams per kilogram

BEQ Benzo(a)pyrene equivalents

**TABLE 5-6**  
 Arsenic, Iron and Manganese in AOC 580 Wells  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Arsenic		Iron		Manganese	
			Result (µg/L)	Qualifier	Result (µg/L)	Qualifier	Result (µg/L)	Qualifier
		MCL <sup>a</sup>	50		1,100 <sup>c</sup>		730 <sup>c</sup>	
		Shallow GW <sup>b</sup>	316		76,600		2,650	
		Deep GW <sup>c</sup>	132		26,000		1,660	
<b>Shallow Groundwater</b>								
E580GW001	580GW00101	04/09/1996	5	U	10,600	=	210	=
E580GW001	580GW00102	07/10/1996	2.5	U	8,260	J	160	J
E580GW001	580GW00103	11/07/1996	2.5	U	8,040	=	165	=
E580GW001	580GW00104	01/21/1997	2.5	U	8,630	=	175	=
E580GW002	580GW00201	04/11/1996	8.3	J	5,410	J	109	J
E580GW002	580GW00202	07/10/1996	9.7	J	7,870	J	88	J
E580GW002	580GW00203	11/06/1996	15.6	=	11,400	=	129	=
E580GW002	580GW00204	01/21/1997	8.6	U	10,600	=	122	=
<b>Deep Groundwater</b>								
E580GW01D	580GW01D01	04/11/1996	84.4	=	5,730	J	1,040	J
E580GW01D	580GW01D02	07/10/1996	96.6	=	7,300	J	1,020	J
E580GW01D	580GW01D03	11/07/1996	110	=	6,980	=	960	=
E580GW01D	580GW01D04	01/21/1997	98.7	=	5,570	=	924	=

<sup>a</sup> U.S. EPA National Primary Drinking Water Standards, EPA 816F-01-007. March 2001.

<sup>b</sup> The screening value reported is the uppermost end of the Zone E background range for deep groundwater

<sup>c</sup> No MCL established for this constituent. EPA Region III Tap Water RBC is used.

-- No applicable criteria

= Chemical is detected at the concentration shown

J Estimated value

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL)

µg/L Micrograms per liter

TABLE 5-4  
 COPCs in Subsurface Soils  
 RFI Report Addendum, AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Antimony		Arsenic		Copper		Lead		Manganese		Vanadium		BEQs			
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier		
			SSL <sup>a</sup>		2.5		14.5		--		400		730		3,000		--	
			Bkgd - SB <sup>b</sup>		1.6		26		192		322		625		71		1.4	
E580SB001	580SB00102	09/14/1995			3.5	UJ	2.2	=	0.94	J	4.7	UJ	15	J	11.6	=	0.451	U
E580SB002	580SB00202	09/14/1995			5.6	UJ	49.9	=	29.9	=	61.2	J	452	J	51.8	=	0.67	U
E580SB003	580SB00302	09/14/1995			5.6	UJ	10.5	=	14.3	=	24.7	J	67.6	J	37.8	=	0.844	U
E580SB004	580SB00402	09/15/1995			1.6	J	17.5	=	32.5	J	106	J	324	J	34.5	J	0.612	U
E580SB005	580SB00502	09/14/1995			5.0	UJ	11.7	=	7.5	=	53.7	J	141	J	24.8	=	0.578	U
E580SB006	580SB00602	09/14/1995			4.8	UJ	21.5	=	143	=	102	J	370	J	25.4	=	0.477	=
E580SB007	580SB00702	09/15/1996			0.43	J	4.6	=	2.1	U	8.7	=	31.3	=	24.3	=	0.439	U
E580SB009	580SB00902	09/15/1996			0.83	J	15.6	=	11.2	=	108	=	186	=	41.4	=	0.716	U
E580SB010	580SB01002	01/14/2002			NA		24.2	=	NA		NA		NA		NA		NA	
E580SB011	580SB01102	01/14/2002			NA		22.6	=	NA		NA		NA		NA		NA	
E580SB012	580SB01202	01/14/2002			0.95	UJ	17.6	=	NA		59.8	J	NA		NA		NA	
E580SB013	580SB01302	01/14/2002			0.08	UJ	19	=	NA		67.3	J	NA		NA		NA	
E580SB014	580SB01402	01/14/2002			NA		NA		NA		2,530	J	NA		NA		NA	
E580SB015	580SB01502	01/14/2002			NA		NA		NA		49.3	J	NA		NA		NA	
E580SB016	580SB01602	01/14/2002			NA		NA		NA		48.7	J	NA		NA		NA	

<sup>a</sup> U.S. EPA. EPA Soil Screening Guidance: Technical Background Document (Table A-1), EPA540/R95/128. May 1996.

<sup>b</sup> The screening value reported is the uppermost end of the Zone E background range for surface soils.

-- No applicable criteria

NA Not Analyzed

= Chemical is detected at the concentration shown

J Estimated value

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL)

UJ Not detected; analytical detection limit is estimated

**TABLE 5-5**  
 COPCs in Deep Groundwater  
 RFI Report Addendum , AOC 580, Zone E, Charleston Naval Complex

Sample Location	Sample ID	Date Collected	Arsenic		Manganese		
			Result (µg/L)	Qualifier	Result (µg/L)	Qualifier	
			MCL <sup>a</sup>	50		730 <sup>c</sup>	
			Deep GW <sup>b</sup>	132		1,660	
E580GW01D	580GW01D01	04/11/1996		84.4	=	1,040	J
E580GW01D	580GW01D02	07/10/1996		96.6	=	1,020	J
E580GW01D	580GW01D03	11/07/1996		110	=	960	=
E580GW01D	580GW01D04	01/21/1997		98.7	=	924	=

<sup>a</sup> U.S. EPA National Primary Drinking Water Standards, EPA 816F-01-007. March 2001.

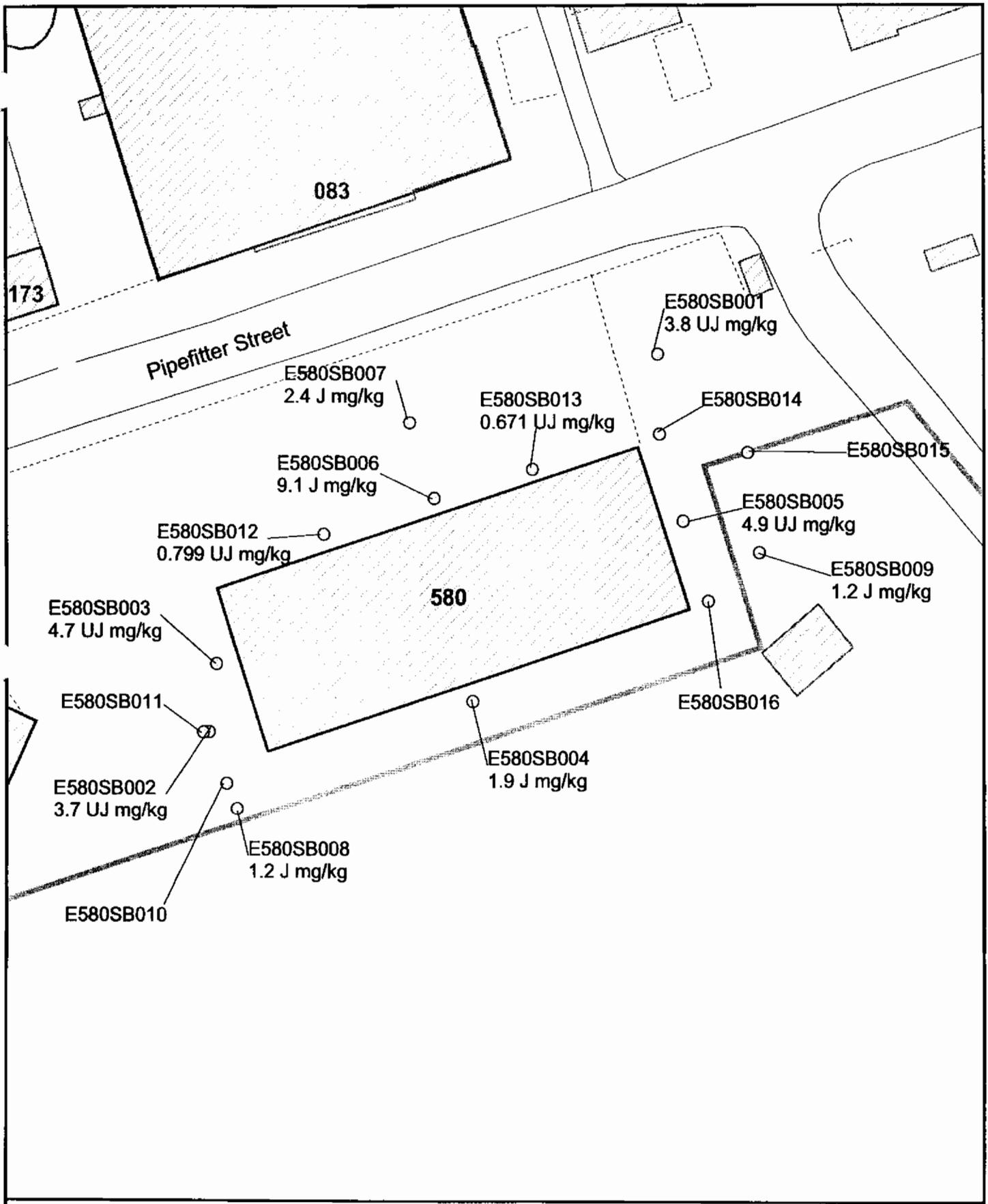
<sup>b</sup> The screening value reported is the uppermost end of the Zone E background range for deep groundwater

<sup>c</sup> No MCL established for this constituent. EPA Region III Tap Water RBC is used.

= Chemical is detected at the concentration shown

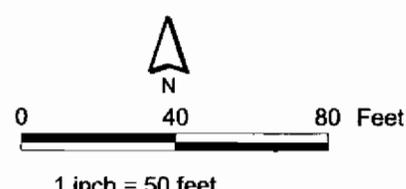
J Estimated value

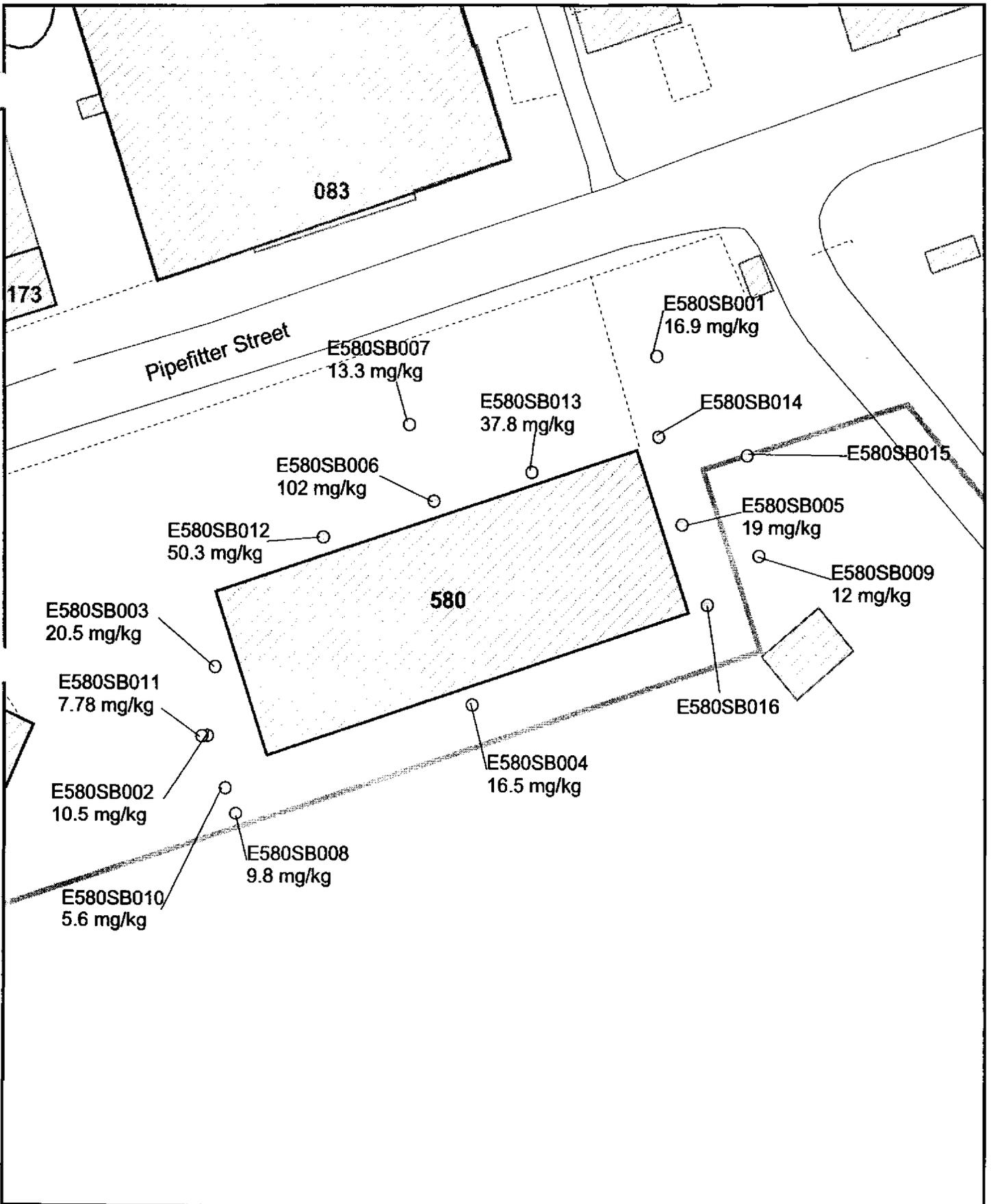
µg/L Micrograms per liter



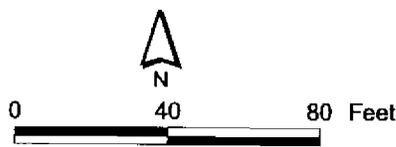
**Figure 5-1**  
 Antimony in Surface Soil  
 AOC 580, Zone E  
 Charleston Naval Complex

- Surface Soil Sample
- ▤ Fence
- ▤ Railroads
- ▤ Roads
- ▭ AOC Boundary
- ▭ Buildings
- ▭ SWMU Boundary
- ▭ Zone Boundary

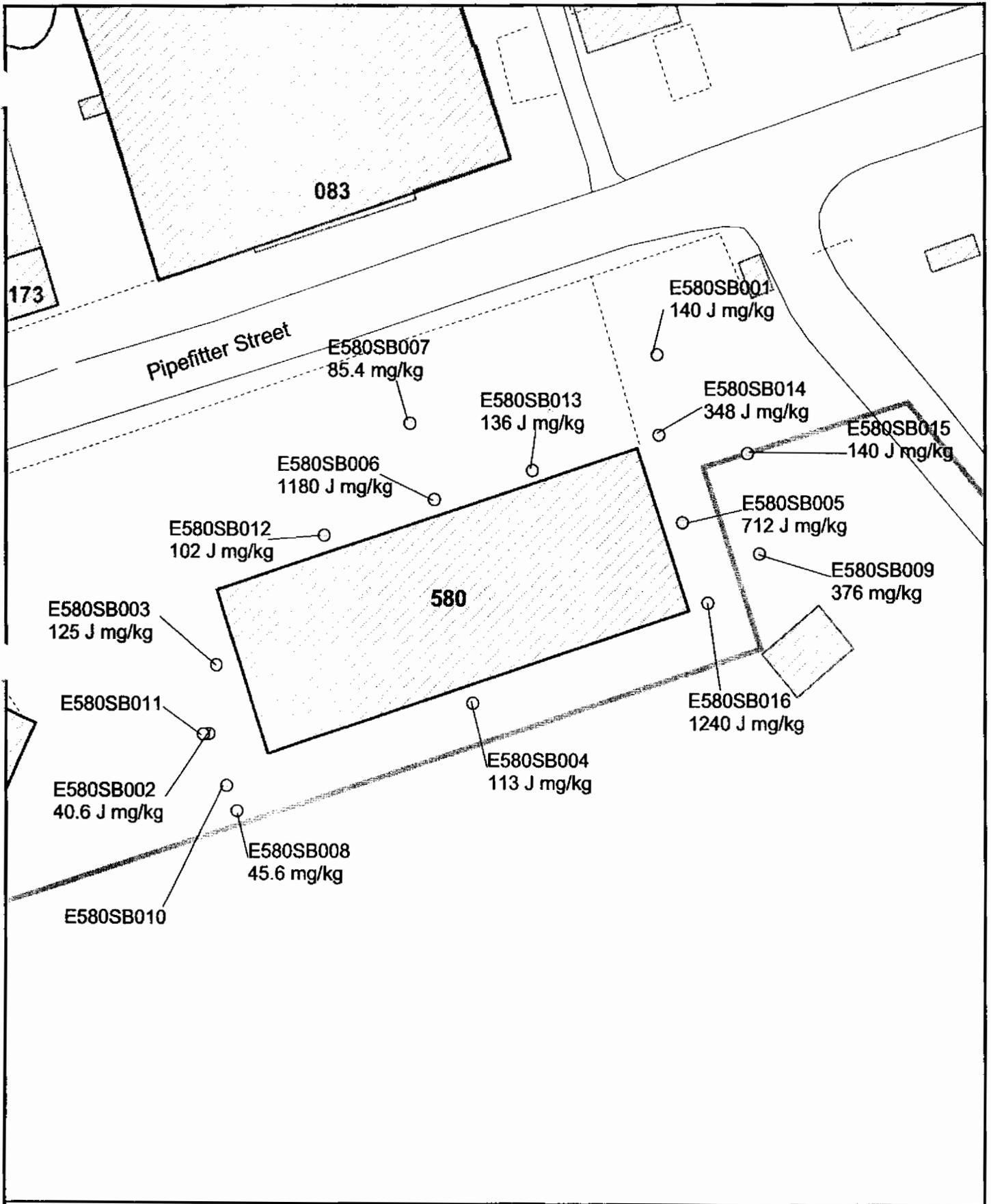




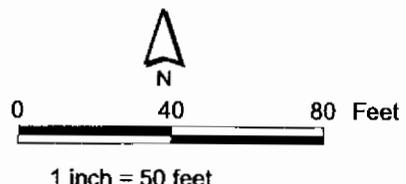
- Surface Soil Sample
- ▤ Fence
- ▤ Railroads
- ▤ Roads
- ▭ AOC Boundary
- ▭ Buildings
- ▭ SWMU Boundary
- ▭ Zone Boundary



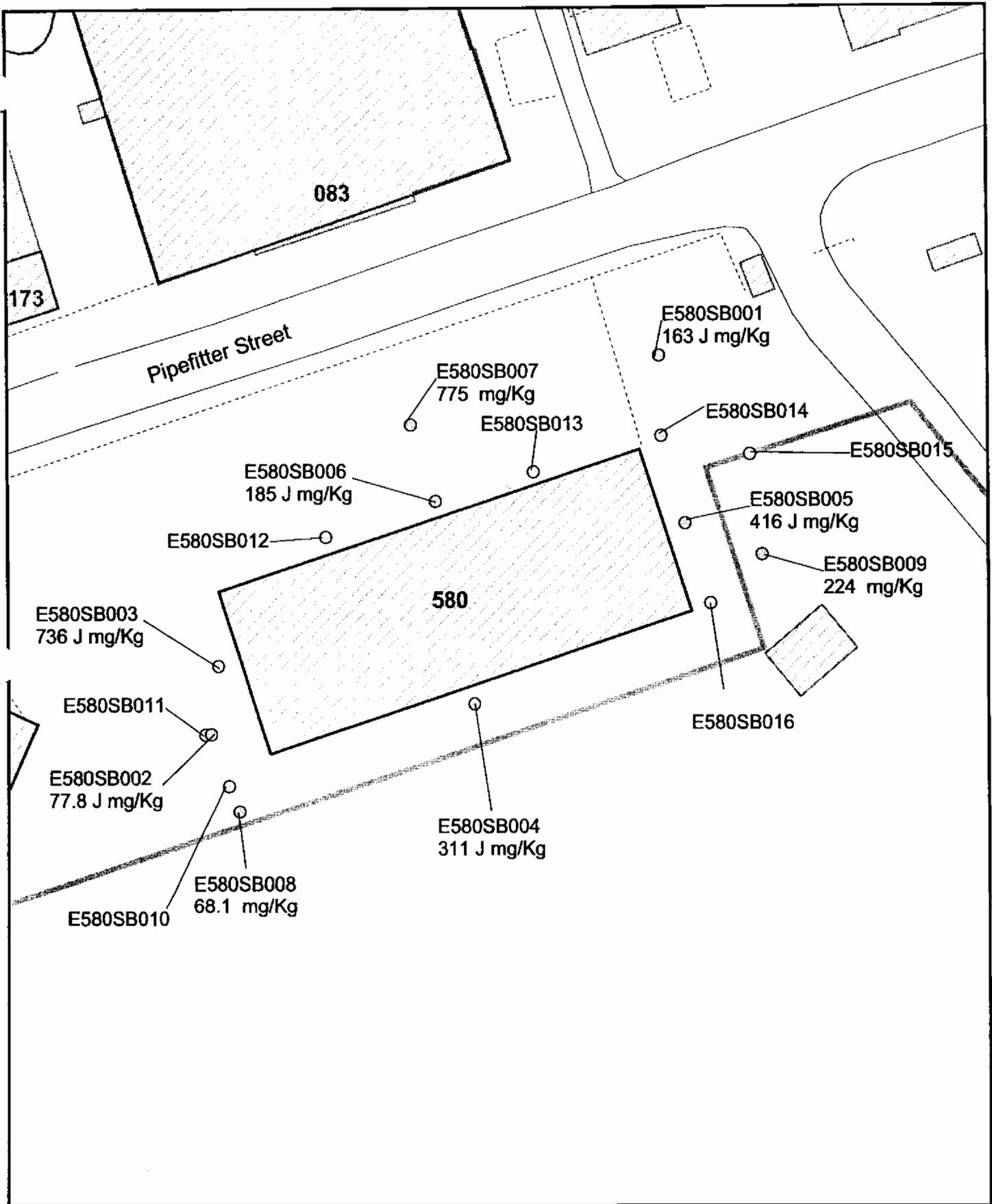
**Figure 5-2**  
Arsenic in Surface Soil  
AOC 580, Zone E  
Charleston Naval Complex



- Surface Soil Sample
- Fence
- Railroads
- Roads
- AOC Boundary
- Buildings
- SWMU Boundary
- Zone Boundary

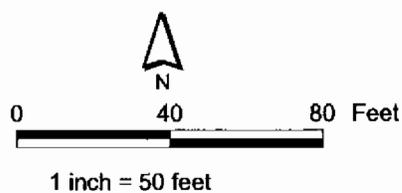


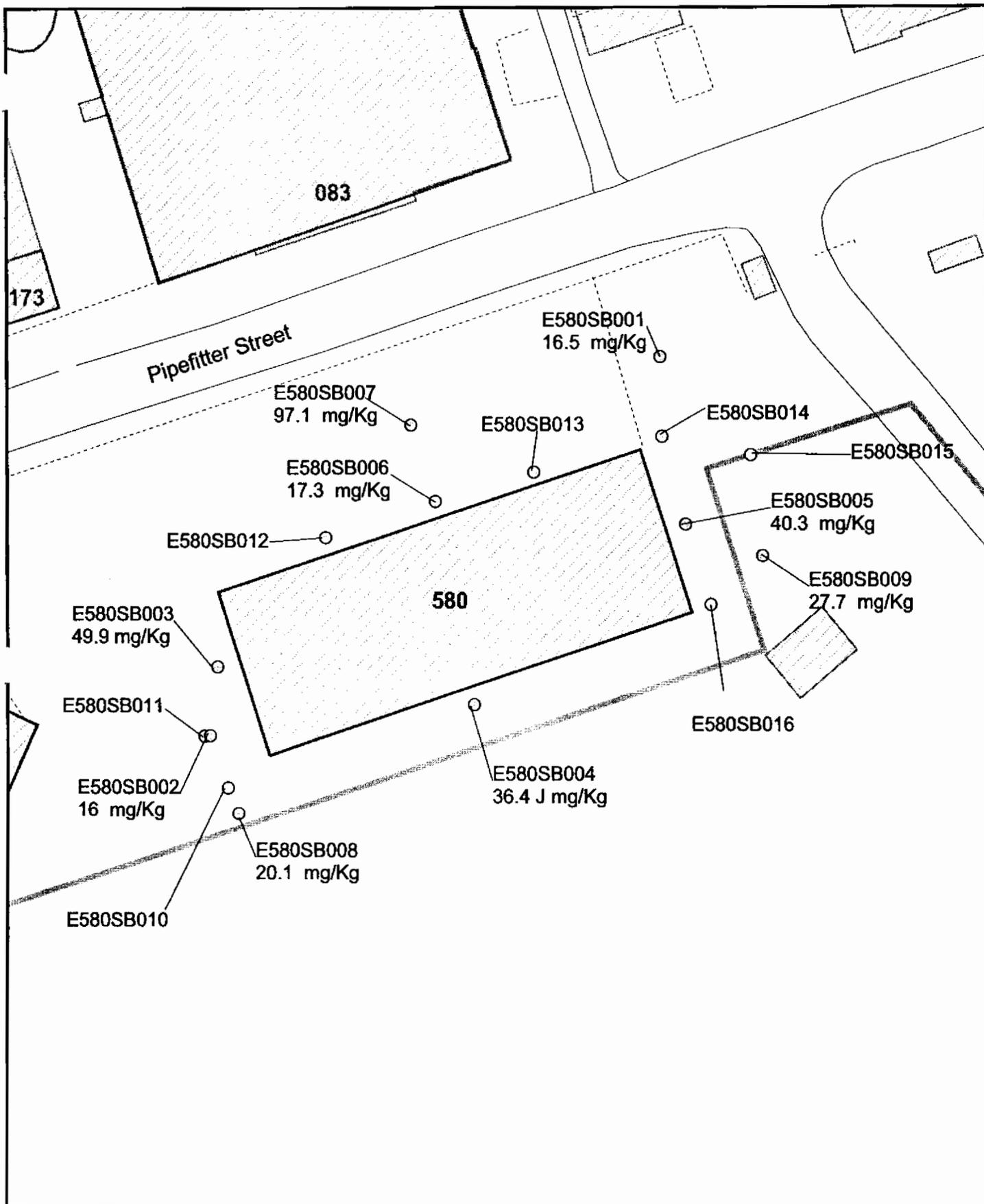
**Figure 5-3**  
Lead in Surface Soil  
AOC 580, Zone E  
Charleston Naval Complex



**Figure 5-4**  
 Manganese in Surface Soil  
 AOC 580, Zone E  
 Charleston Naval Complex

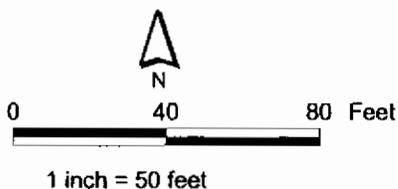
- Surface Soil Sample
- Fence
- Railroads
- Roads
- AOC Boundary
- Buildings
- SWMU Boundary
- Zone Boundary





**Figure 5-5**  
 Vanadium in Surface Soil  
 AOC 580, Zone E  
 Charleston Naval Complex

- Surface Soil Sample
- - - Fence
- ≡ Railroads
- ≡ Roads
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings
- ▭ Zone Boundary





## 6.0 Summary of Information Related to Site Closeout Issues

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### 6.1 RFI Status

Based on review of the data obtained from both the original RFI field investigation and the additional investigation conducted in January 2002, the nature and extent of the COPCs has been adequately defined.

Responses to SCDHEC comments on the *Zone E RFI Report, Revision 0* are attached as Appendix C. With this RFI Report Addendum, the RFI is considered to be complete.

The remaining subsections address the issues that the BCT agreed to evaluate prior to site closeout.

### 6.2 Presence of Inorganics in Groundwater

For the purpose of site closeout documentation, the inorganics in groundwater issue refers to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and antimony) in groundwater at concentrations above the applicable MCL, preceded or followed by detections of these same metals below the MCL or below the practicable quantitation limit. A discussion of arsenic in groundwater was provided in Section 5.0. Thallium and antimony were not identified as COCs at AOC 580. No additional evaluation of this issue is warranted.

### 6.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC

The sanitary sewer investigation (SWMU 37) was designed to include segments of the sewer where releases of contamination were known or considered likely to have occurred. No investigations related to SWMU 37 were conducted in the vicinity of AOC 580. No known or suspected linkage between SWMU 37 and AOC 580 exists. Because there are no COCs at this site, there is no potential for impacts to the sanitary sewer. Further evaluation of this issue is not warranted.

## 1    **6.4 Potential Linkage to AOC 699, Investigated Storm Sewers** 2    **at the CNC**

3    Investigated segments of the storm sewer (AOC 699) were identified in the *Zone L RFI*  
4    *Report, Revision 0* (EnSafe, 1998). Three storm drains are located along the northern side of  
5    Building 10 (AOC 580). The sections of the stormwater sewer system in the vicinity of the  
6    site were not investigated as part of the AOC 699 investigations. There are no data or  
7    information to suggest that AOC 580 has impacted the storm sewer system and there are no  
8    groundwater COCs at AOC 580. Further investigation of a linkage between the storm sewer  
9    system and AOC 580 is not warranted.

## 10   **6.5 Potential Linkage to AOC 504, Investigated Railroad Lines** 11   **at the CNC**

12   Investigated segments of the CNC railroad lines (AOC 504) were identified in the *Zone L*  
13   *RFI Report, Revision 0* (EnSafe, 1998). No AOC 504-related investigations were conducted at  
14   AOC 580.

15   AOC 580 (Building 10) was bounded on the north side by an abandoned railroad line, and a  
16   second railroad line entered Building 10 through the western wall. The nearest active  
17   railroad line is approximately 240 ft to the southwest in Zone F. Certain facility  
18   maintenance related activities (e.g., application of CCA-type of pesticides along old railroad  
19   lines) have likely contributed to anthropogenic background levels of a few chemicals at the  
20   site. This issue was addressed in Section 5.0. There is no known linkage between AOC 580  
21   and the investigated railroad lines of AOC 504. Further evaluation of this issue is not  
22   warranted.

## 23   **6.6 Potential Migration Pathways to Surface Water Bodies at** 24   **the CNC**

25   Two potential migration pathways from the site to surface water are overland flow via  
26   stormwater runoff, and subsurface flow via groundwater. The nearest surface water body to  
27   AOC 580 is the Cooper River, which lies approximately 1,150 ft to the northeast. There were  
28   no COCs identified for soil or groundwater. Therefore, there are no migration pathways of  
29   concern.

## 1 **6.7 Potential Contamination in Oil/Water Separators**

2 There are no OWSs known to be associated with this site. In addition, there is no reference  
3 made to an OWS at this facility in the *Oil Water Separator Data* report (Department of the  
4 Navy, September 2000). Further evaluation of OWSs is not warranted.

## 5 **6.8 Land Use Control Management Plan**

6 There are no COCs identified for unrestricted land use for during the risk-based screening  
7 of the data at AOC 580. Therefore, no land use restrictions are needed for AOC 580. This site  
8 is zoned M-2 (marine-industrial) and will likely be used for non-residential future land use.



## 1 **7.0 Conclusions and Recommendations**

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2 AOC 580 is a former pattern and electric shop formerly located in Building 10. Built in 1918,  
3 it was used until 1935 as a pattern and storage shop. From 1935 until 1955, this unit was  
4 again used as a pattern and electric shop. In the early 1980s the building became the office  
5 for the Nuclear Engineering Department. No information could be found regarding the  
6 operational practices of this facility. In November 2001, a site inspection revealed that the  
7 building is currently out of use, and has been closed and locked.

8 Based on review of historical public works maps, railroad lines used to pass along the north  
9 sides of Building 10. In addition, one railroad line extended into the building through the  
10 western wall and was present until at least 1935, but is no longer represented on the 1937  
11 public works map. The exterior railroad lines appear to have remained in service at least  
12 until 1955, but were no longer present in the 1962 public works map.

13 Materials of concern identified in the *Final Zone E RFI Work Plan* (EnSafe, 1995b) include  
14 degreasers and solvents. Potential receptors that may be exposed to site contaminants  
15 include current and future building users and any site workers present in this area as part  
16 of facility maintenance.

17 The evaluation of data collected during the RFI is summarized in Section 2.0, the additional  
18 investigation is summarized in Section 4.0, and the COPC/COC refinement discussion is  
19 presented in Section 5.0.

20 The overall conclusion for soil from these previous investigations is that there are no COCs  
21 identified for surface or subsurface soil, or shallow or deep groundwater. This site is zoned  
22 M-2 (marine-industrial) and will likely be designated for commercial/industrial future use.  
23 No actions are required to control exposures/risks under current or future land use. This  
24 site is recommended for NFA.



## 1 **8.0 References**

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- 2 CH2M-Jones. *Background PAHs Study Report – Technical Information for Development of*  
3 *Background BEQ Values*. February 2001.
- 4 CH2M-Jones. *Technical Memorandum - Results from Additional Background Sampling of the*  
5 *CNC Railroad Lines and Naval Annex (Zone K)*, August 10, 2001.
- 6 EnSafe Inc./Allen & Hoshall. *Final RFA, Revision 1, NAVBASE Charleston*. June 6, 1995a.
- 7 EnSafe Inc./Allen & Hoshall. *Final Zone E RFI Work Plan, Revision 1, NAVBASE Charleston*.  
8 June 2, 1995b.
- 9 EnSafe Inc./Allen & Hoshall. *Final Zone L RFI Work Plan, Revision 0, NAVBASE Charleston*.  
10 October 18, 1995c.
- 11 EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston*. November 1997.
- 12 EnSafe Inc. *Draft Zone L RFI Report, NAVBASE Charleston*. December 18, 1998.
- 13 EnSafe Inc. *Zone E RFI Work Plan Addendum, Revision 0*. December 1999.
- 14 NAVFAC. *Petroleum Storage Tank Status at the Charleston Naval Complex, Correspondence,*  
15 *SOUTHNAVFACENGCOM, US Navy, August 8, 2001.*
- 16 U.S. Environmental Protection Agency. *Soil Screening Guidance: Technical Background*  
17 *Document*. May 1996.



**Appendix A-1**

Table 10.40.2.1 (*Zone E RFI Report, Revision 0*)

Organic Compounds Detected in Surface and Subsurface Soil  
Charleston Naval Complex, AOC 580, Zone E

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
<b>VOCs (µg/kg)</b>						
Acetone	Upper	5/6	38.0 - 180	111	20,000,000	0
	Lower	3/6	27.0 - 220	99.3	NA	NA
2-Butanone (MEK)	Upper	1/6	10.0	10.0	100,000,000	0
Chloroform	Upper	1/6	2.00	2.00	940,000	0
<b>VOCs (µg/kg)</b>						
Methylene chloride	Upper	2/6	3.00 - 4.00	3.50	760,000	0
<b>SVOCs (µg/kg)</b>						
Acenaphthene	Upper	2/9	68.0 - 110	89.0	12,000,000	0
Acenaphthylene	Upper	1/9	81.0	81.0	8,200,000	0
Anthracene	Upper	4/9	54.0 - 140	95.3	61,000,000	0
Benzo(g,h,i)perylene	Upper	8/9	75.0 - 490	218	8,200,000	0
	Lower	1/8	170	170	NA	NA
Benzoic acid	Upper	4/9	110 - 380	238	100,000	0
	Lower	4/8	270 - 920	535	NA	NA
Carbazole	Upper	1/1	84.0	84.0	290,000	0
2-Chlorophenol	Upper	1/9	65.0	65.0	1,000,000	0
Dibenzofuran	Upper	2/9	40.0 - 64.0	52.0	820,000	0
Di-n-butylphthalate	Lower	1/8	65.0	65.0	NA	NA
Diethylphthalate	Lower	1/8	97.0	97.0	NA	NA
Fluoranthene	Upper	9/9	75.0 - 1,400	519	8,200,000	0
	Lower	3/8	52.0 - 240	126	NA	NA
Fluorene	Upper	2/9	51.0 - 70.0	60.5	8,200,000	0
2-Methylnaphthalene	Upper	3/9	48.0 - 92.0	75.0	8,200,000	0
Naphthalene	Upper	1/9	150	150	8,200,000	0

**Appendix A-1**Table 10.40.2.1 (*Zone E RFI Report, Revision 0*)

Organic Compounds Detected in Surface and Subsurface Soil

Charleston Naval Complex, AOC 580, Zone E

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Phenanthrene	Upper	8/9	83.0 - 710	300	8,200,000	0
	Lower	1/8	92.0	92.0	NA	NA
Pyrene	Upper	9/9	75.0 - 1,300	549	6,100,000	0
	Lower	3/8	51.0 - 260	131	NA	NA
<b>SVOCs (B(a)P Equivalents) (µg/kg)</b>						
B(a)P Equiv.	Upper	9/9	4.70 - 1,110	474	780	2
	Lower	1/8	224	224	NA	NA
Benzo(a)anthracene	Upper	8/9	100 - 640	324	7,800	0
	Lower	1/8	180	180	NA	NA
Benzo(b)fluoranthene	Upper	9/9	42.0 - 580	293	7,800	0
Benzo(k)fluoranthene	Upper	9/9	45.0 - 570	289	78,000	0
	Lower	1/8	300	300	NA	NA
Benzo(a)pyrene	Upper	8/9	100 - 700	364	780	0
	Lower	1/8	190	190	NA	NA
Chrysene	Upper	9/9	50.0 - 790	352	780,000	0
	Lower	1/8	230	230	NA	NA
Dibenz(a,h)anthracene	Upper	4/9	53.0 - 240	163	780	0
Indeno(1,2,3-cd)pyrene	Upper	8/9	60.0 - 390	186	7,800	0
	Lower	1/8	130	130	NA	NA
<b>Dioxins (ng/kg)</b>						
Dioxin Equiv.	Upper	1/1	0.569	0.569	1,000	0
1234678-HpCDD	Upper	1/1	5.11	5.11	NA	NA
1234678-HpCDF	Upper	1/1	12.2	12.2	NA	NA
123678-HxCDD	Upper	1/1	1.17	1.17	NA	NA
123478-HxCDF	Upper	1/1	0.729	0.729	NA	NA

**Appendix A-1**Table 10.40.2.1 (*Zone E RFI Report, Revision 0*)

Organic Compounds Detected in Surface and Subsurface Soil

Charleston Naval Complex, AOC 580, Zone E

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
123678-HxCDF	Upper	1/1	1.46	1.46	NA	NA
OCDF	Upper	1/1	23.7	23.7	NA	NA
12378-PeCDF	Upper	1/1	0.723	0.723	NA	NA

**Notes:**

- $\mu\text{g}/\text{kg}$  = Micrograms per kilogram
- $\text{ng}/\text{kg}$  = Nanograms per kilogram
- RBC = Risk-based concentration
- NA = No industrial RBC established

## Appendix A

Table 10.40.2.2 (Zone E RFI Report, Revision 0)

Inorganic Detections for Soil

Charleston Naval Complex, AOC 580, Zone E

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Aluminum (Al)	Upper	9/9	3,820 - 11,400	7,800	100,000	26,600	0
	Lower	8/8	4,770 - 14,700	8,440	NA	41,100	NA
Antimony (Sb)	Upper	6/9	1.10 - 9.10	2.82	82	1.77	0
	Lower	3/8	0.430 - 1.60	0.953	NA	1.60	NA
Arsenic (As)	Upper	9/9	9.80 - 102	24.5	3.8	23.9	1
	Lower	8/8	2.20 - 49.9	16.7	NA	19.9	NA
Barium (Ba)	Upper	9/9	26.2 - 102	43.3	14,000	130	0
	Lower	8/8	15.6 - 40.0	27.7	NA	94.1	NA
Beryllium (Be)	Upper	9/9	0.320 - 0.870	0.576	1.3	1.70	0
	Lower	8/8	0.310 - 1.10	0.769	NA	2.71	NA
Cadmium (Cd)	Upper	5/9	0.260 - 1.20	0.596	100	1.50	0
	Lower	2/8	0.1000 - 0.230	0.165	NA	0.960	NA
Calcium (Ca)	Upper	9/9	2,860 - 60,100	15,700	NA	NA	NA
	Lower	8/8	706 - 33,000	8,140	NA	NA	NA
Chromium (Cr)	Upper	9/9	14.0 - 31.0	21.1	1,000	94.6	0
	Lower	8/8	5.30 - 34.2	20.7	NA	75.2	NA
Cobalt (Co)	Upper	9/9	2.00 - 10.4	5.82	12,000	19.0	0
	Lower	8/8	2.00 - 18.4	6.06	NA	14.9	NA
Copper (Cu)	Upper	9/9	33.3 - 768	232	8,200	66.0	0
	Lower	7/8	0.940 - 143	34.2	NA	152	NA
Iron (Fe)	Upper	9/9	6,620 - 39,900	18,400	61,000	NA	0
	Lower	8/8	4,300 - 30,900	15,400	NA	NA	NA
Lead (Pb)	Upper	9/9	45.6 - 1,180	314	1,300	265	0
	Lower	7/8	8.70 - 108	66.3	NA	173	NA
Magnesium (Mg)	Upper	9/9	780 - 2,720	1,640	NA	NA	NA
	Lower	8/8	205 - 3,300	1,870	NA	NA	NA
Manganese (Mn)	Upper	9/9	68.1 - 775	328	4,700	302	0
	Lower	8/8	15.0 - 452	199	NA	881	NA

## Appendix A

Table 10.40.2.2 (Zone E RFI Report, Revision 0)

Inorganic Detections for Soil  
Charleston Naval Complex, AOC 580, Zone E

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Mercury (Hg)	Upper	9/9	0.0400 - 1.70	0.578	61	2.60	0
	Lower	3/8	0.140 - 1.50	0.813	NA	1.59	NA
Nickel (Ni)	Upper	9/9	6.80 - 19.1	10.5	4,100	77.1	0
	Lower	8/8	2.90 - 13.0	8.26	NA	57.0	NA
Potassium (K)	Upper	9/9	371 - 2,390	1,120	NA	NA	NA
	Lower	7/8	373 - 2,940	1,530	NA	NA	NA
Selenium (Se)	Upper	3/9	0.420 - 0.720	0.600	1,000	1.70	0
	Lower	2/8	1.000 - 1.50	1.25	NA	2.40	NA
Silver (Ag)	Upper	2/9	0.590 - 3.20	1.90	1,000	NA	0
Sodium (Na)	Upper	9/9	246 - 534	335	NA	NA	NA
	Lower	8/8	224 - 870	429	NA	NA	NA
Tin (Sn)	Upper	7/9	4.50 - 156	41.6	100,000	59.4	NA
	Lower	4/8	3.30 - 9.50	4.98	NA	9.23	NA
Vanadium (V)	Upper	9/9	16.5 - 97.1	35.8	1,400	94.3	0
	Lower	8/8	11.6 - 51.8	31.5	NA	155	NA
Zinc (Zn)	Upper	9/9	84.6 - 889	329	61,000	827	0
	Lower	7/8	6.20 - 163	102	NA	886	NA

**Notes:**

- mg/kg = Milligrams per kilogram
- RBC = Risk-based concentration
- RC = Reference concentration
- NA = No industrial RBC established

**Appendix A-2**

Constituents detected in Groundwater  
 Charleston Naval Complex, AOC 580, Zone E

Consituent	STATION	ID	Date	Value	QUALIFIER	Units
<b>Shallow Wells</b>						
Aluminum	E580GW001	580GW00102	07/10/1996	188	=	ug/L
	E580GW001	580GW00103	11/07/1996	166	J	ug/L
	E580GW001	580GW00104	01/21/1997	186	J	ug/L
	E580GW002	580GW00201	04/11/1996	58.8	J	ug/L
	E580GW002	580GW00202	07/10/1996	131	=	ug/L
	E580GW002	580GW00203	11/06/1996	102	J	ug/L
	E580GW002	580GW00204	01/21/1997	159	J	ug/L
	Arsenic	E580GW002	580GW00201	04/11/1996	8.3	J
E580GW002		580GW00202	07/10/1996	9.7	J	ug/L
E580GW002		580GW00203	11/06/1996	15.6	=	ug/L
Barium	E580GW001	580GW00102	07/10/1996	33.9	=	ug/L
	E580GW001	580GW00103	11/07/1996	36.4	J	ug/L
	E580GW001	580GW00104	01/21/1997	37.9	J	ug/L
	E580GW002	580GW00201	04/11/1996	7.8	J	ug/L
	E580GW002	580GW00202	07/10/1996	7.2	=	ug/L
	E580GW002	580GW00203	11/06/1996	9.2	J	ug/L
	E580GW002	580GW00204	01/21/1997	9.6	J	ug/L
Beryllium	E580GW001	580GW00102	07/10/1996	0.38	J	ug/L
Calcium	E580GW001	580GW00102	07/10/1996	11800	J	ug/L
	E580GW001	580GW00103	11/07/1996	11900	=	ug/L
	E580GW001	580GW00104	01/21/1997	13100	=	ug/L
	E580GW002	580GW00201	04/11/1996	13600	J	ug/L
	E580GW002	580GW00202	07/10/1996	11700	J	ug/L
	E580GW002	580GW00203	11/06/1996	16000	=	ug/L
	E580GW002	580GW00204	01/21/1997	14800	=	ug/L
Chloride	E580GW001	580GW00102	07/10/1996	9400	=	ug/L
	E580GW001	580GW00103	11/07/1996	7100	=	ug/L
	E580GW002	580GW00201	04/11/1996	24600	=	ug/L
	E580GW002	580GW00202	07/10/1996	28900	=	ug/L
	E580GW002	580GW00203	11/06/1996	29900	=	ug/L
	E580GW002	580GW00204	01/21/1997	28300	=	ug/L
Cobalt	E580GW001	580GW00101	04/09/1996	3.8	J	ug/L
	E580GW001	580GW00102	07/10/1996	4	J	ug/L
	E580GW001	580GW00103	11/07/1996	3.7	J	ug/L
	E580GW001	580GW00104	01/21/1997	4.1	J	ug/L
	E580GW002	580GW00201	04/11/1996	2.2	J	ug/L
	E580GW002	580GW00204	01/21/1997	1.3	J	ug/L
Iron	E580GW001	580GW00101	04/09/1996	10600	=	ug/L
	E580GW001	580GW00102	07/10/1996	8260	J	ug/L
	E580GW001	580GW00103	11/07/1996	8040	=	ug/L
	E580GW001	580GW00104	01/21/1997	8630	=	ug/L
	E580GW002	580GW00201	04/11/1996	5410	J	ug/L
	E580GW002	580GW00202	07/10/1996	7870	J	ug/L
	E580GW002	580GW00203	11/06/1996	11400	=	ug/L
	E580GW002	580GW00204	01/21/1997	10600	=	ug/L
Lead	E580GW001	580GW00102	07/10/1996	1.8	J	ug/L
Magnesium	E580GW001	580GW00101	04/09/1996	8660	=	ug/L
	E580GW001	580GW00102	07/10/1996	6480	=	ug/L
	E580GW001	580GW00103	11/07/1996	6560	=	ug/L

**Appendix A-2**

Constituents detected in Groundwater  
 Charleston Naval Complex, AOC 580, Zone E

Constituent	STATION	ID	Date	Value	QUALIFIER	Units
	E580GW001	580GW00104	01/21/1997	7050	=	ug/L
	E580GW002	580GW00201	04/11/1996	5070	J	ug/L
	E580GW002	580GW00202	07/10/1996	4000	=	ug/L
	E580GW002	580GW00203	11/06/1996	5780	=	ug/L
	E580GW002	580GW00204	01/21/1997	5720	=	ug/L
Manganese	E580GW001	580GW00101	04/09/1996	210	=	ug/L
	E580GW001	580GW00102	07/10/1996	160	J	ug/L
	E580GW001	580GW00103	11/07/1996	165	=	ug/L
	E580GW001	580GW00104	01/21/1997	175	=	ug/L
	E580GW002	580GW00201	04/11/1996	109	J	ug/L
	E580GW002	580GW00202	07/10/1996	88.4	J	ug/L
	E580GW002	580GW00203	11/06/1996	129	=	ug/L
	E580GW002	580GW00204	01/21/1997	122	=	ug/L
Mercury	E580GW002	580GW00201	04/11/1996	0.2	J	ug/L
Methyl ethyl ketone (2-Butanone)	E580GW002	580GW00201	04/11/1996	4	J	ug/L
Nickel	E580GW001	580GW00101	04/09/1996	1.3	J	ug/L
	E580GW001	580GW00102	07/10/1996	1.6	J	ug/L
	E580GW001	580GW00103	11/07/1996	1.2	J	ug/L
	E580GW001	580GW00104	01/21/1997	1.7	J	ug/L
	E580GW002	580GW00201	04/11/1996	1.9	J	ug/L
	E580GW002	580GW00202	07/10/1996	1.3	J	ug/L
Potassium	E580GW001	580GW00101	04/09/1996	5370	=	ug/L
	E580GW001	580GW00102	07/10/1996	5310	=	ug/L
	E580GW001	580GW00103	11/07/1996	4910	J	ug/L
	E580GW001	580GW00104	01/21/1997	4770	J	ug/L
	E580GW002	580GW00201	04/11/1996	3670	J	ug/L
	E580GW002	580GW00202	07/10/1996	3060	J	ug/L
	E580GW002	580GW00203	11/06/1996	4260	J	ug/L
	E580GW002	580GW00204	01/21/1997	3900	J	ug/L
Sodium	E580GW001	580GW00102	07/10/1996	21400	=	ug/L
	E580GW001	580GW00103	11/07/1996	22400	=	ug/L
	E580GW001	580GW00104	01/21/1997	20700	=	ug/L
	E580GW002	580GW00201	04/11/1996	45500	=	ug/L
	E580GW002	580GW00202	07/10/1996	43100	=	ug/L
	E580GW002	580GW00203	11/06/1996	53800	=	ug/L
	E580GW002	580GW00204	01/21/1997	48100	=	ug/L
Sulfate (as SO4)	E580GW001	580GW00101	04/09/1996	149000	=	ug/L
	E580GW001	580GW00102	07/10/1996	108000	=	ug/L
	E580GW001	580GW00103	11/07/1996	110000	=	ug/L
	E580GW001	580GW00104	01/21/1997	109000	=	ug/L
	E580GW002	580GW00201	04/11/1996	53000	=	ug/L
	E580GW002	580GW00202	07/10/1996	55700	=	ug/L
	E580GW002	580GW00203	11/06/1996	66200	=	ug/L
	E580GW002	580GW00204	01/21/1997	76400	=	ug/L
Thallium	E580GW001	580GW00102	07/10/1996	4.5	J	ug/L
Vanadium	E580GW001	580GW00104	01/21/1997	0.94	J	ug/L
	E580GW002	580GW00201	04/11/1996	2	J	ug/L
	E580GW002	580GW00204	01/21/1997	1.1	J	ug/L
Zinc	E580GW001	580GW00103	11/07/1996	8	J	ug/L

**Appendix A-2**

Constituents detected in Groundwater  
 Charleston Naval Complex, AOC 580, Zone E

Constituent	STATION	ID	Date	Value	QUALIFIER	Units
	E580GW002	580GW00201	04/11/1996	10.2	J	ug/L
	E580GW002	580GW00203	11/06/1996	8	J	ug/L
<b>Deep Well</b>						
Arsenic	E580GW01D	580GW01D01	04/11/1996	84.4	=	ug/L
	E580GW01D	580GW01D02	07/10/1996	96.6	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	110	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	98.7	=	ug/L
Barium	E580GW01D	580GW01D01	04/11/1996	79.6	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	71.2	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	67.6	J	ug/L
	E580GW01D	580GW01D04	01/21/1997	58.3	J	ug/L
Calcium	E580GW01D	580GW01D01	04/11/1996	187000	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	182000	J	ug/L
	E580GW01D	580GW01D03	11/07/1996	164000	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	154000	=	ug/L
Chloride	E580GW01D	580GW01D01	04/11/1996	482000	=	ug/L
	E580GW01D	580GW01D02	07/10/1996	516000	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	399000	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	340000	=	ug/L
Cobalt	E580GW01D	580GW01D01	04/11/1996	3.5	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	1.8	J	ug/L
	E580GW01D	580GW01D03	11/07/1996	4	J	ug/L
	E580GW01D	580GW01D04	01/21/1997	5.3	J	ug/L
Iron	E580GW01D	580GW01D01	04/11/1996	5730	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	7300	J	ug/L
	E580GW01D	580GW01D03	11/07/1996	6980	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	5570	=	ug/L
Magnesium	E580GW01D	580GW01D01	04/11/1996	25600	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	24800	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	22800	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	20800	=	ug/L
Manganese	E580GW01D	580GW01D01	04/11/1996	1040	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	1020	J	ug/L
	E580GW01D	580GW01D03	11/07/1996	960	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	924	=	ug/L
Mercury	E580GW01D	580GW01D01	04/11/1996	0.2	J	ug/L
Nickel	E580GW01D	580GW01D01	04/11/1996	4.7	J	ug/L
	E580GW01D	580GW01D02	07/10/1996	6.1	J	ug/L
	E580GW01D	580GW01D03	11/07/1996	6	J	ug/L
	E580GW01D	580GW01D04	01/21/1997	7	J	ug/L
Potassium	E580GW01D	580GW01D01	04/11/1996	5590	=	ug/L
	E580GW01D	580GW01D02	07/10/1996	5460	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	5670	J	ug/L
	E580GW01D	580GW01D04	01/21/1997	5630	J	ug/L
Sodium	E580GW01D	580GW01D01	04/11/1996	360000	=	ug/L
	E580GW01D	580GW01D02	07/10/1996	255000	=	ug/L
	E580GW01D	580GW01D03	11/07/1996	274000	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	246000	=	ug/L
Sulfate (as SO4)	E580GW01D	580GW01D01	04/11/1996	151000	=	ug/L
	E580GW01D	580GW01D02	07/10/1996	158000	=	ug/L

**Appendix A-2**

Constituents detected in Groundwater  
Charleston Naval Complex, AOC 580, Zone E

Constituent	STATION	ID	Date	Value	QUALIFIER	Units
	E580GW01D	580GW01D03	11/07/1996	157000	=	ug/L
	E580GW01D	580GW01D04	01/21/1997	142000	=	ug/L
Zinc	E580GW01D	580GW01D01	04/11/1996	4.8	J	ug/L



Meeting Today's Needs with a Vision for Tomorrow

Fax Transmission Cover Sheet

Date: 01/22/02  
To: Herb Kelly From: Gina Anderson  
(843) 769-7384

Fax Number: (352) 271-4811

Total Number of Pages (including this page): 16

Re: \_\_\_\_\_  
\_\_\_\_\_

**COMMENTS**

Herb,

Please find the results for 54576/79.

Original will Follow Via: \_\_\_\_\_ US Mail \_\_\_\_\_ Express Mail \_\_\_\_\_ Other \_\_\_\_\_ None

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Gainesville, Florida 32614

Contact: Mr. Herb Kelly  
Project: Charleston Naval Shipyard

Report Date: January 22, 2002

Page 1 of 1

Client Sample ID:	580SB01502	Project:	CH2M00400
Sample ID:	54576001	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	34.3%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		49.3	0.476	0.698	mg/kg	2	HSC	01/18/02	0232	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

**Notes:**

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- > Actual result is greater than amount reported
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- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- UI Uncertain identification for gamma spectroscopy.
- X Lab-specific qualifier - must be fully described in case narrative and data summary package

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This data report has been prepared and reviewed in accordance with General Engineering Laboratories, Inc. standard operating procedures. Please direct any questions to your Project Manager, Gina Anderson.

---

Reviewed by

## Certificate of Analysis

Company : CH2M Hill  
Address : 3011 S.W. Williston Road  
Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01401	Project:	CH2M00400
Sample ID:	54576002	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	15.7%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		348	0.388	0.600	mg/kg	2	HSC	01/18/02	0302	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

**Notes:**

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- U Indicates the compound was analyzed for but not detected above the detection limit
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---

Reviewed by \_\_\_\_\_

# Certificate of Analysis

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Address : 3011 S.W. Williston Road  
Gainesville, Florida 32614

Contact: Mr. Herb Kelly  
Project: Charleston Naval Shipyard

Report Date: January 22, 2002

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Client Sample ID: 580SB01402  
Sample ID: 54576003  
Matrix: Soil  
Collect Date: 14-JAN-02  
Receive Date: 15-JAN-02  
Collector: Client  
Moisture: 19.7%

Project: CH2M00400  
Client ID: CH2M006

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		2530	0.420	0.617	mg/kg	2	HSC	01/18/02	0308	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

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Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01501	Project:	CH2M00400
Sample ID:	54576004	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	23.6%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		140	0.425	0.623	mg/kg	2	HSC	01/18/02	0314	130494	I

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCDI	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

**Notes:**

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- E Concentration exceeds instrument calibration range
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- U Indicates the compound was analyzed for but not detected above the detection limit
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 Gainesville, Florida 32614

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

Report Date: January 22, 2002

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Client Sample ID: 580SB01601  
 Sample ID: 54576005  
 Matrix: Soil  
 Collect Date: 15-JAN-02  
 Receive Date: 15-JAN-02  
 Collector: Client  
 Moisture: 15.8%

Project: CH2M00400  
 Client ID: CH2M006

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		1240	0.375	0.600	mg/kg	2	HSC	01/18/02	0332	130494	1

The following Prep Methods were performed.

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

Notes:

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---

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Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
Project: Charleston Naval Shipyard

Page 1 of 1

Client Sample ID:	580SB01602	Project:	CH2M00400
Sample ID:	54576006	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	15-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	33.5%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050S/6010 Lead Federal</i>											
Lead		48.7	0.507	0.744	mg/kg	2	HSC	01/18/02	0338	130494	1

### The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

### The following Analytical Methods were performed

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

### Notes:

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 Gainesville, Florida 32614

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

Report Date: January 22, 2002

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Client Sample ID: 580SB01201  
 Sample ID: 54576007  
 Matrix: Soil  
 Collect Date: 14-JAN-02  
 Receive Date: 15-JAN-02  
 Collector: Client  
 Moisture: 36.4%

Project: CH2M00400  
 Client ID: CH2M006

Parameter	Qualifier	Result	DL	RI	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Antimony	U	ND	0.745	12.0	mg/kg	2	HSC	01/18/02	0344	130494	1
Arsenic		50.3	0.430	2.00	mg/kg	2					
Lead		102	0.535	0.786	mg/kg	2					

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCDI	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

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- E Concentration exceeds instrument calibration range
- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- UI Uncertain identification for gamma spectroscopy.
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Reviewed by \_\_\_\_\_

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 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01202	Project:	CH2M00400
Sample ID:	54576008	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Reccive Date:	15-JAN-02		
Collector:	Client		
Moisture:	51.4%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Antimony	U	ND	0.887	12.0	mg/kg	2	HSC	01/18/02	0350	130494	1
Arsenic		17.6	0.513	2.00	mg/kg	2					
Lead		59.8	0.637	0.936	mg/kg	2					

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCDI	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

**Notes:**

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- E Concentration exceeds instrument calibration range
- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- UJ Uncertain identification for gamma spectroscopy.
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Reviewed by \_\_\_\_\_

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 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID: 580SB01301  
 Sample ID: 54576009  
 Matrix: Soil  
 Collect Date: 14-JAN-02  
 Receive Date: 15-JAN-02  
 Collector: Client  
 Moisture: 29.9%

Project: CH2M00400  
 Client ID: CH2M006

Parameter	Qualifier	Result	DL	RL	Units	DP	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Antimony	U	ND	0.626	12.0	mg/kg	2	HSC	01/18/02	0356	130494	1
Arsenic		37.8	0.362	2.00	mg/kg	2					
Lead		136	0.450	0.661	mg/kg	2					

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

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Reviewed by \_\_\_\_\_

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 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01302	Project:	CH2M00400
Sample ID:	54576010	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	42.4%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Antimony	U	ND	0.748	12.0	mg/kg	2	HSC	01/18/02	0401	130494	I
Arsenic		19.0	0.433	2.00	mg/kg	2					
Lead		67.4	0.538	0.790	mg/kg	2					

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
W846 3050B	846 3050BS PREP	BCDI	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
I	SW846 3050B/6010B	

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 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01001	Project:	CH2M00400
Sample ID:	54576011	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	13.6%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Arsenic		5.60	0.299	2.00	mg/kg	2	HSC	01/18/02	0407	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCDf	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

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- E Concentration exceeds instrument calibration range
- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- U1 Uncertain identification for gamma spectroscopy.
- X Lab-specific qualifier - must be fully described in case narrative and data summary package

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---

Reviewed by

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 Address : 3011 S.W. Williston Road  
 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01002	Project:	CH2M00400
Sample ID:	54576012	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	40%		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Arsenic		24.2	0.431	2.00	mg/kg	2	HSC	01/18/02	0413	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

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- E Concentration exceeds instrument calibration range
- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- UI Uncertain identification for gamma spectroscopy.
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Reviewed by \_\_\_\_\_

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 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01101	Project:	CH2M00400
Sample ID:	54576013	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	14.2%		

Parameter	Qualifier	Result	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>										
<i>3050/6010 Arsenic Federal</i>										
Arsenic		7.79	0.298	2.00	mg/kg	2	HSC 01/18/02	0419	130494	1

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

**Notes:**

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- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
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Reviewed by \_\_\_\_\_

## Certificate of Analysis

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 Address : 3011 S.W. Williston Road  
 Gainesville, Florida 32614

Report Date: January 22, 2002

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

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Client Sample ID:	580SB01102	Project:	CH2M00400
Sample ID:	54576014	Client ID:	CH2M006
Matrix:	Soil		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		
Moisture:	42.5%		

Parameter	Qualifier	Result	DL	RI	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3050/6010 Arsenic Federal</i>											
Arsenic		22.6	0.450	2.00	mg/kg	2	HSC	01/18/02	0425	130494	1

The following Prep Methods were performed

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3050B	846 3050BS PREP	BCD1	01/17/02	0915	130493

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SW846 3050B/6010B	

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- X Lab-specific qualifier - must be fully described in case narrative and data summary package

The above sample is reported on a dry weight basis except where prohibited by the analytical procedure.

This data report has been prepared and reviewed in accordance with General Engineering Laboratories, Inc. standard operating procedures. Please direct any questions to your Project Manager, Gina Anderson.

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Reviewed by

## Certificate of Analysis

Company : CH2M Hill  
 Address : 3011 S.W. Williston Road  
 Gainesville, Florida 32614

Contact: Mr. Herb Kelly  
 Project: Charleston Naval Shipyard

Report Date: January 22, 2002

Page 1 of 1

Client Sample ID:	580EB010M1	Project:	CH2M00400
Sample ID:	54579001	Client ID:	CH2M006
Matrix:	Water		
Collect Date:	14-JAN-02		
Receive Date:	15-JAN-02		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
<b>Metals Analysis-ICP Federal</b>											
<i>3005/6010 Arsenic Federal</i>											
Antimony	U	ND	3.80	60.0	ug/L	1	HSC	01/16/02	2212	130492	1
Arsenic	J	6.31	4.57	10.0	ug/L	1					
Lead	U	ND	3.44	5.00	ug/L	1					

**The following Prep Methods were performed**

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3005A	ICP-TRACE SW846 3005A	BCD1	01/16/02	1150	130491

**The following Analytical Methods were performed**

Method	Description	Analyst Comments
1	SW846 3005/6010B	

**Notes:**

The Qualifiers in this report are defined as follows :

- \*\* Indicates the analyte is a surrogate compound.
- < Actual result is less than amount reported
- > Actual result is greater than amount reported
- B Analyte found in the sample as well as the associated blank.
- E Concentration exceeds instrument calibration range
- J Indicates an estimated value. The result was greater than the detection limit, but less than the reporting limit.
- U Indicates the compound was analyzed for but not detected above the detection limit
- UI Uncertain identification for gamma spectroscopy.
- X Lab-specific qualifier - must be fully described in case narrative and data summary package

The above sample is reported on an "as received" basis.

This data report has been prepared and reviewed in accordance with General Engineering Laboratories, Inc. standard operating procedures. Please direct any questions to your Project Manager, Gina Anderson.

Reviewed by \_\_\_\_\_

## Data Validation Summary - Charleston Naval Complex - Zone E

TO: Kris Garcia/CH2M HILL/ATL  
FROM: Herb Kelly/CH2M HILL/GNA  
DATE: March 6, 2002

The purpose of this memorandum is to present the results of the data validation process for the samples collected on January 14, 2002, at AOC 580 in Zone E.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were review and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review (EPA 1994)*. Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to General Engineering Laboratories, Inc., in Charleston, South Carolina, for the analysis of selected metals following SW-846 6010/7000 Series methodology.

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the two-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

- [=] Detected. The analyte was analyzed for and detected at the concentration shown.
- [J] Estimated. The analyte was present but the reported value may not be accurate or precise.
- [U] Undetected. The analyte was analyzed for but not detected above the method detection limit.
- [UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.
- [R] Rejected. The data is not useable.

### Secondary Data Validation Qualifiers

<u>Code</u>	<u>Definition</u>
2S	Second Source
BL	Blank
BD	Blank Spike/Blank Spike Duplicate or (LCS/LCSD) Precision
BS	Blank Spike/LCS
CC	Continuing Calibration Verification
DL	Dilution
FD	Field Duplicate
HT	Holding Time
IB	In-Between (metals - B's → J's )
IC	Initial Calibration
IS	Internal Standard
LD	Lab Duplicate
LR	Concentration exceeded Linear Range
MD	MS/MSD or LCS/LCSD Precision
MS	Matrix Spike/Matrix Spike Duplicate
OT	Other (see DV worksheet)
PD	Pesticide Degradation
PS	Post Spike
RE	Re-extraction/Re-analysis
SD	Serial Dilution
SS	Spiked Surrogate
TN	Tune

**Table 1 - Chemical Analytical Methods – Field and Quality Control Samples**

54576	E580SB016	580SB01602	1/15/02	SO	54576006	N	3	5			X
54576	E580SB016	580SB01601	1/15/02	SO	54576005	N	0	1			X
54576	E580SB015	580SB01502SD	1/14/02	SO	1200134444	SD					X
54576	E580SB015	580SB01502MS	1/14/02	SO	1200134443	MS					X
54576	E580SB015	580SB01502	1/14/02	SO	54576001	N	3	5			X
54576	E580SB015	580SB01501	1/14/02	SO	54576004	N	0	1			X
54576	E580SB014	580SB01402	1/14/02	SO	54576003	N	3	5			X
54576	E580SB014	580SB01401	1/14/02	SO	54576002	N	0	1			X
54576	E580SB013	580SB01302	1/14/02	SO	54576010	N	3	5	X	X	X
54576	E580SB013	580SB01301	1/14/02	SO	54576009	N	0	1	X	X	X
54576	E580SB012	580SB01202	1/14/02	SO	54576008	N	3	5	X	X	X
54576	E580SB012	580SB01201	1/14/02	SO	54576007	N	0	1	X	X	X
54576	E580SB011	580SB01102	1/14/02	SO	54576014	N	3	5		X	
54576	E580SB011	580SB01101	1/14/02	SO	54576013	N	0	1		X	
54576	E580SB010	580SB01002	1/14/02	SO	54576012	N	3	5		X	
54576	E580SB010	580SB01001	1/14/02	SO	54576011	N	0	1		X	
54576W	FIELDQC	580EB010M1	1/14/02	WQ	54579001	EB			X	X	X
54576W		580EB010M1SD	1/14/02	WQ	1200134438	SD			X	X	X
54576W		580EB010M1MS	1/14/02	WQ	1200134437	MS			X	X	X

**MATRIX CODE**

SO - Soil

WQ - Water QC Samples

**SAMPLE TYPE CODE**

EB - Equipment Blank

FD - Field Duplicate

MS - Matrix Spike

SD - Matrix Spike duplicate

N - Native Sample

# Inorganic Parameters

## Quality Control Review

The following list represents the QA/QC measures that are typically reviewed during the data quality evaluation procedure for inorganic parameters.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Sample preparation, initial calibration blank/continuing calibration blank and equipment blank samples were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", in which target parameters have been added prior to digestion/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **Pre/Post Digestion Spike (MS/MSD)** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **ICP Interference Check Sample** – This sample verifies the lab's interelement and background correction factors.
- **Initial Calibration Verification** – This parameter ensures that the instrument is capable of producing acceptable quantitative data for the target analyte list to be measured.
- **Continuing Calibration Verification** – This one-point, mid-range parameter establishes that the initial calibration is still valid by checking the performance of the instrument on a continual basis.
- **ICP Serial Dilution** – The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to the sample matrix.

## Metals Analyses

The QA/QC parameters for the Metals analyses for all of the samples were within acceptable control limits, except as noted below.

### Blanks

Arsenic was detected in the equipment blank sample at a concentration of 6.31 ug/L. The concentrations of arsenic reported in the samples were greater than 5 times the concentration in the blank, therefore no results were qualified as not detected, due to blank contamination.

### Recoveries/ Relative Percent Differences (RPDs) - MS/MSD

All Matrix Spike (MS) and Matrix Spike Duplicate (MSD) recoveries, and relative percent differences (RPDs) were within acceptable quality control limits, except as noted in Table 2 below.

TABLE 2						
MS/MSD Recoveries and RPDs Out of QC Limits: Metals						
<i>Charleston Naval Complex, Zone E, AOC 580, Charleston, SC</i>						
SDG	Sample	Parameter	Recovery	Recovery Limits	Associated Samples	Flag
54576	580SB01502 / #1	Antimony	49.3*/38.2*	80-120	all	Detects – J; Non-Detects – UJ
54450	579SB00902 / #5	Lead	214*/186*	80-120	all	Detects – J
* - out of control limits						

### Serial Dilution

The serial dilution percent difference (%D) for lead at 12.7 percent, was outside acceptable QC limits of 10 percent. Detected results were qualified "J", as estimated and non-detected results were qualified "UJ".

### Rejected Data

No data was rejected for this sampling event.

## Conclusion

A review of the analytical data submitted regarding the investigation of site AOC 580 in Zone E at the Charleston Naval Complex, Charleston, South Carolina by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The analytical data had minor QC concerns as discussed above. However, the validation review demonstrated that the analytical systems were generally in control and the data results can be used in the decision making process.

Attachment 1 - Changed Qualifiers and Results  
Zone E - AOC 580

SDG	Sample ID	Lab Sample ID	Matrix	Parameter Class	Analytical Method	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
54576	580SB01201	54576007	SO	METAL	SW6010	ANTIMONY	0.799	U	0.799	UJ	mg/kg	MS
54576	580SB01201	54576007	SO	METAL	SW6010	LEAD	102	=	102	J	mg/kg	MS,SD
54576	580SB01202	54576008	SO	METAL	SW6010	ANTIMONY	0.95	U	0.95	UJ	mg/kg	MS
54576	580SB01202	54576008	SO	METAL	SW6010	LEAD	59.8	=	59.8	J	mg/kg	MS,SD
54576	580SB01301	54576009	SO	METAL	SW6010	ANTIMONY	0.671	U	0.671	UJ	mg/kg	MS
54576	580SB01301	54576009	SO	METAL	SW6010	LEAD	136	=	136	J	mg/kg	MS,SD
54576	580SB01302	54576010	SO	METAL	SW6010	ANTIMONY	0.802	U	0.802	UJ	mg/kg	MS
54576	580SB01302	54576010	SO	METAL	SW6010	LEAD	67.3	=	67.3	J	mg/kg	MS,SD
54576	580SB01401	54576002	SO	METAL	SW6010	LEAD	348	=	348	J	mg/kg	MS,SD
54576	580SB01402	54576003	SO	METAL	SW6010	LEAD	2530	=	2530	J	mg/kg	MS,SD
54576	580SB01501	54576004	SO	METAL	SW6010	LEAD	140	=	140	J	mg/kg	MS,SD
54576	580SB01502	54576001	SO	METAL	SW6010	LEAD	49.3	=	49.3	J	mg/kg	MS,SD
54576	580SB01601	54576005	SO	METAL	SW6010	LEAD	1240	=	1240	J	mg/kg	MS,SD
54576	580SB01602	54576006	SO	METAL	SW6010	LEAD	48.7	=	48.7	J	mg/kg	MS,SD

CH2M HILL Chain of Custody/ Laboratory Analysis Form

Laboratory: <b>GEL</b>		Site Name: <b>Zone E, AOC 580</b>		Lab Batch/SDG:												
Project Name: <b>Charleston Navy Complex</b>		Project Number: <b>158814.PM.04</b>		TAT: <b>Standard</b>												
Project Manager: <b>Tom Beisel</b>		QA Level: <b>level 3</b>														
Address: <b>GNV: 3011 SW Williston Rd., Gainesville, FL 32605</b>																
Address: <b>ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278</b>																
Send Report To: <b>see last page of COC</b>		EDD: <b>CNC format</b>														
Sample ID	Station ID	Sample Description	Depth		Date & Time Collected	Matrix	# of containers	1 - 4ounce jar					1 - 0.5L HDPE, HNO3		Comments	
			Begin	End				Antimony (SW6010B)	Arsenic (SW6010B)	Lead (SW6010B)	Sb & As (SW6010B)	Lead (SW6010B)				
580SB01001 ✓	E580SB010	Gray sand	0	1	1-14-02/1050	SO	1		X							
580SB01002 ✓	E580SB010	Gray clay	3	5	1-14-02/1105	SO	1		X							
580SB01101 ✓	E580SB011	Tan clay	0	1	1-14-02/1015	SO	1		X							
580SB01102 ✓	E580SB011	Gray clay	3	5	1-14-02/1025	SO	1		X							
580SB01201 ✓	E580SB012	Clay	0	1	1-14-02/0950	SO	1	X	X	X						
580SB01202 ✓	E580SB012	Gray clay	3	5	1-14-02/1000	SO	1	X	X	X						
580SB01301 ✓	E580SB013	Gray clay	0	1	1-14-02/0930	SO	1	X	X	X						RCRA Site
580SB01302 ✓	E580SB013	Gray clay	3	5	1-14-02/0940	SO	1	X	X	X						
580SB01401 ✓	E580SB014	Tan sand	0	1	1-14-02/0845	SO	1			X						
580SB01402 ✓	E580SB014	Tan sand	3	5	1-14-02/0850	SO	1			X						
580SB01501 ✓	E580SB015	Tan clay sand	0	1	1-14-02/0900	SO	1			X						Sampling Complete
580SB01502 ✓	E580SB015	Tan clay sand	3	5	1-14-02/0910	SO	1			X						
580SB01502MS	E580SB015		3	5	1-14-02/0911	SO	1			X						MS
580SB01502SD	E580SB015		3	5	1-14-02/0912	SO	1			X						MSD
580SB01601 ✓	E580SB016	TAN CLAY SAND	0	1	1-15-02/0826	SO	1			X						
580SB01602 ✓	E580SB016	TAN CLAY SAND	3	5	1-15-02/0825	SO	1			X						
580EB010M1 ✓	E580EB010				1-14-01/1110	SQ	1				X	X				EB

*7 days TAT per Tommy Long.*

Sampled By: Chris Blundy Date/Time: 1-14-02 Relinquished by: [Signature] Date/Time: 1-15-02/1440

Additional Samplers: Andrew O'Conor

Received By Lab: Parlette Wendell Date/Time: 1/15/02 1445 Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Received By: \_\_\_\_\_ Date/Time: \_\_\_\_\_ Shipped Via: UPS FedEx Hand Other Tracking#: \_\_\_\_\_

Remarks: \_\_\_\_\_ Temperature: \_\_\_\_\_

Receiver Exceptions: \_\_\_\_\_

**Reports**

Herb Kelly/GNV - 1 hardcopy, 1 CD

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**Response To Comments from Charles B. Watson — SCDHEC  
for Draft Zone E RCRA Facility Investigation Report  
Charleston Naval Complex**

**AOC 580**

**Comment 22.** In the conclusions of the report, lead was noted to be at its highest concentrations along the northern and eastern walls of Building 10. These areas should be investigated thoroughly as part of the RFI.

**EnSafe/Navy Response 22:** Lead was detected in all 9 surface soil samples, however, the mean concentration for AOC 580 was 314 mg/kg, below its residential clean up level of 400 mg/kg, and no sample exceeded the industrial cleanup level of 1,300 mg/kg. Additional samples will be collected along the northern and eastern edges of Building 10 to assure that the site has been delineated.

**CH2M Jones Response:** An additional investigation to delineate the nature and extent of lead in surface and subsurface soils was conducted in January 2002. The results of this investigation are presented in Section 4.0 of the *AOC 580 RFI RA, Revision 0*, and evaluation of lead as a COC is presented in Section 5.0 of the *AOC 580 RFI RA, Revision 0*. CH2M-Jones concluded that lead in surface soils is not a COC for unrestricted or industrial land use.

**Responses To Comments from Eric F. Cathcart — SCDHEC  
for Draft Zone E RCRA Facility Investigation Report  
Charleston Naval Complex**

**AOC 580**

**Comment 63.** Figure 10.40.6 which illustrates the distribution of lead in surface soil could be presented in an isoconcentration map to better understand the distribution of the contaminant. At this time, the Department is unable to determine if the extent of contamination has been fully characterized

**Response 63.** An isoconcentration map will be provided for lead distribution at AOC 580 in the Final Zone E RFI Report.

**CH2M Jones Response:** Figure 5-3 in Section 5 of the *AOC 580 RFI RA, Revision 0* illustrates the nature and extent of lead detected in the surface soils. After reviewing the data in figure 5-3, CH2M Jones concluded that developing isocontour lines for lead was not necessary to determine that it had been delineated. The additional field investigation conducted by CH2M-Jones completed the delineation of lead in soils, per current team agreements.

**Responses To Comments from Dynamac/Gannett Fleming  
for Draft Zone E RCRA Facility Investigation Report  
Charleston Naval Complex**

**AOC 580**

**Section 10.40.4, Page 10.40-15, Line 7: The text states that only one metal (iron) in shallow groundwater exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also exceeded their respective tap-water RBC, according to Table 10.40.4.2 (page 10.40-13). The text should be corrected.**

**EnSafe/Navy Response.** The text will be revised to reflect this correction.

**CH2M Jones Response:** Section 5 of the *AOC 580 RFI RA, Revision 0* discusses COCs in groundwater. Iron and manganese exceed their respective EPA Region III tap water RBCs, however, they are within their respective Zone E background ranges for shallow groundwater. Arsenic exceeds its EPA Region III tap water RBC but does not exceed its MCL of 50 ug/L in shallow groundwater. Consequently, none of these metals are COCs for shallow groundwater.



**Responses to EPA Comments on the  
RFI Report Addendum, Revision 0  
Area of Concern 580, Zone E (April 2002)**

**GENERAL COMMENTS**

1. There is toxicity assessment discussion presented for several of the COPCs. The discussion primarily indicates that the potentially affected organ systems are unique to that contaminant, and, therefore, adjusting the RBC value to an HI=0.1 is not necessary. A summary table that includes all of the COPCs and their target organs would be helpful in evaluating this discussion.

**CH2M-Jones Response:** *Section 4.0 of the Project Team Notebook and Instructions (CH2M-Jones, December 2001) includes details of the process to be followed for COPC/COC refinement. Table 4-1 lists all of the non-carcinogenic chemicals and their respective target organs for toxicity effects. CH2M-Jones tries to ensure that copies of this notebook are provided to all BCT team members; however, please let us know if an additional copy is needed. For reference, the following table includes the target organs for toxicity effects for the COPCs identified in soil at AOC 580.*

**Table 1 List of Target Organs for COPCs Identified in Soil at AOC 580**

Chemical	Endpoint	Target Organ – Systemic Effects	Critical Effect	Source
Antimony	N	Whole body, Blood	Increased mortalities, altered chemistries	HEAST
Arsenic	C	Skin, vascular system	Hyper pigmentation, keratosis	IRIS
Copper	N	GI Tract	Irritation	HEAST
Lead	N	CNS, Kidney, Reproduction	CNS, Kidney, Reproduction	ATSDR
Manganese	N	CNS	CNS effects	IRIS
Vanadium	N	Non-specific	Not listed	IRIS
BEQs	C	Carcinogen	NA	

CNS – Central Nervous System  
GI Tract – Gastrointestinal Tract  
C – Carcinogen  
N – Noncarcinogen  
NA – Not available from sources

**Sources:**

IRIS – Integrated Risk Information Systems, USEPA 2001  
HEAST – Health Effects Assessment Summary Tables, USEPA 1997  
ATSDR – Toxicological Profiles on CD-ROM, Agency for Toxic Substances and Disease Registry, 2000

## SPECIFIC COMMENTS

1. **Page 5-3, Section 5.2.2.** The text states, “The Zone E background range for arsenic in subsurface soils is 0.83 mg/kg to 26 mg/kg and the SSL value is 14.5 mg/kg ... Thus, the applicable COPC screening criteria is the background concentration range.” The logic of this statement is not clear. Each of the screening criterion is applicable. In addition, there is no presentation of the RBC screening values in the arsenic discussion as there is for all other constituents. The section should include a presentation of the RBC screening values, and the existing screening criteria discussion should be clarified.

**CH2M-Jones Response:** *CH2M-Jones concurs that all of the screening criteria are applicable. The wording is awkward and the text will be revised to indicate that, in this instance, the Zone E background concentration range for subsurface soil has primacy for determining whether arsenic is considered a COPC. Thus arsenic is not a COPC for subsurface soil at AOC 580. This page will be reissued as a Revision 1 insert.*

2. **Page 5-5, Section 5.2.4.** The text presents the Zone E background range for lead as 1 mg/kg to 400 mg/kg. It appears coincidental that the maximum detected value is the same as the residential screening value. The maximum background concentration should be confirmed. Further, the text indicates that there is a sample location that exceeds background and the industrial screening value (although the report describes the site concentration and the industrial screening value as “consistent”). The text describes the industrial worker-based value developed for CNC as 1218 mg/kg. The source or a reference for this screening value should be provided. The highest site concentration detected is 1240 mg/kg. This concentration may represent a “hot spot” of elevated lead concentrations. It is not clear from the discussion presented if the elevated lead concentration was detected below the asphalt paving, preventing exposure. Discussion regarding the potential exposure to lead at this potential hot spot should be provided in the text.

**CH2M-Jones Response:** *The upper end of the Zone E background range is coincidentally 400 mg/kg. See Technical Memorandum: A Summary of Inorganic Chemical Concentrations in Background Soil and Groundwater at the CNC (CH2M-Jones, November 2001).*

*Although there was a single exceedence of the industrial RBC, this information is presented in Section 5.2.4 to provide a full description of the lead occurrence at the site. Although there is this exceedance for the industrial worker RBC in a single subsurface soil sample, other factors also come into consideration. Specifically:*

- *The average lead concentration in surface soil is estimated at 341 mg/kg, which is below the residential RBC of 400 mg/kg;*
- *The average lead concentration in subsurface soil is estimated at 268 mg/kg, which is well below the SSL;*
- *The area in which lead exceeds the SSL is limited in size and delineated; and*
- *Lead was not detected in any groundwater samples from site wells and thus does not appear to be leaching or impacting groundwater.*

*For these reasons, residual lead in the soil does not present human exposure concern,*

*even if isolated high detections in a small area exist (much less than the typical exposure area of 0.5-acre). This approach is consistent with the application of IEUBK model derived target lead levels and the SSL guidance. Thus, lead was eliminated as a COPC for both surface and subsurface soils. This is consistent with EPA IEUBK guidance and approach applied at other sites within CNC.*

3. **Page 5-8, Section 5.3.1.** The weight of evidence discussion includes a hypothesis that arsenic, iron, and manganese may all be naturally occurring in the deep groundwater due to reducing conditions. It is not clear from the discussion if any physical parameters (e.g., oxidation- reduction potential, pH) have been collected to support the potential for reducing conditions. The additional discussion may not be necessary. The RFIRA report describes deep groundwater arsenic concentrations as “consistent with” and “similar to” background concentrations. However, the data presented in Tables 5-5 and 5-6 seem to show that the arsenic concentrations are within the background range. For clarity, the arsenic concentration could be limited to comparison with background.

**CH2M-Jones Response:** *With respect to the relationship between arsenic, iron and manganese, throughout the CNC a significant number of background and site monitoring wells have arsenic in groundwater at concentrations above the current drinking water MCL of 50 ug/L. The distribution and frequency appears to be similar in background wells and in site-specific wells. Based on extensive review of the geochemical data and installation-wide hydrogeologic conditions, CH2M-Jones concluded that the presence of arsenic at concentrations exceeding the MCL appears likely to be related to natural geochemical processes, specifically those related to the effects of bacterial reduction of iron in shallow aquifer sediments. A technical memorandum (TM) describing the processes that create the conditions under which arsenic in soil would naturally be released into the groundwater was provided to and accepted by the BCT (An Overview of Arsenic Geochemistry, Terminal Electron Accepting Processes in Groundwater Systems, and Implications for the CNC Hydrogeologic Environment [CH2M-Jones, August 2001]).*

*Based on the rationale presented in this TM, groundwater geochemical data will be evaluated for those sites which have arsenic in groundwater at concentrations exceeding the MCL, but for which there was no arsenic source identified in the soil during the RFI. AOC 580 falls within this category and a geochemical evaluation regarding the relationship between arsenic, iron and manganese in groundwater was performed. Based on this approach, which followed the procedures specified in the TM, it appears that the arsenic in deep groundwater may be caused by the activities of iron-reducing bacteria. Therefore, arsenic in deep groundwater is not considered a site-related COC.*

*With respect to the terms “consistent with” and “similar to,” CH2M-Jones agrees that these statements are vague and that the document would benefit from more specific language. Section 5.3.1 will be revised to reflect clearly that all of the detected values fall within the zone-specific background range of concentrations. This page will be reissued as a Revision 1 insert.*

4. **Page 5-8, Section 5.4.** The text states that there are no COCs under residential or industrial scenarios. The text appears to have adequately addressed the industrial receptor (with the potential limitations noted these comments). However, it is not apparent that the case has been adequately presented for eliminating COPCs for the residential receptors. For example, site concentrations for lead are significantly higher than their residential screening values (e.g., lead) and background screening values at several locations. It is not clear if exposure has been assumed to be limited based upon the presence of asphalt paving over the surface soil. It appears that land use controls may be necessary to prevent future residential exposure to lead at the site.

**CH2M-Jones Response:** *There were no COPCs/COCs identified for future residential land use, even under a scenario that includes an assumption that there is no paving at the site. Lead is supposed to be compared to a residential RBC of 400 mg/kg based on the IEUBK model, which assumes exposures based on arithmetic averages for soil concentrations. Thus average site concentrations of lead are compared with the RBC of 400 mg/kg, which was not exceeded. Even if an isolated hot spot around the high detect area is assumed, it would be very small in area and would not constitute an entire exposure area. In addition, the average for the area is lower than the RBC. For these reasons, lead is not a COC under a residential land use scenario, and AOC 580 can reasonably be considered for unrestricted land use.*

5. **Table 5-3.** The table has inverted the values for the lead screening values. The residential value is listed as 1200 mg/kg, and the industrial screening is listed as 400 mg/kg. The values should be corrected.

**CH2M-Jones Response:** *This will be corrected and the revised Table 5-3 will be reissued as a Revision 1 insert.*