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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT  
ADDENDUM CORRECTIVE MEASURES STUDY WORK PLAN AREA OF CONCERN 598  
AND 599 (AOC 598) (AOC 599) ZONE E CNC CHARLESTON SC  
3/26/2003  
CH2M HILL

# RFI REPORT ADDENDUM

## RFI Report Addendum and CMS Work Plan AOCs 598 and 599, Zone E



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

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

*CH2M-Jones*

*March 2003*

*Contract N62467-99-C-0960*

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**CH2MHILL**

March 26, 2003

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

Re: RFI Report Addendum and CMS Work Plan (Revision 1) – AOCs 598 and 599,  
Zone E

Dear Mr. Scaturo:

Enclosed please find four copies of the RFI Report Addendum and CMS Work Plan (Revision 1) for AOCs 598 and 599 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 Sam Naik. Please do not hesitate to contact him at 770/604-9182, extension 255, should you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Dann Spariosu/EPA, w/att  
Rob Harrell/Navy, w/att  
Gary Foster/CH2M HILL, w/att

# RFI REPORT ADDENDUM

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

SUBMITTED TO  
***U.S. Navy Southern Division  
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PREPARED BY  
***CH2M-Jones***

*March 2003*

*Revision 1  
Contract N62467-99-C-0960  
158814.ZE.PR.01*

## Certification Page for RFI Report Addendum and CMS Work Plan (Revision 1) – AOCs 598 and 599, 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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- 5 **B** CH2M-Jones' Responses to SCDHEC Comments on the *RFI Report Addendum, AOCs*  
6 *598 and 599, Zone E, Revision 0 (CH2M-Jones, 2002)*
- 7 **C** Excerpts from the *Zone E RFI Report, Revision 0* and Figure C-1, *Shallow Groundwater*  
8 *Contours*
- 9 **D** Figure D-1, *Historic Railroad Lines near AOCs 598 and 599 (Public Works Map of the*  
10 *Charleston Navy Shipyard; November 3, 1955)*
- 11 **E** Analytical Results from the July 2002 Sampling Event Conducted by CH2M-Jones
- 12 **F** Data Validation Report from the July 2002 Sampling Event Conducted by CH2M-  
13 Jones

# 1 Acronyms and Abbreviations

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2	AOC	Area of concern
3	ALM	Adult Lead Methodology
4	AST	Aboveground storage tank
5	BCT	BRAC Cleanup Team
6	BEQ	Benzo[a]pyrene equivalent
7	BRAC	Base Realignment and Closure Act
8	BRC	Background reference concentration
9	CA	Corrective action
10	CNC	Charleston Naval Complex
11	COC	Chemical of concern
12	COPC	Chemical of potential concern
13	CSI	Confirmatory sampling investigation
14	DAF	Dilution attenuation factor
15	DET	Environmental Detachment Charleston
16	EnSafe	EnSafe Inc.
17	EPA	U.S. Environmental Protection Agency
18	ft bls	foot below land surface
19	FRE	Fixed-point risk evaluation
20	HHRA	Human health risk assessment
21	IM	Interim measure
22	HI	Hazard index
23	LUC	Land use control
24	MCL	Maximum contaminant level
25	µg/kg	Microgram per kilogram
26	µg/L	Microgram per liter
27	mg/kg	Milligram per kilogram
28	NAVBASE	Naval Base
29	OP	Organophosphorous
30	OWS	Oil/water separator

# 1 **Acronyms and Abbreviations, Continued**

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2	PCB	Polychlorinated biphenyl
3	ppb	Parts per billion
4	RBC	Risk-based concentration
5	RCRA	Resource Conservation and Recovery Act
6	RFI	RCRA Facility Investigation
7	SAP	Sampling and analysis plan
8	SCDHEC	South Carolina Department of Health and Environmental Control
9	SDG	Sample data group
10	SSL	Soil screening level
11	SVOC	Semivolatile organic compound
12	TDS	Total dissolved solids
13	UST	Underground storage tank
14	VOC	Volatile organic compound

**Section 1.0**

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# 1.0 Introduction

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

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

In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at the CNC. This submittal has been prepared by CH2M-Jones to complete the RCRA Facility Investigation (RFI) for Areas of Concern (AOCs) 598 and 599 in Zone E of the CNC. The location of AOCs 598 and 599 in Zone E is shown in Figure 1-1. Figure 1-2 is an aerial photograph of the site.

## 1.1 Background

AOC 598 is a former sonar dome repair area adjacent to Pier J at the CNC. It consisted of a temporary metal building on asphalt pavement. Several storm drains are located in the vicinity. The area was used to clean and repaint sonar domes and to remove adhesives, and the repair work occurred both inside and outside of the building. Currently the area is used by a boat maintenance and repair shop for cleaning and repairing boats.

AOC 599 is a former pump house on Pier J. The pump house was damaged by hurricane Hugo in 1989. Since that time, rainwater has collected in the below-grade structure. The pump house was formerly a transfer station for diesel fuel.

The materials of concern identified in the *Final Zone E RFI Work Plan, Revision 1* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995) include paints, solvents, adhesives, blasting grit, and petroleum hydrocarbons. This area of Zone E is zoned M-2 (for industrial land use). The CNC RCRA Permit identified AOCs 598 and 599 as requiring a confirmatory sampling investigation (CSI).

1 The RFI was initially conducted by the Navy/EnSafe Inc. (EnSafe) team, and the RFI  
2 activities were described in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). Regulatory  
3 review was conducted on this document and a draft response to the comments from  
4 SCDHEC was prepared by the Navy/EnSafe team. A copy of these comments and  
5 responses are included in Appendix A of this document.

6 Benzo[a]pyrene equivalents (BEQs) have been identified as chemicals of concern in the  
7 surface soil at AOCs 598 and 599. As a result, a Corrective Measures Study (CMS) Work  
8 Plan (CMSWP) has been prepared and is appended to this Revision 1 RFI Report  
9 Addendum (RFIRA). This CMSWP is presented in Section 8.0 of this document. CH2M-  
10 Jones' responses to SCDHEC comments on the *RFI Report Addendum, AOCs 598 and 599,*  
11 *Zone E, Revision 0*, originally submitted on October 4, 2002, are presented in Appendix B.

## 12 **1.2 Purpose of the RFI Report Addendum and CMS Work Plan**

13 The purpose of this RFIRA/CMSWP is to document the results of previous RFI  
14 investigations conducted by the Navy/EnSafe team at AOCs 598 and 599. This  
15 RFIRA/CMSWP includes a summary of previous RFI investigations and conclusions, as  
16 well as additional investigations conducted by CH2M-Jones during 2002 at AOCs 598 and  
17 599. This document also discusses various closeout issues and the findings of previous  
18 investigations, existing site conditions, and surrounding area land use.

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

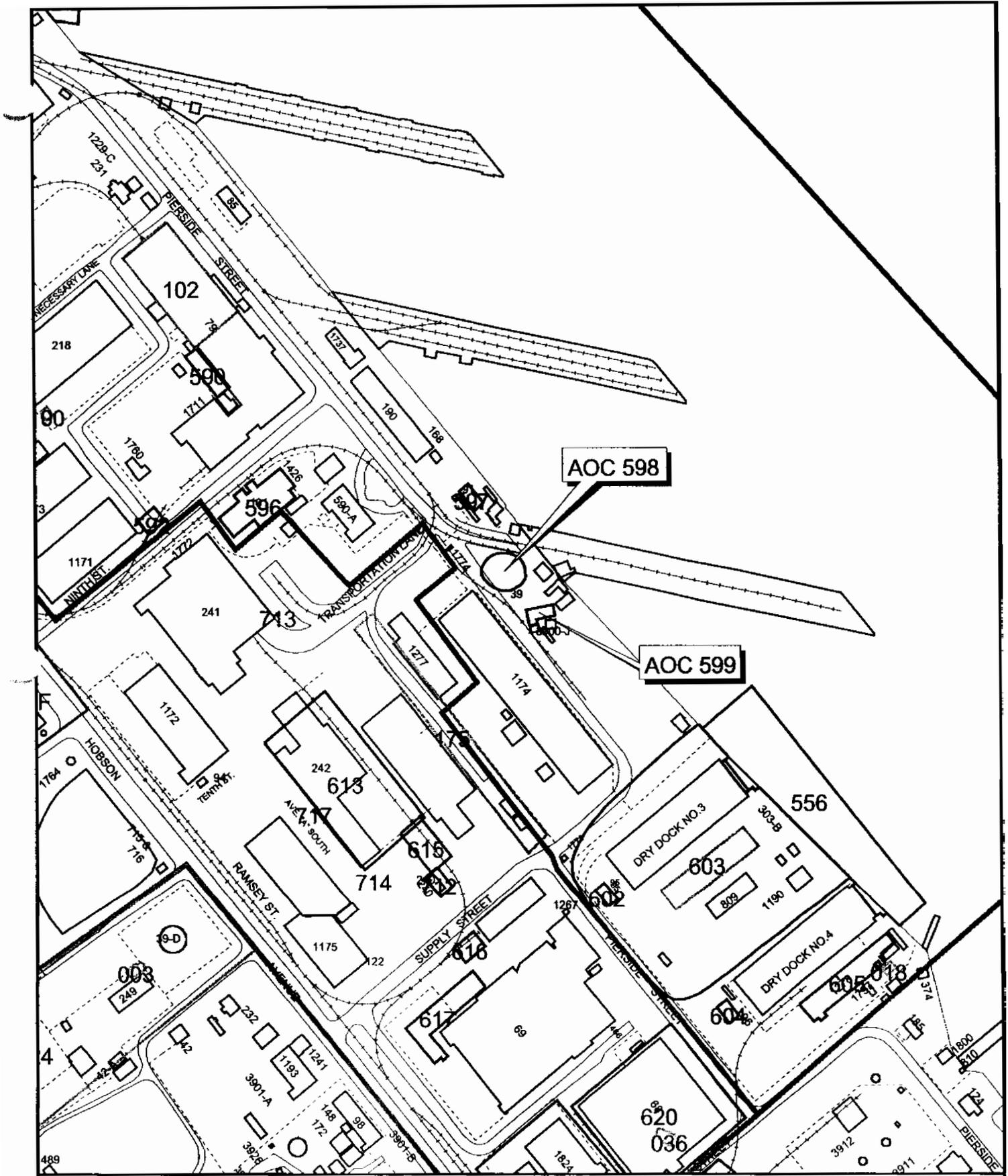
- 21 • Status of the RFI
- 22 • Presence of metals (inorganics) in groundwater
- 23 • Potential linkage to SWMU 37, Investigated Sanitary Sewers at the CNC
- 24 • Potential linkage to Area of Concern (AOC) 699, Investigated Storm Sewers at the CNC
- 25 • Potential linkage of AOC 504, Investigated Railroad Lines at the CNC
- 26 • Potential linkage to surface water bodies (Zone J)
- 27 • Potential contamination associated with oil/water separators (OWSs)
- 28 • Relevance or need for land use controls (LUCs) at the site

## 29 **1.3 Report Organization**

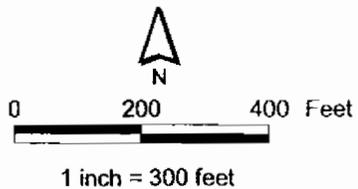
30 This RFIRA/CMSWP consists of the following sections, including this introductory section:

- 1 **1.0 Introduction** – Presents the purpose of the report and background information relating  
2 to the RFIRA/CMSWP.
- 3 **2.0 Summary of RFI Conclusions for AOCs 598 and 599** – Summarizes the conclusions  
4 from the RFI and risk evaluations for AOCs 598 and 599, as presented in the *Zone E RFI*  
5 *Report, Revision 0*.
- 6 **3.0 Interim Measures and UST/AST Removals** – Provides information regarding any  
7 interim measures (IMs) or tank removal activities performed at the site.
- 8 **4.0 Summary of Additional Investigations** – Summarizes information, if any, collected  
9 after completion of the *Zone E RFI Report, Revision 0*.
- 10 **5.0 COPC/COC Refinement** – Provides further evaluation of chemicals of potential concern  
11 (COPC) based on RFI and additional data to assess them as COCs.
- 12 **6.0 Summary of Information Related to Site Closeout Issues** – Discusses the various site  
13 closeout issues that the BRAC Cleanup Team (BCT) agreed to evaluate prior to site  
14 closeout.
- 15 **7.0 Recommendations** – Provides recommendations for proceeding with site closure.
- 16 **8.0 CMS Work Plan for AOCs 598 and 599** – Presents a focused CMSWP to address BEQs  
17 as COCs in surface soil at the AOCs 598 and 599 site.
- 18 **9.0 References** – Lists the references used in this document.
- 19 **Appendix A** – Contains responses to SCDHEC comments for AOCs 598 and 599 from the  
20 *Zone E RFI Report, Revision 0 (EnSafe, 1997)*.
- 21 **Appendix B** – Contains responses to SCDHEC comments regarding the *RFI Report*  
22 *Addendum, AOCs 598 and 599, Zone E, Revision 0 (CH2M-Jones, 2002)*.
- 23 **Appendix C** – Contains excerpts from the *Zone E RFI Report, Revision 0*, including a  
24 summary of detections of chemicals and Figure C-1, a groundwater flow map for the site  
25 vicinity.
- 26 **Appendix D** – Contains Figure D-1, which shows the site location from the Public Works  
27 Map of the Charleston Navy Shipyard dated November 3, 1955, depicting the presence of  
28 railroad lines at the site.
- 29 **Appendix E** – Contains the analytical results summary for the additional soil and  
30 groundwater samples collected by CH2M-Jones during July 2002.

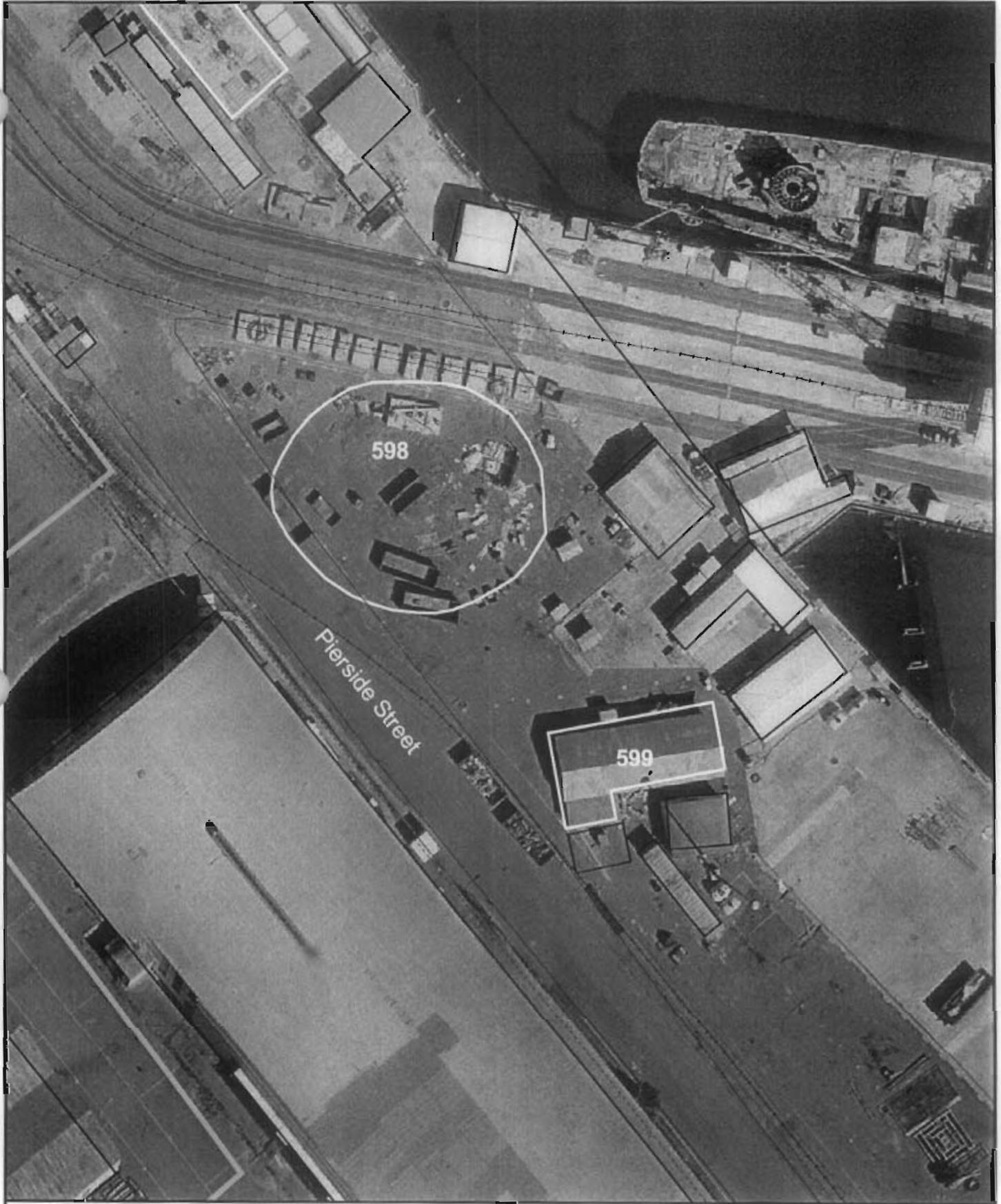
- 1 **Appendix F**– Contains data validation summaries for the analytical results of the July 2002
- 2 sampling.
- 3 All tables and figures appear at the end of their respective sections.



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



**Figure 1-1**  
Location of AOCs 598 and 599 in Zone E  
Charleston Naval Complex



- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary

- Buildings
- Zone Boundary



**Figure 1-2**  
Site Map  
AOC 598 and AOC 599, Zone E  
Charleston Naval Complex

## 2.0 Summary of RFI Conclusions for AOCs 598 and 599

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This section summarizes the results and conclusions from the soil, groundwater, and sediment investigations conducted at AOCs 598 and 599, as reported in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). Appendix C contains a summary of the sampling data collected during the RFI, including a groundwater flow map for the site vicinity.

As part of the Zone E RFI, soil, groundwater, and sediment investigations were conducted at AOCs 598 and 599 from 1995 to 1997. The RFI report presented the results of these investigations and conclusions concerning contamination and risk, as summarized in the following sections. A further evaluation of the COCs identified at this site is provided in Section 5.0. Figure 2-1 shows the RFI soil, groundwater, and sediment sampling locations.

### 2.1 Soil Sampling and Analysis

The RFI at AOCs 598 and 599 included two soil sampling events. During the first sampling event, nine surface soil samples and seven co-located subsurface soil samples were collected and analyzed from locations under concrete and asphalt pavement. The samples collected during the first event were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, cyanide, and pesticides/polychlorinated biphenyls (PCBs). Two subsurface soil samples were selected as duplicates and analyzed for VOCs, SVOCs, herbicides, organophosphorous (OP) pesticides, hexavalent chromium, and dioxins. During the second sampling event, four surface soil samples and three co-located subsurface soil samples were collected to delineate the extent of constituents detected during first event sampling. Samples from the second sampling event were analyzed for SVOCs and metals. No duplicate samples were collected during the second sampling event.

#### 2.1.1 Surface Soil Results

During the RFI, surface soil detections of organic compounds were evaluated against the U.S. Environmental Protection Agency (EPA) Region III industrial risk-based concentrations (RBCs) (with a hazard index [HI]=0.1 for noncarcinogens). Surface soil detections of inorganic compounds were evaluated against the EPA Region III industrial RBCs (HI=0.1 for noncarcinogens) and the Zone E background reference concentrations (BRCs).

1 Detected concentrations of organic and inorganic analytes exceeding their respective criteria  
2 are as follows:

### 3 **VOCs**

4 No VOCs exceeded the screening criteria in surface soils.

### 5 **SVOCs**

6 The RFI report stated that among detected SVOC compounds, elevated BEQ concentrations  
7 were detected at four locations. There were four calculated BEQ concentrations that  
8 exceeded the industrial RBC of 780 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) for benzo[a]pyrene.  
9 These BEQ detections were found in samples from E598SB002 at 7,095  $\mu\text{g}/\text{kg}$ , E598SB006 at  
10 1,395  $\mu\text{g}/\text{kg}$ , E599SB003 at 1,017  $\mu\text{g}/\text{kg}$ , and E599SB007 at 24,920  $\mu\text{g}/\text{kg}$ . BEQ calculations  
11 were performed using the method adopted by the BCT at the time of writing of the *Zone E*  
12 *RFI Report, Revision 0*.

### 13 **Inorganics**

14 The RFI report stated that among detected inorganic analytes, only lead exceeded the  
15 screening criteria. At a concentration of 1,810 milligrams per kilogram ( $\text{mg}/\text{kg}$ ), at soil  
16 boring location E598SB005, lead exceeded both the industrial reuse target screening criterion  
17 of 1,300  $\text{mg}/\text{kg}$  and the Zone E surface soil BRC of 265  $\text{mg}/\text{kg}$ .

### 18 **Pesticides/PCBs**

19 Detected pesticide concentrations did not exceed the screening criteria. There were no PCB  
20 concentrations detected above laboratory detection limits.

### 21 **Dioxins**

22 There were no dioxin detections above laboratory detection limits.

## 23 **2.1.2 Subsurface Soil Results**

24 During the RFI, subsurface soil detections of organic compounds were compared with  
25 generic soil screening levels (SSLs) (using a dilution attenuation factor [DAF]=10).

26 Subsurface soil detections of inorganic compounds were compared with generic SSLs (using  
27 a DAF=10) and the Zone E BRCs.

28 Detected concentrations of organic and inorganic compounds from subsurface soil samples  
29 are as follows:

## 1 **VOCs**

2 No VOCs exceeded the screening criteria in subsurface soil.

## 3 **SVOCs**

4 The RFI report stated that among detected SVOC compounds, elevated benzo[a]pyrene and  
5 chrysene concentrations were detected at three locations. BEQ concentrations for subsurface  
6 soil were not calculated during the RFI.

- 7 • Benzo[a]anthracene detections at three locations exceeded the SSL of 700 µg/kg:  
8 E598SB002 at 2,100 µg/kg, E598SB003 at 720 µg/kg, and E598SB005 at 1,500 µg/kg.
- 9 • Chrysene detections at three locations exceeded the SSL of 1,000 µg/kg: E598SB002 at  
10 1,700 µg/kg, E598SB003 at 1,100 µg/kg, and E598SB005 at 1,700 µg/kg.

## 11 **Inorganics**

12 Among detected inorganic analytes, arsenic and lead exceeded the screening criteria.

- 13 • One arsenic detection at 21.6 mg/kg, at E599SB001, exceeded both its SSL of 15 mg/kg  
14 and the Zone E BRC of 19.9 mg/kg in subsurface soil.
- 15 • One duplicate sample showed a lead detection at 1,680 mg/kg (at E598SB002) exceeded  
16 both its SSL of 400 mg/kg and the Zone E BRC of 173 mg/kg in subsurface soil. This  
17 concentration, as presented in the RFI report, comes from a duplicate sample,  
18 E598CB002, which was collected from the soil boring E598SB002. The normal sample at  
19 E598SB002 showed a lead detection of 462 mg/kg, which exceeds the SSL of 400 mg/kg  
20 and Zone E BRC of 173 mg/kg in subsurface soil.

## 21 **Pesticides/PCBs**

22 Detected pesticide concentrations did not exceed the screening criteria. There were no PCB  
23 concentrations detected above laboratory detection limits.

## 24 **Dioxins**

25 Detected dioxin concentrations in subsurface soil samples did not exceed screening criteria.

## 26 **2.2 Groundwater Sampling and Analysis**

27 The RFI for AOCs 598 and 599 included the installation of two shallow monitoring wells,  
28 E598GW001 (formerly identified as NBCE598001) and E599GW001 (formerly identified as  
29 NBCE599001), as shown in Figure 2-1. The groundwater samples were analyzed for VOCs,

1 SVOCs, metals, pesticides/PCBs, cyanide, pH, chlorides, sulfates, and total dissolved solids  
2 (TDS). No duplicate samples were collected at this site.

3 During the RFI, each well was sampled four times between 1996 and 1997. Constituents  
4 detected in the groundwater samples were evaluated relative to the EPA Region III tap  
5 water RBCs, maximum contaminant levels (MCLs), and the Zone E BRCs for shallow  
6 aquifers.

## 7 **2.2.1 Shallow Groundwater Results**

8 Analyte concentrations in shallow groundwater samples were detected as follows at this  
9 site:

### 10 **VOCs**

11 No VOCs were detected in shallow groundwater above laboratory detection limits.

### 12 **SVOCs**

13 No SVOCs exceeded the screening criteria in shallow groundwater samples.

### 14 **Inorganics**

15 Among detected analytes, barium and iron exceeded screening criteria.

- 16 • Barium, at a concentration of 672 micrograms per liter ( $\mu\text{g}/\text{L}$ ) at E598GW001, exceeded  
17 its tap water RBC of 260  $\mu\text{g}/\text{L}$  in shallow groundwater and shallow groundwater BRC of  
18 211  $\mu\text{g}/\text{L}$ , but was below the MCL of 2,000  $\mu\text{g}/\text{L}$ .
- 19 • Iron, at concentrations of 67,100  $\mu\text{g}/\text{L}$  at E598GW001 and 12,800  $\mu\text{g}/\text{L}$  at E599GW001,  
20 exceeded its tap water RBC of 1,100  $\mu\text{g}/\text{L}$  in shallow groundwater. No primary MCL  
21 exists for iron and no shallow groundwater BRC was developed for iron in Zone E  
22 during the RFI.

### 23 **Pesticides/PCBs**

24 One pesticide, heptachlor, was detected in one shallow groundwater sample. No PCBs  
25 exceeded the screening criteria in shallow groundwater samples.

- 26 • Heptachlor was detected in the first groundwater samples collected at monitoring well  
27 E599GW001 at a concentration of 0.058  $\mu\text{g}/\text{L}$ , which exceeded its tap water RBC of  
28 0.00230  $\mu\text{g}/\text{L}$ , but not its MCL of 0.4  $\mu\text{g}/\text{L}$ . Heptachlor was not detected in the three  
29 subsequent groundwater samples from this well nor in any other groundwater samples  
30 at this site.

## 2.3 Sediment Sampling and Analysis

The RFI for AOCs 598 and 599 included two sediment samples collected from locations shown in Figure 2-1. The sediment samples were analyzed for VOCs, SVOCs, and metals. These sediments were found in the storm drain catch basins and are not true sediments collected along surface water bodies.

Detections in sediment samples were evaluated during the RFI against the EPA Region III industrial RBCs for soil (with a HI=0.1 for noncarcinogens).

The detected concentrations of organic and inorganic compounds from sediment samples are as follows:

### VOCs

No VOCs were detected above laboratory detection limits.

### SVOCs

No SVOC detections exceeded the screening criteria in sediment samples.

### Inorganics

Among detected inorganic analytes, two metals exceeded their respective screening criteria:

- Arsenic exceeded the industrial soil RBC of 3.8 mg/kg at a concentration of 6.2 mg/kg at E598M0001, and at a concentration of 6.1 mg/kg at E599M0001.
- Copper exceeded the industrial soil RBC of 8,200 mg/kg at a concentration of 17,900 mg/kg at E599M0001.

Subsequent to the RFI, the sediments that were present in the floor drain at AOCs 598 and 599 were removed as part of the IM for AOC 699, which was conducted by the Environmental Detachment Charleston (DET) in 1999. As a result, these sediments are no longer present at this site.

## 2.4 RFI Human Health Risk Assessment (HHRA)

The *Zone E RFI Report, Revision 0* used a fixed-point risk evaluation (FRE) approach at this site. The FRE included site resident and site worker exposure scenarios. The detailed risk assessment for the AOCs 598 and 599 site are presented in Section 10.47.8 of the RFI report.

1 **2.4.1 Soils**

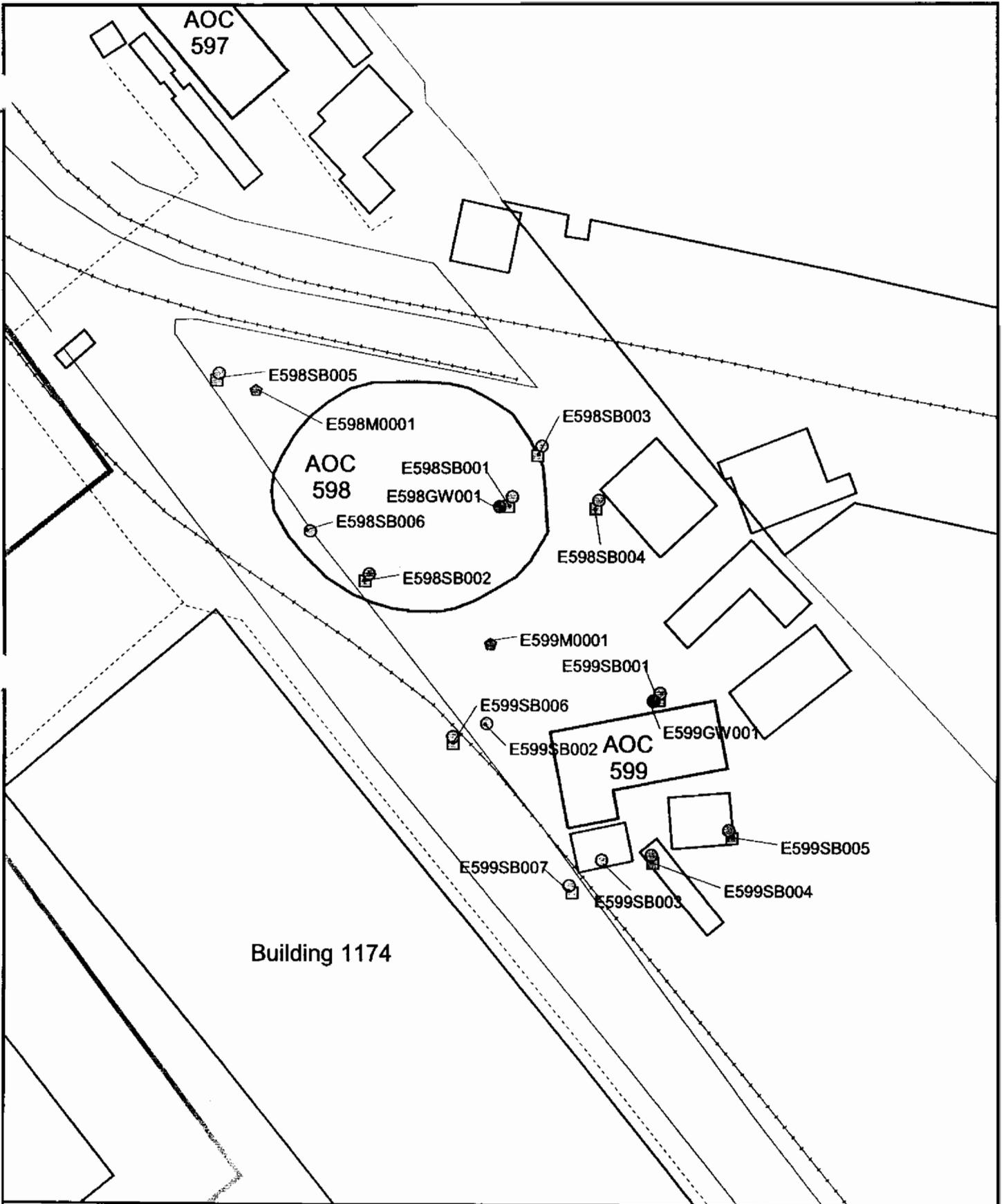
2 BEQs and lead were retained as COCs for surface soil for both the unrestricted and  
3 industrial/commercial land use scenarios. No COCs were identified for subsurface soils at  
4 AOCs 598 and 599.

5 **2.4.2 Groundwater**

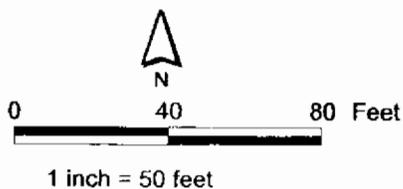
6 The RFI report indicated that heptachlor epoxide should be retained as a shallow  
7 groundwater COC. However, heptachlor epoxide was not detected above detection limits in  
8 the groundwater. The RFI report appears to have incorrectly reported heptachlor epoxide as  
9 a COC rather than heptachlor. Heptachlor as a COC is discussed further in Section 5.0 of  
10 this RFIRA/CMSWP.

11 **2.5 RFI Conclusions and Recommendations**

12 The *Zone E RFI Report, Revision 0* recommended that a CMS be conducted at AOCs 598 and  
13 599 to address BEQs in surface soil and heptachlor epoxide in shallow groundwater.



- Groundwater Monitoring Well
- ⊞ Sediment
- Surface Soil
- ⊠ Subsurface Soil
- - - Fence
- ≡ Railroads
- ∧ Roads
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings
- - - Zone Boundary



**Figure 2-1**  
RFI Sampling Locations  
AOCs 598 and 599, Zone E  
Charleston Naval Complex

**Section 2.0**

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**Section 3.0**

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

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### 2 **3.1 Interim Measures**

3 An IM was conducted by the DET for AOC 699 (January 1999), which included portions of  
4 the storm sewer system associated with AOCs 598 and 599. The activities conducted for the  
5 IM included hydro-blast cleaning of catch basins, manholes, and associated interconnecting  
6 piping. During this IM, at the storm drains located at AOCs 598 and 599 (sediment sampling  
7 locations E598M0001 and E599M0001), all sediments were removed from these sewer  
8 appurtenances. The IM activities are documented in *Interim Measure Completion Report for*  
9 *AOC 699 Storm Drain Cleaning* (DET, 1999).

### 10 **3.2 UST/AST Removals**

11 There is no indication of an underground storage tank (UST) or aboveground storage tank  
12 (AST) being present at this site.



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

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2 This section summarizes the results and conclusions from a soil investigation conducted at  
3 AOCs 598 and 599 by CH2M-Jones during July 2002 to verify the concentrations of BEQs  
4 and further delineate the nature and extent of lead in soil.

5 A sampling and analysis plan (SAP) for AOCs 598 and 599 was prepared by CH2M-Jones  
6 and submitted to SCDHEC during June 2002. The soil sampling was conducted during July  
7 2002. Appendices E and F present the analytical data summaries and the data validation  
8 report for this additional sampling, respectively.

### 9 **4.1 Soil Sampling and Analysis**

10 Three RFI soil boring locations E598SB002, E599SB007 (which showed elevated BEQ  
11 concentrations in surface soil of 7,095 µg/kg and 24,920 µg/kg, respectively), and  
12 E598SB005 (which showed elevated lead concentrations in surface soil of 1,810 µg/kg) were  
13 resampled during July 2002 to verify if source material for BEQs and lead were present at  
14 these locations. The new borings were identified as E598SB011, E599SB008, and E598SB010,  
15 respectively. Three additional soil boring locations, identified as E598SB007, E598SB008, and  
16 E598SB009, were sampled to further delineate lead concentrations. At these resampling  
17 locations and the new sampling locations, surface and subsurface samples were collected  
18 from the 0 to 1 foot below land surface (ft bls) and 3 to 5 ft bls depth intervals. Figure 4-1  
19 shows the soil sampling locations.

20 Table 4-1 presents the detected concentrations of BEQs and lead in surface and subsurface  
21 soil during the July 2002 sampling event. Figure 4-1 shows the detected concentrations of  
22 BEQs and lead in the soil samples collected.

#### 23 **4.1.1 Surface Soil Results**

24 Surface soil results were compared to EPA Region III RBCs (HI=0.1), generic SSLs (based on  
25 DAF=1 for VOCs and DAF = 10 for other chemicals) and for inorganic chemicals, the range  
26 of background concentrations detected in Zone E grid samples. These detections are  
27 discussed below.

1 **BEQs**

2 BEQ concentrations in surface soil samples were 61  $\mu\text{g}/\text{kg}$  at E599SB008 and 296  $\mu\text{g}/\text{kg}$  at  
3 E598SB011. Both of these detections are below the industrial RBC of 780  $\mu\text{g}/\text{kg}$  for  
4 benzo[a]pyrene and the CNC BEQ sitewide reference concentration of 1,304  $\mu\text{g}/\text{kg}$  for  
5 surface soils.

6 **Lead**

7 During the July 2002 sampling, there were four detections of lead in surface soil samples  
8 ranging from 39.2 mg/kg to 135 mg/kg, which are below the unrestricted (i.e., residential)  
9 land use screening goal of 400 mg/kg and the SSL of 400 mg/kg.

10 **4.1.2 Subsurface Soil Results**

11 **Lead**

12 During the July 2002 sampling, there were four detections of lead in subsurface soil samples  
13 ranging from 26.8 mg/kg to 119 mg/kg, which are below the SSL of 400 mg/kg and the  
14 maximum Zone E subsurface soil background concentration of 322 mg/kg.

**TABLE 4-1**  
 Detected Concentrations of BEQs and Lead in Surface and Subsurface Soil, July 2002 Sampling  
*RFI Report Addendum and CMS Work Plan, AOCs 598 and 599, Zone E, Charleston Naval Complex*

Analyte	Station ID	Sample ID	Concentration ( $\mu\text{g}/\text{kg}$ )	Qualifier	Date Collected	EPA Region III Residential RBC	SSL	Zone E Background Range of Concentrations
<b>BEQs<sup>a</sup></b>	<b>Surface Soil</b>					88	NA	1,304
	E598SB011	598SB01101	295.5	=	07/20/2002			
	E599SB008	599SB00901	60.6	U	07/20/2002			
<b>Lead</b>	<b>Surface Soil</b>		<b>(mg/kg)</b>			400	400	1 - 400
	E598SB007	598SB00701	135	J	07/20/2002			
	E598SB008	598SB00801	112	J	07/20/2002			
	E598SB009	598SB00901	39.2	J	07/20/2002			
	E598SB010	598SB01001	34.7	J	07/20/2002			
	<b>Subsurface Soil</b>					400	400	1.8 - 322
	E598SB007	598SB00702	119	J	07/20/2002			
	E598SB008	598SB00802	26.8	J	07/20/2002			
	E598SB009	598SB00902	28.9	J	07/20/2002			

<sup>a</sup> BEQ calculation method based on the *Background PAHs Study Report: Technical Information for Development of Background BEQ values* (CH2M-Jones, 2001a).

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

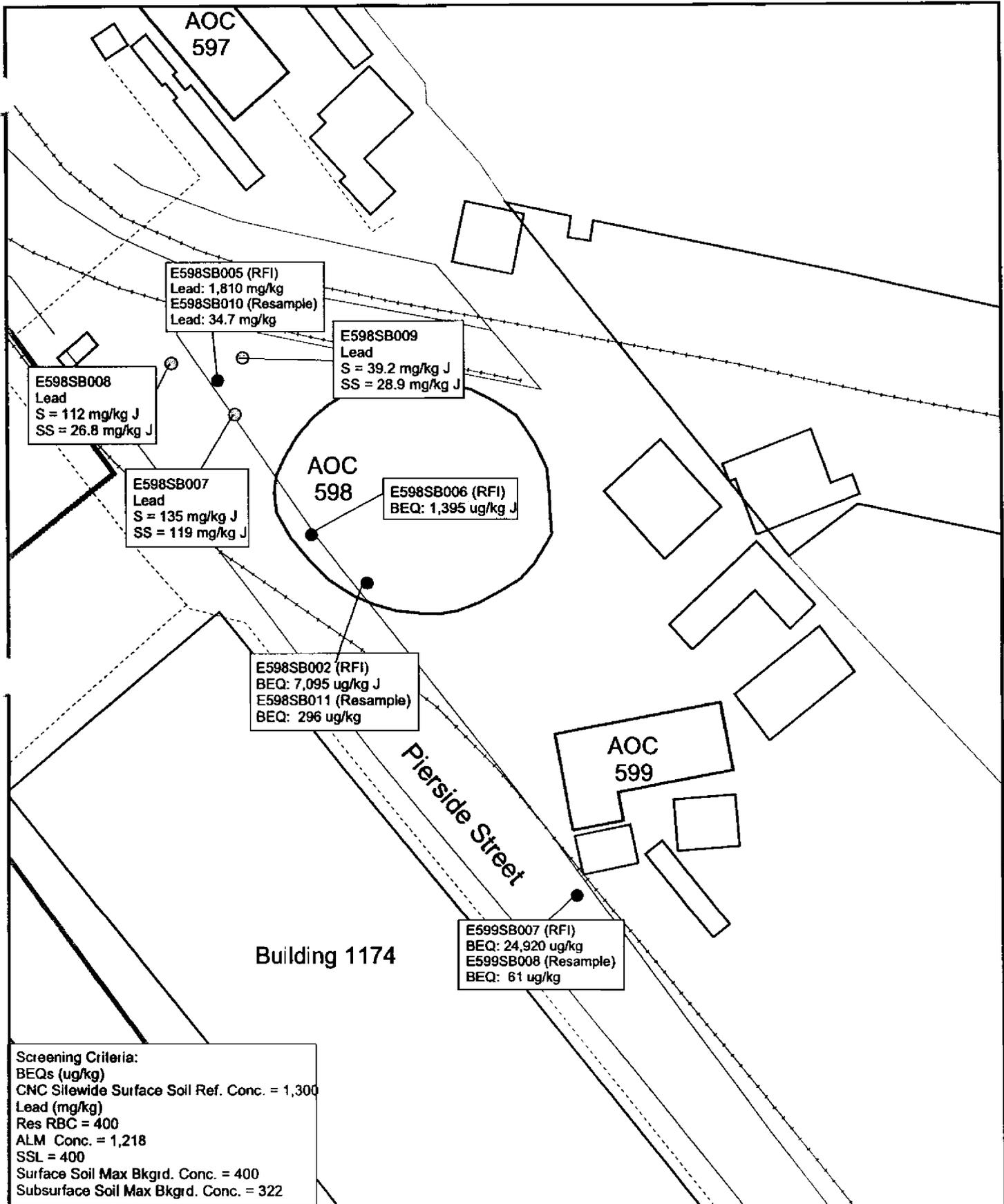
J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quantification limit.

$\mu\text{g}/\text{kg}$  Micrograms per kilogram

$\text{mg}/\text{kg}$  Milligrams per kilogram

NA Not applicable/not available

U Indicates that the concentration was not detected.



Screening Criteria:  
 BEQs (ug/kg)  
 CNC Sitewide Surface Soil Ref. Conc. = 1,300  
 Lead (mg/kg)  
 Res RBC = 400  
 ALM Conc. = 1,218  
 SSL = 400  
 Surface Soil Max Bkgrd. Conc. = 400  
 Subsurface Soil Max Bkgrd. Conc. = 322

○ 2002 Soil Boring Location      S = Surface Soil  
 ● RFI Surface Soil Exceedances    SS = Subsurface Soil  
 --- Fence  
 --- Railroads  
 --- Roads  
 □ AOC Boundary  
 □ SWMU Boundary  
 □ Buildings  
 □ Zone Boundary

0      40      80 Feet  
 1 inch = 50 feet

**Figure 4-1**  
 Surface Soil Exceedances with  
 July 2002 Sampling Locations  
 AOCs 598 and 599, Zone E  
 Charleston Naval Complex

File Path: C:\1805\F\projects\Zone\_E\AOC-598-599-cnc-soils.apr Date: 26 Sep 2002 9:09 User: TWJ/EY



## 1 5.0 COPC/COC Refinement

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2 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs and lead as surface soil  
3 COCs and heptachlor as a shallow groundwater COC for AOCs 598 and 599 for the  
4 unrestricted and future industrial land use scenarios. These chemicals are further discussed  
5 below. In addition, the BCT has agreed that detections of VOCs in soil should be rescreened  
6 using generic SSLs based on a DAF=1. This section presents the results of this rescreening.

### 7 5.1 Soil COCs

#### 8 5.1.1 BEQs

9 Table 5-1 lists the detected BEQ concentrations in surface soils from the RFI sampling and  
10 2002 sampling. During the RFI, BEQ concentrations in surface soil exceeded the CNC  
11 surface soil BEQ sitewide reference concentration of 1,304 µg/kg at three sampling  
12 locations: E598SB002 at 7,095 µg/kg, E599SB007 at 24,920 µg/kg, and E598SB006 at 1,395  
13 µg/kg. During the July 2002 verification sampling at these locations, BEQ detections from  
14 resampled locations E598SB002 and E599SB007 did not exceed the CNC BEQ sitewide  
15 reference concentration of 1,304 µg/kg for surface soils (See Table 4-1).

16 The BEQ concentration at E598SB006 of 1,395 µg/kg detected during the RFI is only slightly  
17 higher than the CNC BEQ sitewide reference concentration of 1,304 µg/kg for surface soils.  
18 This detection did not exceed the maximum railroad area background BEQ concentration of  
19 5,133 µg/kg. Figure D-1 in Appendix D shows the presence of historic railroad lines at the  
20 site from the Public Works Map of the CNC, dated November 3, 1955. These railroad lines  
21 were located in areas where higher detections of BEQs were found during the RFI sampling.  
22 The railroad lines are still present at the site.

23 The background concentration sampling effort conducted at the CNC for arsenic and BEQs  
24 along the railroad lines during 2001 indicated a distribution of elevated concentrations of  
25 BEQs in surface soils around railroad lines and paved areas. The details of this investigation  
26 are found in the *Technical Memorandum: Results from Additional Background Sampling of the*  
27 *CNC Railroad Lines and Naval Annex (Zone K)* (CH2M-Jones, 2001b). The range of railroad  
28 background BEQ concentrations detected during this investigation was from 87 µg/kg to  
29 5,133 µg/kg.

1 This sample location and others at AOCs 598 and 599 are under asphalt pavement, which  
2 could be the source of the detected BEQs. Direct exposure to these exceeded BEQ  
3 concentrations is not a concern in this highly industrial area of Zone E. The detected BEQs  
4 are also likely associated with the previous railroad lines at the site, and are not likely  
5 associated with site operations at AOCs 598 and 599. However, due to the historic elevated  
6 detections of BEQs in RFI surface soil samples from E598SB002, E598SB006 and E599SB007,  
7 BEQs will be considered as COCs in surface soils at AOCs 598 and 599.

8 No BEQs were detected in subsurface soil above the CNC BEQ sitewide reference  
9 concentration of 1,400  $\mu\text{g}/\text{kg}$  for subsurface soils. No BEQs were detected in groundwater  
10 above laboratory detection limits at this site, indicating that BEQs are not a leaching concern  
11 at this site. Based on these considerations, BEQs are not considered to be COCs in the  
12 subsurface soil at this site.

### 13 **5.1.2 Lead**

14 Table 5-1 shows the detections of lead in surface and subsurface soil samples at AOCs 598  
15 and 599. During the RFI sampling there was one surface soil detection of lead above the  
16 unrestricted land use criterion of 400 mg/kg, at E598SB005 (1,810 mg/kg). During the July  
17 2002 sampling, this location was resampled as E598SB010, and lead was detected at a  
18 concentration of 34.7 mg/kg, which is below the unrestricted (i.e., residential) land use  
19 criterion. Surface soil samples were collected in order to further delineate lead around soil  
20 boring E598SB005. Lead concentrations ranged from 39.2 mg/kg to 135 mg/kg, which are  
21 also below the unrestricted land use screening goal of 400 mg/kg. The recent detections of  
22 lead at and around the RFI boring location of E598SB005, which showed the elevated lead  
23 detection, indicate that there is no source of lead in soils in this area, and that the lead  
24 concentrations in this area are below screening criteria. All soil samples were collected from  
25 below asphalt/concrete pavement, indicating that the residual lead concentrations are not a  
26 direct exposure concern at the site.

27 In subsurface soil samples, two detections of lead from the RFI sampling exceeded the SSL  
28 of 400 mg/kg for lead. These detections were found at E598SB001 (at 456 mg/kg) and  
29 E598SB002 (at 462 mg/kg). Site averages for the subsurface lead concentration were  
30 calculated first using only the RFI detections, and later including the July 2002 sampling  
31 data. Both values are presented in Table 5-1. Both site averages (185 mg/kg and 155 mg/kg)  
32 are below the SSL of 400 mg/kg, indicating that the lead concentrations in subsurface soil  
33 are not a leaching concern at the site.

1 Lead was detected in one out of eight groundwater samples during the four RFI sampling  
2 events. This single detection at a concentration of 1.1 µg/L at E598GW001 did not exceed the  
3 treatment technique action level (TTAL) for lead of 15 µg/L, indicating that lead is not a  
4 leaching concern, and that there is no impact to groundwater from lead concentrations in  
5 soil at the site. The RFI groundwater sampling results for lead are provided in Appendix C.  
6 Based on these considerations, lead is not considered a COC in soil at this site.

### 7 **5.1.3 Soil VOC Rescreening using SSL at DAF=1**

8 Soil VOC detections were compared to SSLs at DAF=1, and only one chemical, methylene  
9 chloride, exceeded this screening criterion. Methylene chloride was detected in only one of  
10 nine surface soil samples and was not detected in seven subsurface soil samples. These  
11 detections do not represent a widespread distribution of methylene chloride. The single  
12 detection of methylene chloride was 4 µg/kg in surface soil at E598SB004, which is above  
13 the SSL (DAF=1) of 1 µg/kg, as shown in Table 5-1.

14 There were no methylene chloride detections in groundwater samples collected from  
15 monitoring wells associated with AOCs 598 and 599, indicating that methylene chloride in  
16 soil at this site does not pose a threat to groundwater via leaching.

17 Methylene chloride was detected in six of the laboratory blank samples associated with the  
18 AOCs 598 and 599 sample data group (SDG 23560) at concentrations ranging from 5 µg/kg  
19 to 8 µg/kg, as shown in Appendix C. Methylene chloride is a recognized common  
20 laboratory contaminant and has been widely detected previously in many blanks associated  
21 with CNC samples. Based on EPA's "ten times rule," methylene chloride at concentrations  
22 up to 80 parts per billion (ppb) may be considered as possible laboratory contamination.  
23 Because of its presence at low concentrations in the laboratory blanks and in only one site  
24 sample, it is likely that methylene chloride is detected due to contamination as a laboratory  
25 contaminant. For these reasons, methylene chloride is not considered a COC for soil at this  
26 site.

## 27 **5.2 Groundwater COCs**

### 28 **5.2.1 Heptachlor**

29 The *Zone E RFI Report, Revision 0* identified heptachlor epoxide as a COC in groundwater.  
30 Heptachlor epoxide was not detected in groundwater above laboratory detection limits, but  
31 may have been considered in place of heptachlor, which was detected during the RFI at  
32 concentrations below its MCL.

1 Table 5-2 presents the heptachlor detections from four groundwater sampling events at  
2 shallow wells at this site. Heptachlor was detected in one out of seven groundwater samples  
3 during the four RFI sampling events. This single detection at a concentration of 0.058 µg/L  
4 at E599GW001 exceeded its tap water RBC of 0.015 µg/L, but not its MCL of 0.4 µg/L. This  
5 single low-level detection of heptachlor in the first groundwater samples from monitoring  
6 well E599GW001 was followed by three consecutive non-detect values for this chemical,  
7 indicating that the initial detection was anomalous. Therefore, heptachlor is not considered  
8 a COC in shallow groundwater.

### 9 **5.3 COC Summary**

10 BEQs are identified as surface soil COCs at AOCs 598 and 599. Section 8.0 presents a  
11 CMSWP to address BEQs in soil. No other COCs that require further action are identified in  
12 subsurface soil, sediment, or groundwater at AOCs 598 and 599.

**TABLE 5-1**

Detected Concentrations of BEQs, Lead, and Methylene Chloride in Surface and Subsurface Soil  
*RFI Report Addendum and CMS Work Plan, AOCs 598 and 599, Zone E, Charleston Naval Complex*

Analyte	Station ID	Sample ID	Concentration (µg/kg)	Qualifier	Date Collected	EPA Region III Residential RBC	SSL	Zone E Background Range of Conc.	
<b>BEQs<sup>a</sup></b>	<b>Surface Soil</b>					88	NA	1,304	
	E598SB001	598SB00101	590.9	=	09/19/1995				
	E598SB002	598SB00201	7,095	=	09/19/1995				
	E598SB003	598SB00301	609.8	=	09/20/1995				
	E598SB004	598SB00401	748.8	=	09/20/1995				
	E598SB005	598SB00501	910.9	=	09/16/1995				
	E598SB006	598SB00601	1,395	=	09/16/1995				
	E599SB001	599SB00101	20.3	=	09/20/1995				
	E599SB002	599SB00201	117.2	=	09/20/1995				
	E599SB003	599SB00301	1,017	=	09/20/1995				
	E599SB004	599SB00401	530.4	=	09/20/1995				
	E599SB005	599SB00501	471.2	=	09/20/1995				
	E599SB006	599SB00601	110	=	09/16/1995				
	E599SB007	599SB00701	24,920	=	09/16/1995				
	E598SB011	598SB01101	295.5	=	07/20/2002				
	E599SB008	599SB00901	60.6	U	07/20/2002				
		<b>Subsurface Soil</b>					88	NA	1,400
		E598SB001	598SB00102	348.2	=	09/19/1995			
E598SB002		598SB00202	340.1	=	09/19/1995				
E598SB003		598SB00302	715.9	=	09/20/1995				
E598SB004		598SB00402	1,014	=	09/20/1995				
E598SB005		598SB00502	1,007	=	09/16/1995				
E599SB001		599SB00102	228.5	=	09/20/1995				
E599SB004		599SB00402	654.4	=	09/20/1995				
E599SB005		599SB00502	591.4	=	09/20/1995				
E599SB006		599SB00602	405.3	=	09/16/1995				
E599SB007		599SB00702	114.1	=	09/16/1995				
<b>Lead</b>		<b>Surface Soil</b>					400	400	1 - 400
		E598SB001	598SB00101	127	J	09/19/1995			
		E598SB002	598SB00201	212	J	09/19/1995			
		E598SB003	598SB00301	60.3	J	09/19/1995			
	E598SB004	598SB00401	229	J	09/19/1995				
	E598SB005	598SB00501	1,810	=	09/16/1995				
	E598SB006	598SB00601	272	=	09/16/1995				
	E599SB001	599SB00101	27.5	J	09/20/1995				
	E599SB002	599SB00201	423	J	09/20/1995				
	E599SB003	599SB00301	30.3	J	09/20/1995				
	E599SB004	599SB00401	36	J	09/20/1995				
	E599SB005	599SB00501	233	J	09/20/1995				
	E599SB006	599SB00601	206	=	09/16/1995				
	E599SB007	599SB00701	28.5	=	09/16/1995				
	E598SB007	598SB00701	135	J	07/20/2002				
	E598SB008	598SB00801	112	J	07/20/2002				
	E598SB009	598SB00901	39.2	J	07/20/2002				
	E598SB010	598SB01001	34.7	J	07/20/2002				

**TABLE 5-1**  
 Detected Concentrations of BEQs, Lead, and Methylene Chloride in Surface and Subsurface Soil  
*RFI Report Addendum and CMS Work Plan, AOCs 598 and 599, Zone E, Charleston Naval Complex*

Analyte	Station ID	Sample ID	Concentration ( $\mu\text{g}/\text{kg}$ )	Qualifier	Date Collected	EPA Region III Residential RBC	SSL	Zone E Background Range of Conc.	
<b>Lead</b>	<b>Subsurface Soil</b>					400	400	1.8 - 322	
	E598SB001	598SB00102	<b>456</b>	J	09/19/1995				
	E598SB002	598SB00202	<b>462</b>	J	09/19/1995				
	E598SB003	598SB00302	66.6	J	09/20/1995				
	E598SB004	598SB00402	126	J	09/20/1995				
	E598SB005	598SB00502	124	=	09/16/1995				
	E599SB001	599SB00102	68.1	J	09/20/1995				
	E599SB004	599SB00402	8.4	J	09/20/1995				
	E599SB005	599SB00502	373	J	09/20/1995				
	E599SB006	599SB00602	142	=	09/16/1995				
	E599SB007	599SB00702	19.3	=	09/16/1995				
	E598SB007	598SB00702	119	J	07/20/2002				
	E598SB008	598SB00802	26.8	J	07/20/2002				
	E598SB009	598SB00902	28.9	J	07/20/2002				
	<b>Subsurface soil site average without July 2002 results</b>			184					
<b>Subsurface soil site average including July 2002 results</b>			155						
<b>Methylene Chloride</b>	<b>Surface Soil</b>					85	DAF = 1 0.001	NA	
	E598SB001	598SB00101	16	U	09/19/1995				
	E598SB002	598SB00201	25	U	09/19/1995				
	E598SB003	598SB00301	12	U	09/20/1995				
	E598SB004	598SB00401	<b>4</b>	J	09/20/1995				
	E599SB001	599SB00101	14	U	09/20/1995				
	E599SB002	599SB00201	6	U	09/20/1995				
	E599SB003	599SB00301	6	U	09/20/1995				
	E599SB004	599SB00401	6	U	09/20/1995				
	E599SB005	599SB00501	6	U	09/20/1995				
	<b>Subsurface Soil</b>						85	0.001	NA
	E598SB001	598SB00102	13	U	09/19/1995				
	E598SB002	598SB00202	28	U	09/19/1995				
	E598SB003	598SB00302	6	U	09/20/1995				
	E598SB004	598SB00402	6	U	09/20/1995				
E599SB001	599SB00102	7	U	09/20/1995					
E599SB004	599SB00402	6	U	09/20/1995					
E599SB005	599SB00502	15	U	09/20/1995					

<sup>a</sup> BEQ calculation method based on the *Background PAHs Study Report: Technical Information for Development of Background BEQ Values* (CH2M-Jones, 2001a).

Concentrations in bold and outlined text exceed the appropriate screening criteria.

- = Indicates that the analyte was detected at the concentration shown.
- J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quantification limit.
- NA Not applicable/not analyzed
- U Indicates that the concentration was not detected.

**TABLE 5-2**  
**Heptachlor Concentrations in Shallow Groundwater**  
*RFI Report Addendum and CMS Work Plan, AOCs 598 and 599, Zone E, Charleston Naval Complex*

Station ID	Sample ID	Concentration ( $\mu\text{g/L}$ )	Qualifier	Date Collected	EPA Region III Tap Water RBC	MCL
<b>Heptachlor</b>						
E598GW001	598GW00101	0.04	U	03/20/1996	0.015	0.4
E599GW001	599GW00101	0.058	=	03/21/1996		
E599GW001	599GW00102	0.056	U	07/16/1996		
E598GW001	598GW00103	0.04	UJ	12/16/1996		
E599GW001	599GW00103	0.04	UJ	12/17/1996		
E598GW001	598GW00104	0.04	U	02/26/1997		
E599GW001	599GW00104	0.04	U	02/27/1997		

$\mu\text{g/L}$  Micrograms per liter

MCL Maximum Contaminant Level

- = Indicates that the analyte was detected at the concentration shown.
- J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quantification limit.
- U Indicates that the concentration was not detected laboratory detection limit.
- UJ Indicates that the concentration was not detected and is estimated.



## 6.0 Summary of Information Related to Site Closeout Issues

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### 6.1 RFI Status

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) addressed Solid Waste Management Units (SWMUs)/AOCs within Zone E of the CNC, including AOCs 598 and 599. On the basis of the initial RFI work as well as the additional sampling and analysis by CH2M-Jones as described in this report, and with the submission of this RFIRA/CMSWP, the RFI is considered to be complete. BEQs have been identified as surface soil COCs due to historic BEQ exceedances in surface soil samples at sample locations E598SB002, E598SB006 and E599SB007.

### 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.

There were no detections of antimony in shallow wells above the laboratory detection limits. Arsenic was not detected above its MCL in shallow wells. Thallium detections in shallow groundwater wells exceeded the MCL during the third RFI sampling event. One of the detections also exceeded the Zone E shallow groundwater maximum background concentration for thallium of 6 µg/L. However, these detections were preceded and followed by sampling events in which thallium concentrations were below laboratory detection limits. Intermittent detections of thallium at the site in shallow groundwater do not point to a site-specific source, but can be attributed to natural occurrence. Appendix C presents thallium concentrations from the RFI groundwater sampling at AOCs 598 and 599. Further evaluation of this issue is not warranted.

1 **6.3 Potential Linkage to SWMU 37, Investigated Sanitary**  
2 **Sewers at the CNC**

3 There are no data suggesting that there was an impact to the sanitary sewers from this site.  
4 Therefore, further evaluation of this issue is not warranted.

5 **6.4 Potential Linkage to AOC 699, Investigated Storm Sewers**  
6 **at the CNC**

7 The DET IM conducted for AOC 699 removed sediments from the catch basins, manholes,  
8 and piping at the site. No sediments were left behind in these appurtenances. No data  
9 suggest that impacts to the storm sewers have been caused by this site. Based on these  
10 findings, further evaluation of this issue is not warranted.

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

13 The nearest existing railroad lines to AOCs 598 and 599 are approximately 8 feet southwest  
14 and northeast of the site. There is no known linkage between AOCs 598 and 599 and the  
15 investigated railroad lines of AOC 504. Further evaluation of this issue is not warranted.

16 **6.6 Potential Migration Pathways to Surface Water Bodies at**  
17 **the CNC**

18 The nearest surface water body to AOCs 598 and 599 is the Cooper River, which lies  
19 approximately 60 feet northeast of the site. The only potential migration pathway from the  
20 site to surface water is via overland flow via stormwater runoff. The entire site is covered  
21 with buildings and pavement, which eliminates contact of surface soil with stormwater.  
22 Similarly, runoff directed to the storm sewer system, which discharges to the Cooper River,  
23 does not contact the surface soil. Further evaluation of a potential pathway for contaminant  
24 migration via stormwater runoff is not warranted.

25 **6.7 Potential Contamination in Oil/Water Separators (OWSs)**

26 There are no OWSs associated with AOCs 598 and 599. In addition, there is no reference to  
27 an OWS at the site in the *Oil Water Separator Data* report, Department of the Navy,  
28 September 2000. Therefore, further evaluation of this issue is not warranted.

## 1 **6.8 Land Use Controls (LUCs)**

- 2 The Navy/CH2M-Jones team is proposing that this site be used only for industrial land use.
- 3 LUCs restricting the land use to industrial use only will be implemented by the BCT. The
- 4 LUC issue will be addressed in the CMSWP and the CMS Report for AOCs 598 and 599.



## 1 7.0 Recommendations

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2 AOC 598 is a former sonar dome repair area adjacent to Pier J. It consisted of a temporary  
3 metal building on asphalt pavement. Several storm drains are located in the vicinity. The  
4 area was used to clean and repaint sonar domes and to remove adhesives, and the repair  
5 work occurred both inside and outside of the building. Currently the area is used by a boat  
6 maintenance and repair shop for cleaning and repairing boats.

7 AOC 599 is a former pump house on Pier J. The pump house was damaged by hurricane  
8 Hugo in 1989. Since that time, rainwater has collected in the below-grade structure. The  
9 pump house was formerly a transfer station for diesel fuel.

10 The CNC RCRA Permit identified AOCs 598 and 599 as requiring a CSI.

11 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs and lead as surface soil  
12 COCs and heptachlor epoxide as a COC in shallow groundwater for AOCs 598 and 599.  
13 However, as a result of further evaluation, only BEQs in surface soil are identified as COCs  
14 under the industrial and unrestricted future land use scenarios.

15 A focused CMS is recommended for this site to evaluate potential remedies for addressing  
16 BEQs in site surface soil. Section 8.0 presents this focused CMSWP. Should a future property  
17 owner decide to use the property for unrestricted (i.e., residential) land use, the future  
18 owner may make a demonstration that the property is suitable for the proposed use or  
19 perform the necessary additional investigations and remediation, as necessary, for that  
20 proposed use. Because this site is within Zone E, LUCs that are applicable across Zone E will  
21 also apply at this location.

22 Once the BCT concurs with the proposed remedy, a Statement of Basis will be prepared that  
23 will be made available for public comment in accordance with SCDHEC policy. This will  
24 allow for public participation in the final remedy selection.



## 1 **8.0 CMS Work Plan for AOCs 598 and 599**

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2 BEQs were identified as COCs in surface soil for the unrestricted (i.e., residential) and  
3 industrial future land use scenarios at AOCs 598 and 599. Surface soil BEQ concentrations of  
4 7.095 mg/kg, 1.395 mg/kg, and 24.92 mg/kg detected during the initial RFI at soil boring  
5 locations E598SB002, E598SB006 and E599SB007, exceeded the CNC BEQ sitewide reference  
6 concentration for surface soils of 1.304 mg/kg. Therefore, a CMS will be conducted to  
7 evaluate potential corrective measures and to identify an appropriate remedy for the site.

8 This section presents a focused CMSWP for BEQs in surface soil at AOCs 598 and 599.  
9 Media cleanup standards (MCSs) are identified for COCs, and potential remedies that  
10 should be evaluated are also presented.

### 11 **8.1 Remedial Action Objectives**

12 Remedial action objectives (RAOs) are medium-specific goals that the remedial actions are  
13 designed to accomplish in order to protect human health and the environment by  
14 preventing or reducing exposures under current and future land use conditions. The RAOs  
15 identified for surface soil at AOCs 598 and 599 are to prevent ingestion and direct/dermal  
16 contact with soil containing COCs at unacceptable levels. No remedial actions are required  
17 for groundwater at AOCs 598 and 599.

### 18 **8.2 Remedial Goal Options and Media Cleanup Standards**

19 Throughout the process of remediating a hazardous waste site, a risk manager uses a  
20 progression of increasingly acceptable site-specific media levels in considering remedial  
21 alternatives. Under the RCRA program, remedial goal options (RGOs) and MCSs are  
22 developed at the end of the risk assessment in the RFI/Remedial Investigation (RI)  
23 programs, before completion of the CMS.

24 RGOs can be based on a variety of criteria, such as specific incremental lifetime cancer risk  
25 (ILCR) levels (e.g., 1E-04, 1E-05, or 1E-06), HI levels (e.g., 0.1, 1.0, 3.0), or site background  
26 concentrations. For a particular RGO, specific MCSs can be determined as target  
27 concentration values. Achieving these MCSs is accepted as demonstrating that RGOs and  
28 RAOs have been achieved. Achieving these goals should promote the protection of human

1 health and the environment, while achieving compliance with applicable state and federal  
2 standards.

3 The exposure medium of concern for AOCs 598 and 599 is surface soil impacted by BEQs.  
4 Because the AOCs 598 and 599 area is located within a highly developed area of the CNC,  
5 and there are no surface water bodies in the immediate vicinity of the site, ecological  
6 exposures were not considered applicable for evaluation.

7 The general vicinity around AOCs 598 and 599 within Zone E has elevated concentrations of  
8 BEQs, making it unfit for future unrestricted land use purposes. For BEQs, the target MCS  
9 for surface soil should be the CNC BEQ sitewide reference concentration developed by the  
10 BCT of 1,304  $\mu\text{g}/\text{kg}$ . An MCS will be met if the site statistical estimates of concentrations are  
11 similar to the background statistical estimates. For point comparisons between site and  
12 background levels, site concentration ranges may be compared with the ranges of  
13 background concentrations. Other potential RGOs, such as the 1E-06 ILCR, were considered  
14 but regarded as not applicable for BEQs because the site background concentrations of BEQs  
15 are significantly greater than this level.

### 16 **8.3 Potential Remedies to Evaluate**

17 Because of the relatively small quantity of contaminated soil, the list of practicable remedial  
18 alternatives for this site is limited. The two presumptive remedies that will be evaluated as  
19 part of the CMS include:

- 20 • Soil excavation and offsite disposal with LUCs, and
- 21 • LUCs

### 22 **8.4 Focused CMS Approach**

23 The focused CMS will consist of the following tasks that will be performed in the order  
24 presented below:

- 25 1. The corrective measure alternative described above will be screened using several  
26 criteria and decision factors.
- 27 2. The CMS and preferred corrective measure alternative will be documented in the CMS  
28 report.

## 1 **8.5 Approach to Evaluating Corrective Measure Alternatives**

2 According to the RCRA permit issued by SCDHEC (SCDHEC, 1998), the alternatives will be  
3 evaluated with the following five standards:

- 4 1. Protecting human health and the environment.
- 5 2. Attaining media cleanup standards (RGOs).
- 6 3. Controlling the source of releases to minimize future releases that may pose a threat to  
7 human health and the environment.
- 8 4. Complying with applicable standards for the management of wastes generated by  
9 remedial activities.
- 10 5. Other factors include (a) long-term reliability and effectiveness; (b) reduction in toxicity,  
11 mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and  
12 (e) cost.

13 Each of the five criteria is defined in more detail below:

- 14 1. **Protecting human health and the environment.** The alternatives will be evaluated on  
15 the basis of their ability to protect human health and the environment. The ability of an  
16 alternative to achieve this criterion may or may not be independent of its ability to  
17 achieve the other four standards. For example, an alternative may be protective of  
18 human health, but may not be able to attain the MCSs if the MCSs are not directly tied to  
19 protecting human health.
- 20 2. **Attaining media cleanup standards (RGOs).** The alternatives will be evaluated on the  
21 basis of their ability to achieve the RGOs defined in this CMSWP. Another aspect of this  
22 criterion is the timeframe to achieve the RGOs. Estimates of the timeframe for the  
23 alternatives to achieve RGOs will be provided.
- 24 3. **Controlling the source of releases.** This criterion deals with the control of releases of  
25 contamination from the source (the area in which the contamination originated).
- 26 4. **Complying with applicable standards for management of wastes.** This criterion deals  
27 with the management of wastes derived from implementing the alternatives, for  
28 example, treatment or disposal of excavated material. The soil removal alternative will  
29 be designed to comply with all applicable standards for management of remediation  
30 wastes. Consequently, this criterion will not be explicitly included in the detailed

1 evaluation presented in the CMS but will be part of a work plan specific to the removal  
2 action should a removal action become the chosen alternative.

3 5. **Other factors.** Five other factors are to be considered if an alternative is found to meet  
4 the four criteria described above. These other factors are as follows:

5 a. Long-term reliability and effectiveness

6 The two alternatives will be evaluated on the basis of their reliability, and the  
7 potential impact should the chosen alternative fail. In other words, a qualitative  
8 assessment will be made as to the chance of the alternative's failure and the  
9 consequences of that failure.

10 b. Reduction in the toxicity, mobility, or volume of wastes

11 Alternatives with technologies that reduce the toxicity, mobility, or volume of the  
12 contamination will be generally favored over those that do not. Consequently, a  
13 qualitative assessment of this factor will be performed for each alternative.

14 c. Short-term effectiveness

15 Alternatives will be evaluated on the basis of the risk they create during the  
16 implementation of the remedy. Factors that may be considered include fire,  
17 explosion, and exposure of workers to hazardous substances.

18 d. Implementability

19 The alternatives will be evaluated for their implementability by considering any  
20 difficulties associated with conducting the alternatives (such as the construction  
21 disturbances they may create), operation of the alternatives, and the availability of  
22 equipment and resources to implement the technologies comprising the alternatives.

23 e. Cost

24 A net present value of each alternative will be developed. These cost estimates will  
25 be used for the relative evaluation of the alternatives, not to bid or budget the work.  
26 The estimates will be based on information available at the time of the CMS and on a  
27 conceptual design of the alternative. They will be "order-of-magnitude" estimates  
28 with a generally expected accuracy of -50 percent to +50 percent for the scope of  
29 action described for each alternative. The estimates will be categorized into capital  
30 costs and operations and maintenance costs for each alternative.

31 In addition to the criteria described above, the alternative will be evaluated for its ability to  
32 achieve all contractual obligations of CH2M-Jones and the Navy.

## 1 **8.6 Focused CMS Report**

- 2 A focused CMS Report will be prepared to present the identification, development, and  
3 evaluation of the potential corrective measure for AOCs 598 and 599. A proposed outline of  
4 the report, as shown in Table 8-1, provides an example of the report format and content.

**TABLE 8-1**  
 Outline of Focused CMS Report for AOCs 598 and 599  
*RFI Report Addendum and CMS Work Plan, AOCs 598 and 599, Zone E, Charleston Naval Complex*

<b>Section No.</b>	<b>Section Title</b>
<b>1.0</b>	<b>Introduction</b>
1.1	Corrective Measures Study Purpose and Scope
1.2	Report Organization
1.3	Background Information
1.3.1	Facility Description
1.3.2	Site History and Background
1.3.2.1	Nature and Extent of Contamination
1.3.2.2	Summary of Risk Assessment
<b>2.0</b>	<b>Remedial Goal Objectives</b>
<b>3.0</b>	<b>Detailed Analysis of Focused Alternatives</b>
3.1	Approach
3.2	Evaluation Criteria
3.3	Description of Alternatives
3.3.1	Alternative 1: Soil Excavation and Disposal with Land Use Controls
3.3.2	Alternative 2: Land Use Controls
3.4	Detailed Analysis of Alternatives
3.4.1	Analysis of Alternative 1
3.4.2	Analysis of Alternative 2
3.5	Comparative Analysis of Alternatives
<b>4.0</b>	<b>Recommended Remedial Alternative</b>
<b>5.0</b>	<b>References</b>
<b>Appendix A</b>	<b>Corrective Measure Alternative Cost Estimate<sup>b</sup></b>
	List of Tables
	List of Figures

<sup>a</sup> Additional alternatives will be analyzed as found necessary.

<sup>b</sup> Additional appendices will be added, if necessary.



## 1 9.0 References

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- 2 CH2M-Jones. *Background Study Report: Technical Information for Development of Background*  
3 *BEQ Values*. February 2001a.
- 4 CH2M-Jones. *Technical Memorandum: A Summary of Inorganic Chemical Concentrations in*  
5 *Background Soil and Groundwater at the CNC*. August 13, 2001b.
- 6 CH2M-Jones. *RFI Report Addendum, AOCs 598 and 599. Revision 0*. October 4, 2002.
- 7 EnSafe Inc./Allen & Hoshall. *Final Zone E RFI Work Plan, Revision 1, NAVBASE Charleston*.  
8 June 1995.
- 9 EnSafe Inc./Allen & Hoshall. *Final RCRA Facility Assessment, NAVBASE Charleston*. July  
10 1995.
- 11 EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston*. 1997.
- 12 South Carolina Department of Health and Environmental Control, *Final RCRA Part B*  
13 *Permit No. SC0 170 022 560*.
- 14 U.S. Naval Detachment. *Interim Measure Completion Report for AOC 699 Storm Drain Cleaning*.  
15 March 1999.

## **Appendix A**

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Responses To SCDHEC Comments on AOCs 598 and 599 of the  
*Zone E RCRA Facility Investigation Report, Revision 0 (EnSafe, 1997)*  
Charleston Naval Complex  
North Charleston, SC

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**CHARLES B. WATSON COMMENTS**

**SCDHEC Comment 26:**

Soil samples identified exceedances for lead in several areas of AOC 598 and AOC 599. Page 10.47-36 states that "soil samples collected for the AOC 597 RFI define the extent of lead in soil to the north of sample location 598SB005, it is unclear whether the extent has been adequately defined to the west of sample location 598SB005". The Department recommends additional boreholes in the western area. Also, additional boreholes should be located near the center of AOC 598.

**Navy/EnSafe Response:**

**Additional samples will be collected in the area west of 598SB005 to assure that the site has been delineated.**

**CH2M-Jones Response:**

*Additional samples were collected west of RFI soil boring location E598SB005 during the July 2002 sampling conducted by CH2M-Jones to delineate the lead concentrations in soil.*



### **Engineering Comments Prepared by Jerry Stamps**

1. Samples were collected to confirm the elevated BEQ concentrations detected in the original Zone E RFI. The confirmation samples consistently resulted in concentrations much different from what was originally detected. The Department is weary of making No Further Action (NFA) decisions based upon the conflicting results without some sort of weight-of-evidence to confirm the actual BEQ concentrations present in the soil. For example, the confirmation sample collected for lead was accompanied by additional samples around it to demonstrate that the lead was not a concern. Consequently, the Department is not concerned about the lead concentration. Though the Department is not necessarily mandating additional sampling, the Department does not concur that a NFA is appropriate at this time. Therefore, the Navy may either conduct additional soil sampling to provide the data necessary to demonstrate that the BEQ concentrations are much lower than originally detected or implement LUCs for this site.

#### **CH2M-Jones Response:**

*The soil borings at this site with elevated BEQ detections are all under asphalt pavement and in the vicinity of railroad lines. As stated in the RFI Report Addendum (line 1-5, Page 5-2), the source of the detected BEQs could be the overlying asphalt pavement and the possibility of asphalt entrainment in the soil sample. The low concentrations of BEQs detected during resampling of these soil boring locations indicates the absence of BEQ source material in the soils at these locations. Similar to other sites at the CNC where BEQ concentrations above the CNC sitewide reference concentrations have been detected in soil and BEQs have been identified as COCs, BEQs will be identified as COCs at AOCs 598 and 599 as well. Since all of Zone E will undergo LUCs, we agree with SCDHEC that the request for NFA in the Revision 0 RFI Report Addendum for AOCs 598 and 599 should be changed to identify BEQs as surface soil COCs. Therefore a recommendation for implementing a Corrective Measures Study (CMS) will be made in Revision 1 of the RFI Report Addendum. The text will be changed accordingly, and a CMS Work Plan will be added to the Revision 1 document.*



Chemicals Detected in Zone E Soil Samples  
AOC 598

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
<b><i>Volatile Organic Compounds (ug/kg)</i></b>						
Acetone	598SB001	ND	78.00	780000.00	NA	NA
	598SB002	ND	38.00			
	598SB003	ND	26.00			
	598SB004	29.00	37.00			
Methylene chloride	598SB004	4.00	ND	85000.00	NA	NA
<b><i>Semi-volatile Compounds (ug/kg)</i></b>						
2-Chlorophenol	598SB002	ND	77.00	390000.00	NA	NA
2-Methylnaphthalene	598SB003	120.00	ND	NA	NA	NA
	598SB004	150.00	ND			
	598SB006	630.00	NS			
4-Bromophenyl-phenylether	598SB002	ND	140.00			
	598SB004	99.00	ND	450000.00	NA	NA
Acenaphthene	598SB001	ND	220.00			
	598SB002	1700.00	1295.00	470000.00	NA	NA
	598SB003	840.00	510.00			
	598SB004	1300.00	120.00			
	598SB005	810.00	1700.00			
	598SB006	1900.00	NS			
Acenaphthylene	598SB004	82.00	ND	310000.00	NA	NA
	598SB005	110.00	110.00			
	598SB006	140.00	NS			
Anthracene	598SB001	67.00	130.00	23000000.00	NA	NA
	598SB002	6900.00	655.00			
	598SB003	560.00	370.00			
	598SB004	290.00	150.00			
	598SB005	400.00	1300.00			
	598SB006	450.00	NS			
Benzo(a)anthracene	598SB001	190.00	300.00	880.00	NA	NA
	598SB002	9200.00	1140.00			
	598SB003	360.00	720.00			
	598SB004	440.00	670.00			
	598SB005	480.00	1500.00			
	598SB006	300.00	NS			
Benzo(a)pyrene	598SB001	370.00	220.00	88.00	NA	NA
	598SB002	4900.00	1005.00			
	598SB003	360.00	450.00			
	598SB004	440.00	600.00			
	598SB005	520.00	730.00			
	598SB006	900.00	NS			
Benzo(b)fluoranthene	598SB001	440.00	340.00	880.00	NA	NA
	598SB002	ND	795.00			
	598SB003	460.00	ND			
	598SB004	460.00	830.00			
	598SB005	740.00	960.00			
	598SB006	1400.00	NS			
Benzo(g,h,i)perylene	598SB001	290.00	110.00	310000.00	NA	NA
	598SB002	1700.00	500.00			

Chemicals Detected in Zone E Soil Samples  
AOC 598

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Benzo(k)fluoranthene	598SB003	290.00	300.00			
	598SB004	280.00	450.00			
	598SB005	280.00	200.00			
	598SB006	760.00	NS			
	598SB001	340.00	150.00	8800.00	NA	NA
	598SB002	8200.00	725.00			
Benzoic acid	598SB003	230.00	680.00			
	598SB004	340.00	370.00			
	598SB005	530.00	870.00			
	598SB006	650.00	NS			
	598SB003	120.00	100.00	3100000.00	NA	NA
	598SB004	250.00	150.00			
Butylbenzylphthalate	598SB004	98.00	ND	1600000.00	NA	NA
Carbazole	598SB002	ND	98.00	32000.00	NA	NA
Chrysene	598SB001	450.00	590.00	88000.00	NA	NA
	598SB002	13000.00	965.00			
	598SB003	530.00	1100.00			
	598SB004	480.00	990.00			
	598SB005	670.00	1700.00			
	598SB006	560.00	NS			
Di-n-butylphthalate	598SB004	190.00	95.00	780000.00	NA	NA
Di-n-octyl phthalate	598SB004	85.00	ND	160000.00	NA	NA
Dibenz(a,h)anthracene	598SB001	130.00	53.00	88000.00	NA	NA
	598SB002	1000.00	319.00			
	598SB003	140.00	160.00			
	598SB004	180.00	220.00			
	598SB005	78.00	ND			
	598SB006	240.00	NS			
Dibenzofuran	598SB002	740.00	560.00	31000.00	NA	NA
	598SB003	320.00	150.00			
	598SB004	320.00	ND			
	598SB005	180.00	330.00			
	598SB006	860.00	NS			
	598SB002	250.00	ND	630000.00	NA	NA
Diethylphthalate	598SB003	110.00	ND			
	598SB004	100.00	ND			
	598SB001	320.00	390.00	310000.00	NA	NA
Fluoranthene	598SB002	21000.00	2480.00			
	598SB003	2000.00	1800.00			
	598SB004	1400.00	2100.00			
	598SB005	1900.00	7600.00			
	598SB006	1700.00	NS			
	598SB001	ND	56.00	310000.00	NA	NA
Fluorene	598SB002	1700.00	1175.00			
	598SB003	330.00	300.00			
	598SB004	270.00	ND			
	598SB005	57.00	1100.00			
	598SB006	1100.00	NS			
	598SB001	240.00	91.00	880.00	NA	NA
Indeno(1,2,3-cd)pyrene						

Chemicals Detected in Zone E Soil Samples  
AOC 598

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
	598SB002	1800.00	452.00			
	598SB003	250.00	260.00			
	598SB004	350.00	390.00			
	598SB005	290.00	210.00			
	598SB006	780.00	NS			
N-Nitrosodiphenylamine	598SB004	240.00	ND	130000.00	NA	NA
Naphthalene	598SB002	ND	82.00	310000.00	NA	NA
	598SB003	1300.00	180.00			
	598SB004	320.00	ND			
	598SB005	69.00	ND			
	598SB006	2100.00	NS			
Pentachlorophenol	598SB002	ND	110.00	5300.00	NA	NA
Phenanthrene	598SB001	230.00	170.00	310000.00	NA	NA
	598SB002	15000.00	2450.00			
	598SB003	2500.00	1200.00			
	598SB004	600.00	400.00			
	598SB005	230.00	590.00			
	598SB006	1500.00	NS			
Pyrene	598SB001	350.00	490.00	230000.00	NA	NA
	598SB002	21000.00	2080.00			
	598SB003	1500.00	1600.00			
	598SB004	1400.00	1800.00			
	598SB005	1900.00	5600.00			
	598SB006	1200.00	NS			
<b>Chlorinated Pesticides (ug/kg)</b>						
4,4'-DDD	598SB001	132.00	ND	2700.00	NA	NA
4,4'-DDE	598SB001	59.60	ND	1900.00	NA	NA
	598SB004	ND	16.30			
4,4'-DDT	598SB001	21.60	ND	1900.00	NA	NA
Aldrin	598SB001	2.91	ND	38.00	NA	NA
Endosulfan II	598SB001	10.90	ND	47000.00	NA	NA
Endrin aldehyde	598SB001	13.80	ND	2300.00	NA	NA
Heptachlor epoxide	598SB001	6.20	ND	70.00	NA	NA
Methoxychlor	598SB001	24.90	ND	390000.00	NA	NA
alpha-Chlordane	598SB001	7.99	ND	490.00	NA	NA
delta-BHC	598SB002	6.27	ND	350.00	NA	NA
gamma-BHC (Lindane)	598SB001	2.39	ND	350.00	NA	NA
gamma-Chlordane	598SB001	3.80	ND	490.00	NA	NA
<b>Dioxin/Dibenzofuran (ng/kg)</b>						
1234678-HpCDD	598CB002	NS	3.08	NA	NA	NA
OCDD	598CB002	NS	22.64	NA	NA	NA
Total Hepta-Dioxins	598CB002	NS	9.15	NA	NA	NA
Total Hepta-Furans	598CB002	NS	1.49	NA	NA	NA
Total Hexa-Dioxins	598CB002	NS	7.02	NA	NA	NA
Total Hexa-Furans	598CB002	NS	0.47	NA	NA	NA
Total Penta-Dioxins	598CB002	NS	1.56	NA	NA	NA
Total Tetra-Dioxins	598CB002	NS	1.53	NA	NA	NA

Chemicals Detected in Zone E Soil Samples  
AOC 598

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
<i>Inorganic Compounds (mg/kg)</i>						
Aluminum (Al)	598SB001	2020.00	8270.00	7800.00	26000.00	4100.00
	598SB002	5770.00	2395.00			
	598SB003	6400.00	7000.00			
	598SB004	3700.00	5390.00			
	598SB005	7340.00	8430.00			
Antimony (Sb)	598SB001	4.90	0.82	3.10	1.77	1.60
	598SB002	ND	0.81			
	598SB003	0.78	0.71			
	598SB004	1.80	1.10			
	598SB005	0.92	1.30			
	598SB006	2.20	NS			
Arsenic (As)	598SB001	9.80	10.40	0.43	23.90	19.90
	598SB002	7.40	6.00			
	598SB003	13.50	9.80			
	598SB004	13.10	11.50			
	598SB005	5.60	12.10			
	598SB006	7.90	NS			
Barium (Ba)	598SB001	32.90	36.50	550.00	130.00	94.10
	598SB002	46.60	104.50			
	598SB003	33.70	50.50			
	598SB004	39.80	26.90			
	598SB005	29.10	37.40			
	598SB006	104.00	NS			
Beryllium (Be)	598SB001	0.32	0.52	0.15	1.70	2.71
	598SB002	0.40	0.30			
	598SB003	0.78	0.52			
	598SB004	0.33	0.34			
	598SB005	0.33	0.41			
	598SB006	0.43	NS			
Cadmium (Cd)	598SB001	0.45	0.34	3.90	1.50	0.96
	598SB002	0.37	1.37			
	598SB003	0.45	ND			
	598SB004	0.57	0.51			
	598SB005	0.52	0.27			
	598SB006	0.60	NS			
Calcium (Ca)	598SB001	11800.00	35100.00	NA	NA	NA
	598SB002	37100.00	80331.00			
	598SB003	49600.00	28100.00			
	598SB004	29600.00	19100.00			
	598SB005	23100.00	14400.00			
	598SB006	26900.00	NS			
Chromium (Cr)	598SB001	16.80	22.90	39.00	94.60	75.20
	598SB002	15.10	22.50			
	598SB003	24.70	17.80			
	598SB004	16.80	15.20			
	598SB005	19.10	22.10			
	598SB006	16.60	NS			

Chemicals Detected in Zone E Soil Samples  
AOC 598

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Cobalt (Co)	598SB001	3.30	2.50	470.00	19.00	14.90
	598SB002	2.20	0.96			
	598SB003	2.10	1.70			
	598SB004	2.90	1.80			
	598SB005	1.40	2.70			
	598SB006	2.40	NS			
Copper (Cu)	598SB001	59.50	38.70	310.00	66.00	152.00
	598SB002	25.90	37.80			
	598SB003	19.60	16.10			
	598SB004	85.60	60.90			
	598SB005	14.90	25.60			
	598SB006	78.30	NS			
Iron (Fe)	598SB001	5320.00	13400.00	2300.00	NA	NA
	598SB002	10200.00	6125.00			
	598SB003	9510.00	14700.00			
	598SB004	7970.00	10000.00			
	598SB005	8880.00	24100.00			
	598SB006	10900.00	NS			
Lead (Pb)	598SB001	127.00	456.00	400.00	265.00	173.00
	598SB002	212.00	1071.00			
	598SB003	60.30	66.60			
	598SB004	229.00	126.00			
	598SB005	1810.00	124.00			
	598SB006	272.00	NS			
Magnesium (Mg)	598SB001	404.00	2400.00	NA	NA	NA
	598SB002	1960.00	1983.50			
	598SB003	2460.00	1860.00			
	598SB004	1210.00	1330.00			
	598SB005	1020.00	1140.00			
	598SB006	1610.00	NS			
Manganese (Mn)	598SB001	48.40	166.00	180.00	302.00	881.00
	598SB002	86.90	75.00			
	598SB003	86.00	101.00			
	598SB004	83.00	71.50			
	598SB005	55.30	131.00			
	598SB006	89.90	NS			
Mercury (Hg)	598SB001	0.04	0.04	2.30	2.60	1.59
	598SB002	0.04	0.07			
	598SB003	0.05	0.06			
	598SB004	0.07	0.05			
	598SB005	0.20	0.28			
	598SB006	0.56	NS			
Nickel (Ni)	598SB001	13.00	11.30	160.00	77.10	57.00
	598SB002	7.50	11.35			
	598SB003	9.90	6.80			
	598SB004	13.70	7.80			
	598SB005	5.30	11.70			
	598SB006	9.10	NS			
Potassium (K)	598SB001	687.00	1710.00	NA	NA	NA

**Chemicals Detected in Zone E Soil Samples  
AOC 598**

<b>Name</b>	<b>ID</b>	<b>Surface Conc.</b>	<b>Subsurface Conc.</b>	<b>RBC (THQ=.1)</b>	<b>Surface UTL</b>	<b>Subsurface UTL *</b>
	598SB002	1150.00	938.50			
	598SB003	1540.00	1450.00			
	598SB004	909.00	1100.00			
	598SB005	428.00	562.00			
	598SB006	626.00	NS			
Selenium (Se)	598SB002	ND	1.00	39.00	1.70	2.40
	598SB003	0.98	1.00			
	598SB004	0.79	ND			
Sodium (Na)	598SB001	292.00	843.00	NA	NA	NA
	598SB002	538.00	963.50			
	598SB003	932.00	721.00			
	598SB004	428.00	701.00			
	598SB005	269.00	403.00			
	598SB006	698.00	NS			
Thallium (Tl)	598SB001	ND	0.70	0.29	2.80	NA
Tin (Sn)	598SB001	7.30	18.10	477.00	59.40	9.23
	598SB002	4.90	7.40			
	598SB003	2.90	3.40			
	598SB004	6.70	4.30			
	598SB006	5.60	NS			
Vanadium (V)	598SB001	8.80	25.00	55.00	94.30	155.00
	598SB002	18.40	13.85			
	598SB003	20.30	24.00			
	598SB004	13.50	17.80			
	598SB005	17.00	24.10			
	598SB006	18.90	NS			
Zinc (Zn)	598SB001	278.00	314.00	2300.00	827.00	886.00
	598SB002	267.00	637.00			
	598SB003	138.00	98.10			
	598SB004	312.00	172.00			
	598SB005	84.70	141.00			
	598SB006	297.00	NS			

**Notes:**

ND: Not Detected

NS: No Sample Taken/Sample Not Analyzed

NA: Not applicable

For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.

For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.

\* Surface soil samples will be used for human health risk assessment for the Zone E report.

Chemicals Detected in Zone E Soil Samples  
AOC 599

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *	
<b><i>Volatile Organic Compounds (ug/kg)</i></b>							
Acetone	599SB003	50.0000	ND	780000.00	NA	NA	
	599SB005	60.0000	36.0000				
	599SB004	ND	58.0000				
Toluene	599SB005	ND	2.0000	1600000.00	NA	NA	
<b><i>Semi-volatile Compounds (ug/kg)</i></b>							
2-Methylnaphthalene	599SB003	510.0000	ND	NA	NA	NA	
	599SB004	ND	2100.0000				
	599SB005	ND	120.0000				
	599SB006	67.0000	70.0000				
	599SB007	2600.0000	ND				
	Acenaphthene	599SB004	160.0000	1800.0000	470000.00	NA	NA
		599SB005	93.0000	390.0000			
599SB007		3400.0000	52.0000				
Acenaphthylene	599SB006	43.0000	45.0000	310000.00	NA	NA	
Anthracene	599SB004	120.0000	ND	23000000.00	NA	NA	
	599SB005	ND	405.0000				
	599SB006	81.0000	73.0000				
	599SB007	5200.0000	ND				
Benzo(a)anthracene	599SB001	ND	190.0000	880.00	NA	NA	
	599SB002	130.0000	ND				
	599SB003	870.0000	ND				
	599SB004	300.0000	580.0000				
	599SB005	240.0000	375.0000				
	599SB006	240.0000	180.0000				
	599SB007	19000.0000	55.0000				
Benzo(a)pyrene	599SB001	ND	170.0000	88.00	NA	NA	
	599SB002	89.0000	ND				
	599SB003	580.0000	ND				
	599SB004	310.0000	300.0000				
	599SB005	240.0000	330.0000				
	599SB006	360.0000	290.0000				
	599SB007	17000.0000	95.0000				
Benzo(b)fluoranthene	599SB001	93.0000	240.0000	880.00	NA	NA	
	599SB002	150.0000	ND				
	599SB003	760.0000	ND				
	599SB004	360.0000	420.0000				
	599SB005	320.0000	400.0000				
	599SB006	510.0000	410.0000				
	599SB007	17000.0000	79.0000				
Benzo(g,h,i)perylene	599SB001	150.0000	190.0000	310000.00	NA	NA	
	599SB002	92.0000	ND				
	599SB003	400.0000	ND				
	599SB004	320.0000	270.0000				
	599SB005	260.0000	370.0000				
	599SB006	190.0000	160.0000				
	599SB007	5500.0000	ND				
Benzo(k)fluoranthene	599SB001	ND	120.0000	8800.00	NA	NA	

Chemicals Detected in Zone E Soil Samples  
AOC 599

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
	599SB003	440.0000	ND			
	599SB004	200.0000	280.0000			
	599SB005	180.0000	300.0000			
	599SB007	ND	69.0000			
Benzoic acid	599SB001	ND	250.0000	31000000.00	NA	NA
	599SB002	130.0000	ND			
	599SB004	160.0000	ND			
	599SB005	150.0000	310.0000			
Chrysene	599SB001	ND	280.0000	88000.00	NA	NA
	599SB002	160.0000	ND			
	599SB003	1000.0000	ND			
	599SB004	420.0000	590.0000			
	599SB005	360.0000	580.0000			
	599SB006	330.0000	290.0000			
	599SB007	20000.0000	66.0000			
Dibenz(a,h)anthracene	599SB003	230.0000	ND	88000.00	NA	NA
	599SB004	130.0000	230.0000			
	599SB005	150.0000	140.0000			
	599SB006	ND	43.0000			
	599SB007	3600.0000	ND			
Dibenzofuran	599SB004	85.0000	690.0000	31000.00	NA	NA
	599SB005	ND	96.0000			
	599SB007	4100.0000	ND			
Di-n-butylphthalate	599SB005	ND	130.0000	7800000.00	NA	NA
Fluoranthene	599SB001	ND	330.0000	3100000.00	NA	NA
	599SB002	240.0000	ND			
	599SB003	3600.0000	ND			
	599SB004	510.0000	3600.0000			
	599SB005	470.0000	945.0000			
	599SB006	380.0000	270.0000			
	599SB007	44000.0000	120.0000			
Fluorene	599SB003	870.0000	ND	310000.00	NA	NA
	599SB004	ND	1000.0000			
	599SB005	ND	210.0000			
	599SB006	46.0000	43.0000			
	599SB007	9000.0000	ND			
Indeno(1,2,3-cd)pyrene	599SB001	110.0000	140.0000	880.00	NA	NA
	599SB003	390.0000	ND			
	599SB004	220.0000	210.0000			
	599SB005	230.0000	185.0000			
	599SB006	170.0000	130.0000			
	599SB007	7000.0000	49.0000			
Naphthalene	599SB003	320.0000	ND	310000.00	NA	NA
	599SB006	44.0000	38.0000			
	599SB007	3200.0000	ND			
Phenanthrene	599SB001	ND	110.0000	310000.00	NA	NA
	599SB002	150.0000	ND			
	599SB003	1900.0000	ND			
	599SB004	130.0000	3800.0000			

**Chemicals Detected in Zone E Soil Samples  
AOC 599**

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Pyrene	599SB005	140.0000	395.0000			
	599SB006	230.0000	180.0000			
	599SB007	48000.0000	140.0000			
	599SB001	160.0000	370.0000	230000.00	NA	NA
	599SB002	260.0000	ND			
	599SB003	2500.0000	ND			
	599SB004	740.0000	1900.0000			
	599SB005	600.0000	1650.0000			
	599SB006	510.0000	420.0000			
599SB007	29000.0000	99.0000				
<b>Chlorinated Pesticides (ug/kg)</b>						
4,4'-DDE	599SB005	6.1200	ND	19000.00	NA	NA
Methoxychlor	599SB002	24.1000	ND	390000.00	NA	NA
<b>Dioxin/Dibenzofuran (ng/kg)</b>						
1234678-HpCDD	599SB005		2.5140	NA	NA	NA
OCDD	599SB005		39.4860	NA	NA	NA
Total Hepta-Dioxins	599SB005		10.0290	NA	NA	NA
Total Hexa-Dioxins	599SB005		4.2290	NA	NA	NA
<b>Inorganic Compounds (mg/kg)</b>						
Cyanide (CN)	599SB003	0.4500	ND	73.00	0.5	NA
Aluminum (Al)	599SB001	4550.0000	8550.0000	7800.00	26000	41100
	599SB002	7170.0000	ND			
	599SB003	3760.0000	ND			
	599SB004	7560.0000	5570.0000			
	599SB005	5990.0000	5375.0000			
	599SB006	5360.0000	4180.0000			
	599SB007	10700.0000	7190.0000			
Antimony (Sb)	599SB001	ND	1.1000	3.10	1.77	1.6
	599SB002	0.6200	ND			
	599SB003	0.6800	ND			
	599SB004	0.7100	0.7200			
	599SB005	1.2000	1.0650			
	599SB006	1.0000	0.8400			
	599SB007	0.4700	0.7400			
Arsenic (As)	599SB001	9.5000	21.6000	0.43	23.9	19.9
	599SB002	5.2000	ND			
	599SB003	11.7000	ND			
	599SB004	12.1000	8.9000			
	599SB005	10.8000	10.2000			
	599SB006	5.4000	4.1000			
	599SB007	3.9000	11.0000			
Barium (Ba)	599SB001	15.8000	36.5000	550.00	130	94.1
	599SB002	46.9000	ND			
	599SB003	22.2000	ND			
	599SB004	27.0000	11.3000			
	599SB005	51.8000	37.4500			

Chemicals Detected in Zone E Soil Samples  
AOC 599

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Beryllium (Be)	599SB006	43.0000	43.9000			
	599SB007	57.4000	21.3000			
	599SB001	0.3300	0.6000	0.15	1.7	2.71
	599SB002	0.3800	ND			
	599SB003	0.2000	ND			
	599SB004	0.4700	0.4800			
	599SB005	0.4200	0.3400			
	599SB006	0.4500	0.2800			
Cadmium (Cd)	599SB007	0.6500	0.5700			
	599SB001	ND	0.1600	3.90	1.5	0.96
	599SB004	0.2200	0.3700			
	599SB005	0.8100	0.4400			
	599SB006	0.4600	0.4800			
	599SB007	0.2500	0.9700			
	599SB001	4920.0000	20400.0000	NA	NA	NA
Calcium (Ca)	599SB002	24900.0000	ND			
	599SB003	7510.0000	ND			
	599SB004	108000.0000	179000.0000			
	599SB005	19400.0000	23150.0000			
	599SB006	44000.0000	27500.0000			
	599SB007	20700.0000	168000.0000			
	599SB001	9.8000	21.4000	39.00	94.6	75.2
	599SB002	14.4000	ND			
Chromium (Cr)	599SB003	8.6000	ND			
	599SB004	26.1000	36.7000			
	599SB005	17.1000	19.6500			
	599SB006	16.3000	11.2000			
	599SB007	21.4000	37.1000			
	599SB001	1.4000	4.2000	470.00	19	14.9
	599SB002	1.2000	ND			
	599SB003	1.7000	ND			
Cobalt (Co)	599SB004	2.0000	1.2000			
	599SB005	2.4000	1.7000			
	599SB006	1.9000	1.4000			
	599SB007	2.4000	1.2000			
	599SB001	12.6000	97.1000	310.00	66	152
	599SB002	8.4000	ND			
	599SB003	14.5000	ND			
	599SB004	23.4000	9.4000			
Copper (Cu)	599SB005	68.0000	33.1500			
	599SB006	36.0000	34.2000			
	599SB007	15.8000	13.7000			
	599SB001	8710.0000	16200.0000	2300.00	NA	NA
	599SB002	13000.0000	ND			
	599SB003	6990.0000	ND			
	599SB004	10300.0000	7400.0000			
	599SB005	11700.0000	11600.0000			
Iron (Fe)	599SB006	9440.0000	6960.0000			
	599SB007	12000.0000	6280.0000			

Chemicals Detected in Zone E Soil Samples  
AOC 599

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Lead (Pb)	599SB001	27.5000	68.1000	400.00	265	173
	599SB002	423.0000	ND			
	599SB003	30.3000	ND			
	599SB004	36.0000	8.4000			
	599SB005	233.0000	261.0000			
	599SB006	206.0000	142.0000			
	599SB007	28.5000	19.3000			
Magnesium (Mg)	599SB001	810.0000	1920.0000	NA	NA	NA
	599SB002	1130.0000	ND			
	599SB003	594.0000	ND			
	599SB004	2930.0000	4840.0000			
	599SB005	1360.0000	1410.0000			
	599SB006	1360.0000	1620.0000			
	599SB007	2270.0000	5870.0000			
Manganese (Mn)	599SB001	62.1000	89.9000	180.00	302	881
	599SB002	42.8000	ND			
	599SB003	29.0000	ND			
	599SB004	121.0000	107.0000			
	599SB005	83.7000	93.7000			
	599SB006	216.0000	67.5000			
	599SB007	54.4000	171.0000			
Mercury (Hg)	599SB001	0.0300	0.0600	2.30	2.6	1.59
	599SB002	0.0700	ND			
	599SB003	0.1100	ND			
	599SB004	0.0500	ND			
	599SB005	0.2400	0.0700			
	599SB006	0.5900	0.5300			
	599SB007	0.1100	ND			
Nickel (Ni)	599SB001	4.2000	9.5000	160.00	77.1	57
	599SB002	5.5000	ND			
	599SB003	3.9000	ND			
	599SB004	10.7000	16.8000			
	599SB005	11.5000	7.5000			
	599SB006	8.8000	6.9000			
	599SB007	9.0000	15.5000			
Potassium (K)	599SB001	1010.0000	1700.0000	NA	NA	NA
	599SB002	1170.0000	ND			
	599SB003	920.0000	ND			
	599SB004	1240.0000	1480.0000			
	599SB005	1450.0000	1175.0000			
	599SB006	473.0000	384.0000			
	599SB007	1160.0000	987.0000			
Selenium (Se)	599SB001	ND	0.7300	39.00	1.7	2.4
	599SB004	0.9700	2.0000			
	599SB005	ND	0.7000			
	599SB006	0.5100	ND			
Sodium (Na)	599SB007	ND	1.5000			
	599SB001	254.0000	435.0000	NA	NA	NA
	599SB002	432.0000	ND			

**Chemicals Detected in Zone E Soil Samples  
AOC 599**

<b>Name</b>	<b>ID</b>	<b>Surface Conc.</b>	<b>Subsurface Conc.</b>	<b>RBC (THQ=.1)</b>	<b>Surface UTL</b>	<b>Subsurface UTL *</b>
	599SB003	262.0000	ND			
	599SB004	778.0000	959.0000			
	599SB005	401.0000	394.5000			
	599SB006	361.0000	263.0000			
	599SB007	385.0000	956.0000			
Tin (Sn)	599SB001	2.5000	6.0000	4700.00	59.4	9.23
	599SB002	6.3000	ND			
	599SB003	3.0000	ND			
	599SB004	3.1000	2.8000			
	599SB005	12.3000	4.7500			
	599SB006	5.8000	5.6000			
Vanadium (V)	599SB001	13.7000	30.4000	55.00	94.3	155
	599SB002	25.1000	ND			
	599SB003	13.3000	ND			
	599SB004	22.1000	22.7000			
	599SB005	23.0000	18.9500			
	599SB006	22.5000	15.5000			
	599SB007	30.2000	25.8000			
Zinc (Zn)	599SB001	36.0000	168.0000	2300.00	827	886
	599SB002	48.7000	ND			
	599SB003	42.2000	ND			
	599SB004	93.7000	58.2000			
	599SB005	354.0000	193.0000			
	599SB006	222.0000	628.0000			
	599SB007	65.5000	208.0000			

**Notes:**

**ND: Not Detected**

**NS: No Sample Taken/Sample Not Analyzed**

**NA: Not applicable**

**For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.**

**For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.**

**\* Surface soil samples will be used for human health risk assessment for the Zone E report.**

Chemicals Detected in Zone E Groundwater Samples  
AOC 598

Name	Location	Round 1 Conc.	Round 2 Conc.	Round 3 Conc.	Round 4 Conc.	RBC (THQ=.1)	UTL	MCL
<b>Semi-volatile Compounds (ug/l)</b>								
4-Methylphenol (p-Cresol)	598GW00	10.00	ND	NS	NS	18	NA	NA
Acenaphthene	598GW00	4.00	2.00	NS	NS	220.00	NA	NA
Benzoic acid	598GW00	3.00	1.00	NS	NS	15000.00	NA	NA
Fluorene	598GW00	1.00	ND	NS	NS	NA	NA	NA
Phenanthrene	598GW00	1.00	1.00	NS	NS	NA	NA	NA
bis(2-Ethylhexyl)phthalate (BEHP)	598GW00	ND	1.00	NS	NS	4.80	NA	6
<b>Other Compounds (mg/l)</b>								
Chloride	598GW00	5610.00	7150.00	7100.00	8840.00	NA	NA	NA
Sulfate	598GW00	ND	2.00	ND	ND	NA	NA	NA
Total Dissolved Solids (TDS)	598GW00	9910.00	14800.00	12900.00	15000.00	NA	NA	NA
<b>Inorganic Compounds (ug/l)</b>								
Aluminum (Al)	598GW00	ND	44.10	101.00	108.00	3700	2810	NA
Arsenic (As)	598GW00	9.00	18.00	17.90	43.50	0.05	18.7	50
Barium (Ba)	598GW00	672.00	309.00	337.00	341.00	260	211	2000
Beryllium (Be)	598GW00	ND	0.68	ND	0.51	0.02	0.43	4
Calcium (Ca)	598GW00	362000.00	299000.00	349000.00	330000.00	NA	NA	NA
Chromium (Cr)	598GW00	ND	1.00	ND	1.70	3700	12.3	100
Cobalt (Co)	598GW00	ND	2.70	ND	1.00	220	2.5	NA
Iron (Fe)	598GW00	67100.00	27800.00	7750.00	67000.00	1100	NA	NA
Lead (Pb)	598GW00	ND	ND	ND	1.10	15	4.8	15
Magnesium (Mg)	598GW00	206000.00	355000.00	331000.00	353000.00	NA	NA	NA
Manganese (Mn)	598GW00	187.00	135.00	146.00	136.00	84	2560	NA
Mercury (Hg)	598GW00	ND	0.34	ND	ND	1.1	NA	2
Nickel (Ni)	598GW00	1.30	2.20	1.70	ND	73	15.2	100
Potassium (K)	598GW00	108000.00	136000.00	111000.00	122000.00	NA	NA	NA
Sodium (Na)	598GW00	3110000	4560000	2330000	4580000	NA	NA	NA
Thallium (Tl)	598GW00	ND	ND	8.20	ND	0.29	5.4	2
Vanadium (V)	598GW00	2.50	ND	6.80	2.70	26	11.4	NA

Notes:

ND: Not Detected

NS: No Sample Taken/Sample Not Analyzed

NA: Not applicable

For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.

For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.

Chemicals Detected in Zone E Groundwater Samples  
AOC 599

Name	Location	Round 1 Conc.	Round 2 Conc.	Round 3 Conc.	Round 4 Conc.	RBC (THQ=.1)	UTL	MCL
<b><i>Chlorinated Pesticides (ug/l)</i></b>								
Endrin	599GW001	ND	0.08	ND	ND	NA	NA	2
Heptachlor	599GW001	0.06	ND	ND	ND	NA	NA	0.4
<b><i>Other Compounds (mg/l)</i></b>								
Chloride	599GW001	ND	940.00	272.00	168.00	NA	NA	NA
Sulfate	599GW001	ND	4.30	ND	0.53	NA	NA	NA
Total Dissolved Solids (TDS)	599GW001	ND	2410.00	1220.00	960.00	NA	NA	NA
<b><i>Inorganic Compounds (ug/l)</i></b>								
Cyanide (CN)	599GW001	4.20	ND	NS	NS	73	7.9	200
Aluminum (Al)	599GW001	41.90	42.50	38.30	35.50	3700	2810	NA
Barium (Ba)	599GW001	ND	101.00	181.00	191.00	260	211	2000
Calcium (Ca)	599GW001	ND	64000.00	81300.00	93400.00	NA	NA	NA
Chromium (Cr)	599GW001	ND	ND	ND	2.10	3700	12.3	100
Iron (Fe)	599GW001	12800.00	4770.00	1570.00	2140.00	1100	NA	NA
Magnesium (Mg)	599GW001	ND	47700.00	50700.00	40900.00	NA	NA	NA
Manganese (Mn)	599GW001	ND	164.00	194.00	233.00	84	2560	NA
Nickel (Ni)	599GW001	ND	ND	1.80	2.10	73	15.2	100
Potassium (K)	599GW001	ND	39500.00	40900.00	31100.00	NA	NA	NA
Sodium (Na)	599GW001	ND	301000.00	345000.00	210000.00	NA	NA	NA
Thallium (Tl)	599GW001	ND	ND	3.30	ND	0.29	5.4	2
Vanadium (V)	599GW001	1.70	5.30	5.70	4.40	26	11.4	NA
Zinc (Zn)	599GW001	16.10	ND	ND	ND	1100	27.3	NA

Notes:

ND: Not Detected

NS: No Sample Taken/Sample Not Analyzed

NA: Not applicable

For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.

For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.

Analytical Summary

03/20/2003 11:35 AM

StationID	LABQC		LABQC		LABQC		LABQC		LABQC	
SampleID	BLK0356039		BLK0356040		BLK0356071		BLK0356072		BLK0356073	
DateCollected										
DateExtracted										
DateAnalyzed	09/26/1995		09/27/1995		09/25/1995		09/28/1995		09/28/1995	
SDGNumber	23560		23560		23560		23560		23560	
Parameter	Units									
1,1,1,2-Tetrachloroethane	ug/Kg	5 U	5 U							
1,2,3-Trichloropropane	ug/Kg	5 U	5 U							
1,2-Dibromo-3-chloropropane	ug/Kg	10 U	10 U							
1,4-Dioxane	ug/Kg	500 U	500 U							
3-Chloropropene	ug/Kg	5 U	5 U							
Acetonitrile	ug/Kg	200 U	200 U							
Acrolein	ug/Kg	50 U	50 U							
Acrylonitrile	ug/Kg	50 U	50 U							
Chloroprene	ug/Kg	5 U	5 U							
Dichlorodifluoromethane	ug/Kg	5 U	5 U							
Ethylene Dibromide (1,2-Dibromoethane)	ug/Kg	5 U	5 U							
Isobutyl alcohol	ug/Kg	200 U	200 U							
Methacrylonitrile	ug/Kg	100 U	100 U							
Methyl iodide	ug/Kg	5 U	5 U							
Methylene bromide	ug/Kg	10 U	10 U							
Propionitrile	ug/Kg	100 U	100 U							
trans-1,4-Dichloro-2-butene	ug/Kg	5 U	5 U							
Trichlorofluoromethane	ug/Kg	5 U	5 U							
1,2,4-Trichlorobenzene	ug/Kg									
Chloromethane	ug/Kg	10 U	10 U	10 U				10 U		
Chloromethane	ug/L						10 U			
Vinyl chloride	ug/Kg	10 U	10 U	10 U				10 U		
Vinyl chloride	ug/L						10 U			
Bromomethane	ug/Kg	10 U	10 U	10 U				10 U		
Bromomethane	ug/L						10 U			
Chloroethane	ug/Kg	10 U	10 U	10 U				10 U		
Chloroethane	ug/L						10 U			
1,1-Dichloroethene	ug/Kg	5 U	5 U	5 U				5 U		
1,1-Dichloroethene	ug/L						5 U			
Acetone	ug/Kg	12	10 U	12				10 U		
Acetone	ug/L						10 U			
Carbon Disulfide	ug/Kg	5 U	5 U	5 U				5 U		
Carbon Disulfide	ug/L						5 U			

Analytical Data Summary

03/20/2003 10:53 AM

StationID	LABQC	LABQC	LABQC	LABQC	LABQC
SampleID	BLK0356074	BLK0356075	BLK0356076	BLK0356093	BLK0356096
DateCollected					
DateExtracted					
DateAnalyzed	09/29/1995	09/29/1995	10/02/1995	09/27/1995	09/26/1995
SDGNumber	23560	23560	23560	23560	23560

Parameter	Units	LABQC		LABQC		LABQC		LABQC	
1,1,1,2-Tetrachloroethane	ug/Kg								
1,2,3-Trichloropropane	ug/Kg								
1,2-Dibromo-3-chloropropane	ug/Kg								
1,4-Dioxane	ug/Kg								
3-Chloropropene	ug/Kg								
Acetonitrile	ug/Kg								
Acrolein	ug/Kg								
Acrylonitrile	ug/Kg								
Chloroprene	ug/Kg								
Dichlorodifluoromethane	ug/Kg								
Ethylene Dibromide (1,2-Dibromoethane)	ug/Kg								
Isobutyl alcohol	ug/Kg								
Methacrylonitrile	ug/Kg								
Methyl iodide	ug/Kg								
Methylene bromide	ug/Kg								
Propionitrile	ug/Kg								
trans-1,4-Dichloro-2-butene	ug/Kg								
Trichlorofluoromethane	ug/Kg								
1,2,4-Trichlorobenzene	ug/Kg								
Chloromethane	ug/Kg		10 U	10 U	10 U	10 U	10 U	10 U	
Chloromethane	ug/L	10 U							
Vinyl chloride	ug/Kg		10 U	10 U	10 U	10 U	10 U	10 U	
Vinyl chloride	ug/L	10 U							
Bromomethane	ug/Kg		10 U	10 U	10 U	10 U	10 U	10 U	
Bromomethane	ug/L	10 U							
Chloroethane	ug/Kg		10 U	10 U	10 U	10 U	10 U	10 U	
Chloroethane	ug/L	10 U							
1,1-Dichloroethene	ug/Kg		5 U	5 U	5 U	5 U	5 U	5 U	
1,1-Dichloroethene	ug/L	5 U							
Acetone	ug/Kg		10 J	10 U	10 U	10 U	12		
Acetone	ug/L	10 U							
Carbon Disulfide	ug/Kg		5 U	5 U	5 U	5 U	5 U	5 U	
Carbon Disulfide	ug/L	5 U							

Analytical Summary

03/20/2003 5 AM

StationID	LABQC	LABQC
SampleID	BLK0356097	BLK0356098
DateCollected		
DateExtracted		
DateAnalyzed	09/26/1995	09/27/1995
SDGNumber	23560	23560

Parameter	Units				
1,1,1,2-Tetrachloroethane	ug/Kg				
1,2,3-Trichloropropane	ug/Kg				
1,2-Dibromo-3-chloropropane	ug/Kg				
1,4-Dioxane	ug/Kg				
3-Chloropropene	ug/Kg				
Acetonitrile	ug/Kg				
Acrolein	ug/Kg				
Acrylonitrile	ug/Kg				
Chloroprene	ug/Kg				
Dichlorodifluoromethane	ug/Kg				
Ethylene Dibromide (1,2-Dibromoethane)	ug/Kg				
Isobutyl alcohol	ug/Kg				
Methacrylonitrile	ug/Kg				
Methyl iodide	ug/Kg				
Methylene bromide	ug/Kg				
Propionitrile	ug/Kg				
trans-1,4-Dichloro-2-butene	ug/Kg				
Trichlorofluoromethane	ug/Kg				
1,2,4-Trichlorobenzene	ug/Kg				
Chloromethane	ug/Kg	42	U	39	U
Chloromethane	ug/L				
Vinyl chloride	ug/Kg	44	U	43	U
Vinyl chloride	ug/L				
Bromomethane	ug/Kg	46	U	44	U
Bromomethane	ug/L				
Chloroethane	ug/Kg	44	U	44	U
Chloroethane	ug/L				
1,1-Dichloroethene	ug/Kg	46	U	44	U
1,1-Dichloroethene	ug/L				
Acetone	ug/Kg	37	U	47	U
Acetone	ug/L				
Carbon Disulfide	ug/Kg	43	U	42	U
Carbon Disulfide	ug/L				

Analytical Data Summary

03/20/2003 10:53 AM

StationID	LABQC	LABQC	LABQC	LABQC	LABQC
SampleID	BLK0356039	BLK0356040	BLK0356071	BLK0356072	BLK0356073
DateCollected					
DateExtracted					
DateAnalyzed	09/26/1995	09/27/1995	09/25/1995	09/28/1995	09/28/1995
SDGNumber	23560	23560	23560	23560	23560
Parameter	Units				
Methylene Chloride	ug/Kg	8	5	8	5 U
Methylene Chloride	ug/L				5 U
1,1-Dichloroethane	ug/Kg	5 U	5 U	5 U	5 U
1,1-Dichloroethane	ug/L				5 U
Vinyl acetate	ug/Kg	10 U	10 U	10 U	10 U
Vinyl acetate	ug/L				10 U
Methyl ethyl ketone (2-Butanone)	ug/Kg	10 U	10 U	10 U	10 U
Methyl ethyl ketone (2-Butanone)	ug/L				10 U
1,2-Dichloroethene (total)	ug/Kg	5 U	5 U	5 U	5 U
1,2-Dichloroethene (total)	ug/L				5 U
Chloroform	ug/Kg	5 U	5 U	5 U	5 U
Chloroform	ug/L				5 U
1,1,1-Trichloroethane	ug/Kg	5 U	5 U	5 U	5 U
1,1,1-Trichloroethane	ug/L				5 U
Carbon Tetrachloride	ug/Kg	5 U	5 U	5 U	5 U
Carbon Tetrachloride	ug/L				5 U
1,2-Dichloroethane	ug/Kg	5 U	5 U	5 U	5 U
1,2-Dichloroethane	ug/L				5 U
Benzene	ug/Kg	5 U	5 U	5 U	5 U
Benzene	ug/L				5 U
Trichloroethylene (TCE)	ug/Kg	5 U	5 U	5 U	5 U
Trichloroethylene (TCE)	ug/L				5 U
1,2-Dichloropropane	ug/Kg	5 U	5 U	5 U	5 U
1,2-Dichloropropane	ug/L				5 U
Bromodichloromethane	ug/Kg	5 U	5 U	5 U	5 U
Bromodichloromethane	ug/L				5 U
2-Chloroethyl vinyl ether	ug/Kg	10 U	10 U	10 U	10 U
2-Chloroethyl vinyl ether	ug/L				10 U
cis-1,3-Dichloropropene	ug/Kg	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	ug/L				5 U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/Kg	10 U	10 U	10 U	10 U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/L				10 U
Toluene	ug/Kg	5 U	5 U	5 U	5 U

Analytical Summary

03/20/2003 11:3 AM

StationID	LABQC		LABQC		LABQC		LABQC		LABQC	
SampleID	BLK0356074		BLK0356075		BLK0356076		BLK0356093		BLK0356096	
DateCollected										
DateExtracted										
DateAnalyzed	09/29/1995		09/29/1995		10/02/1995		09/27/1995		09/26/1995	
SDGNumber	23560		23560		23560		23560		23560	
Parameter	Units									
Methylene Chloride	ug/Kg		7		5	U	5		8	
Methylene Chloride	ug/L	5	U							
1,1-Dichloroethane	ug/Kg		5	U	5	U	5	U	5	U
1,1-Dichloroethane	ug/L	5	U							
Vinyl acetate	ug/Kg		10	U	10	U	10	U	10	U
Vinyl acetate	ug/L	10	U							
Methyl ethyl ketone (2-Butanone)	ug/Kg		10	U	10	U	10	U	10	U
Methyl ethyl ketone (2-Butanone)	ug/L	10	U							
1,2-Dichloroethene (total)	ug/Kg		5	U	5	U	5	U	5	U
1,2-Dichloroethene (total)	ug/L	5	U							
Chloroform	ug/Kg		5	U	5	U	5	U	5	U
Chloroform	ug/L	5	U							
1,1,1-Trichloroethane	ug/Kg		5	U	5	U	5	U	5	U
1,1,1-Trichloroethane	ug/L	5	U							
Carbon Tetrachloride	ug/Kg		5	U	5	U	5	U	5	U
Carbon Tetrachloride	ug/L	5	U							
1,2-Dichloroethane	ug/Kg		5	U	5	U	5	U	5	U
1,2-Dichloroethane	ug/L	5	U							
Benzene	ug/Kg		5	U	5	U	5	U	5	U
Benzene	ug/L	5	U							
Trichloroethylene (TCE)	ug/Kg		5	U	5	U	5	U	5	U
Trichloroethylene (TCE)	ug/L	5	U							
1,2-Dichloropropane	ug/Kg		5	U	5	U	5	U	5	U
1,2-Dichloropropane	ug/L	5	U							
Bromodichloromethane	ug/Kg		5	U	5	U	5	U	5	U
Bromodichloromethane	ug/L	5	U							
2-Chloroethyl vinyl ether	ug/Kg		10	U	10	U	10	U	10	U
2-Chloroethyl vinyl ether	ug/L	10	U							
cis-1,3-Dichloropropene	ug/Kg		5	U	5	U	5	U	5	U
cis-1,3-Dichloropropene	ug/L	5	U							
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/Kg		10	U	10	U	10	U	10	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/L	10	U							
Toluene	ug/Kg		5	U	5	U	5	U	5	U



Analytical Data Summary

03/20/2003 10:33 AM

StationID	LABQC		LABQC		LABQC		LABQC		LABQC	
SampleID	BLK0356039		BLK0356040		BLK0356071		BLK0356072		BLK0356073	
DateCollected										
DateExtracted										
DateAnalyzed	09/26/1995		09/27/1995		09/25/1995		09/28/1995		09/28/1995	
SDGNumber	23560		23560		23560		23560		23560	
Parameter	Units									
Toluene	ug/L						5	U		
trans-1,3-Dichloropropene	ug/Kg		5	U	5	U	5	U	5	U
trans-1,3-Dichloropropene	ug/L						5	U		
1,1,2-Trichloroethane	ug/Kg		5	U	5	U	5	U	5	U
1,1,2-Trichloroethane	ug/L						5	U		
2-Hexanone	ug/Kg		10	U	10	U	10	U	10	U
2-Hexanone	ug/L						10	U		
Tetrachloroethylene (PCE)	ug/Kg		5	U	5	U	5	U	5	U
Tetrachloroethylene (PCE)	ug/L						5	U		
Dibromochloromethane	ug/Kg		5	U	5	U	5	U	5	U
Dibromochloromethane	ug/L						5	U		
Chlorobenzene	ug/Kg		5	U	5	U	5	U	5	U
Chlorobenzene	ug/L						5	U		
Ethylbenzene	ug/Kg		5	U	5	U	5	U	5	U
Ethylbenzene	ug/L						5	U		
Xylenes, Total	ug/Kg		5	U	5	U	5	U	5	U
Xylenes, Total	ug/L						5	U		
Styrene	ug/Kg		5	U	5	U	5	U	5	U
Styrene	ug/L						5	U		
Bromoform	ug/Kg		5	U	5	U	5	U	5	U
Bromoform	ug/L						5	U		
1,1,2,2-Tetrachloroethane	ug/Kg		5	U	5	U	5	U	5	U
1,1,2,2-Tetrachloroethane	ug/L						5	U		

Analytical Data Summary

03/20/2003 10:53 AM

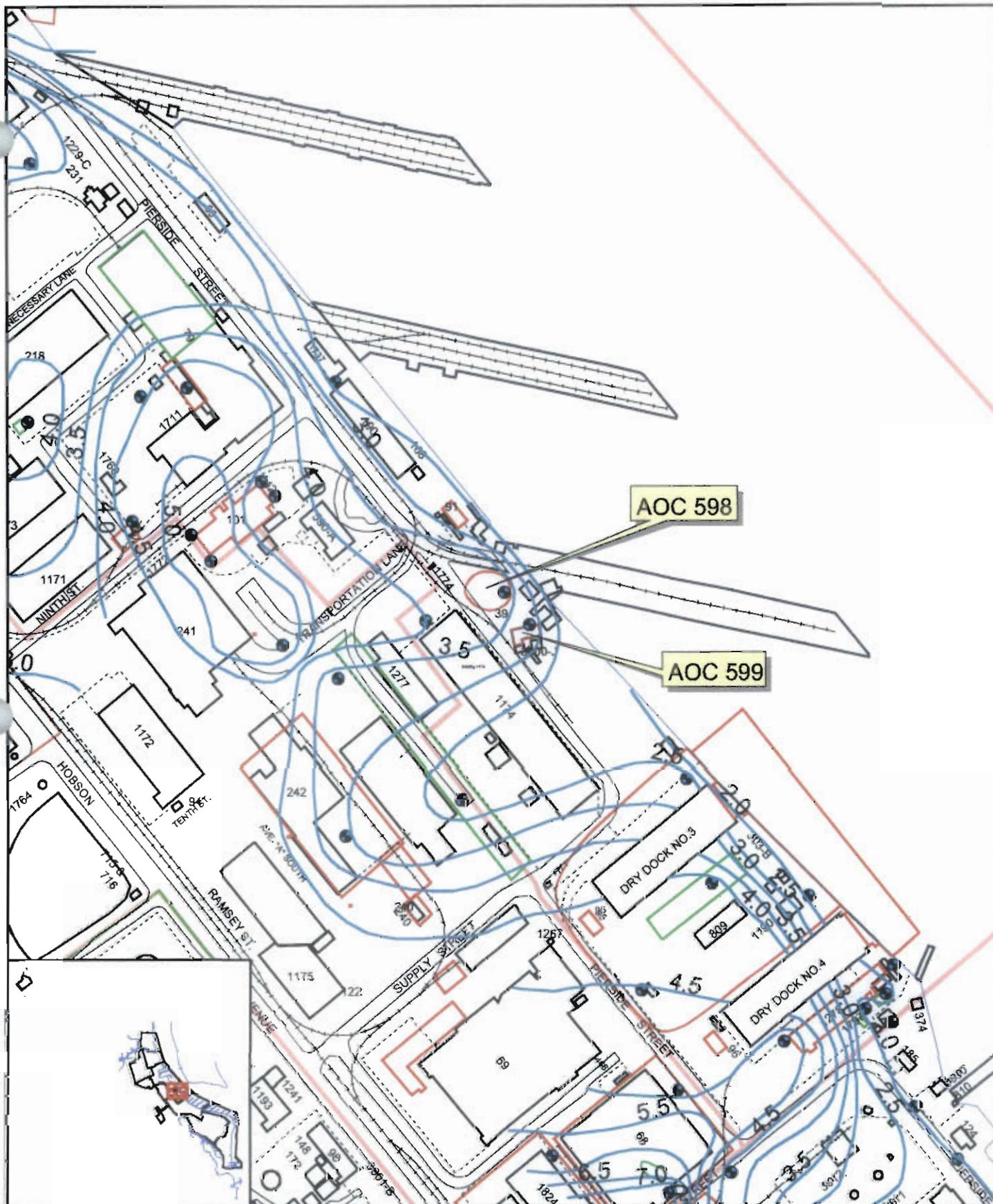
StationID	LABQC	LABQC	LABQC	LABQC	LABQC				
SampleID	BLK0356074	BLK0356075	BLK0356076	BLK0356093	BLK0356096				
DateCollected									
DateExtracted									
DateAnalyzed	09/29/1995	09/29/1995	10/02/1995	09/27/1995	09/26/1995				
SDGNumber	23560	23560	23560	23560	23560				
Parameter	Units								
Toluene	ug/L	5	U						
trans-1,3-Dichloropropene	ug/Kg			5	U	5	U	5	U
trans-1,3-Dichloropropene	ug/L	5	U						
1,1,2-Trichloroethane	ug/Kg			5	U	5	U	5	U
1,1,2-Trichloroethane	ug/L	5	U						
2-Hexanone	ug/Kg			10	U	10	U	10	U
2-Hexanone	ug/L	10	U						
Tetrachloroethylene (PCE)	ug/Kg			5	U	5	U	5	U
Tetrachloroethylene (PCE)	ug/L	5	U						
Dibromochloromethane	ug/Kg			5	U	5	U	5	U
Dibromochloromethane	ug/L	5	U						
Chlorobenzene	ug/Kg			5	U	5	U	5	U
Chlorobenzene	ug/L	5	U						
Ethylbenzene	ug/Kg			5	U	5	U	5	U
Ethylbenzene	ug/L	5	U						
Xylenes, Total	ug/Kg			5	U	5	U	5	U
Xylenes, Total	ug/L	5	U						
Styrene	ug/Kg			5	U	5	U	5	U
Styrene	ug/L	5	U						
Bromoform	ug/Kg			5	U	5	U	5	U
Bromoform	ug/L	5	U						
1,1,2,2-Tetrachloroethane	ug/Kg			5	U	5	U	5	U
1,1,2,2-Tetrachloroethane	ug/L	5	U						

Analytical Data Summary

03/26/2003 11:41 AM

StationID	LABQC	LABQC
SampleID	BLK0356097	BLK0356098
DateCollected		
DateExtracted		
DateAnalyzed	09/26/1995	09/27/1995
SDGNumber	23560	23560

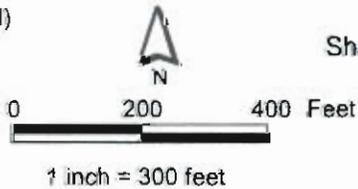
Parameter	Units	LABQC		LABQC	
Toluene	ug/L				
trans-1,3-Dichloropropene	ug/Kg	53	U	44	U
trans-1,3-Dichloropropene	ug/L				
1,1,2-Trichloroethane	ug/Kg	55	U	43	U
1,1,2-Trichloroethane	ug/L				
2-Hexanone	ug/Kg	65	U	44	U
2-Hexanone	ug/L				
Tetrachloroethylene (PCE)	ug/Kg	51	U	45	U
Tetrachloroethylene (PCE)	ug/L				
Dibromochloromethane	ug/Kg	55	U	44	U
Dibromochloromethane	ug/L				
Chlorobenzene	ug/Kg	50	U	44	U
Chlorobenzene	ug/L				
Ethylbenzene	ug/Kg	49	U	46	U
Ethylbenzene	ug/L				
Xylenes, Total	ug/Kg	170	U	150	U
Xylenes, Total	ug/L				
Styrene	ug/Kg	51	U	44	U
Styrene	ug/L				
Bromoform	ug/Kg	58	U	43	U
Bromoform	ug/L				
1,1,2,2-Tetrachloroethane	ug/Kg	57	U	43	U
1,1,2,2-Tetrachloroethane	ug/L				



AOC 598

AOC 599

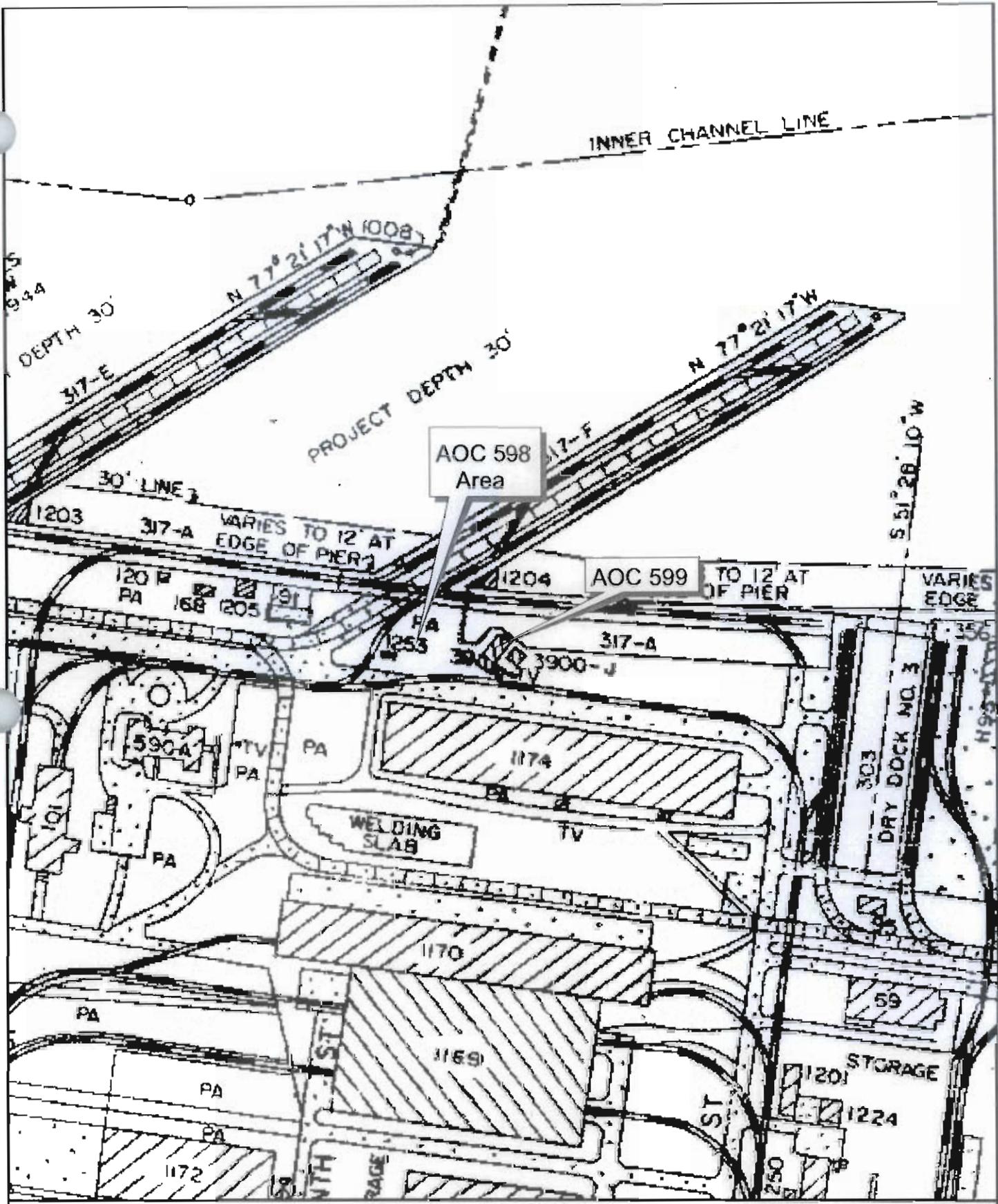
- Shallow Groundwater Elevation (ft. above msl)
- Shallow Groundwater Monitoring Well
- Fence
- Railroads
- Roads
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary



**Figure C-1**  
 Shallow Groundwater Contour Map, May 2002  
 AOCs 598 and 599, Zone E  
 Charleston Naval Complex

**CH2M HILL**

**Appendix D**



--- Railroad Line



**Figure B-1**  
 Historic Railroad Lines near AOCs 598 and 599  
 AOCs 598 and 599, Zone E

Image from Public Works drawing h606-152, November 3, 1955



Analytical Data Summary

03/20/2003 10:06 AM

StationID	E598SB007	E598SB007	E598SB008	E598SB008	
SampleID	598SB00701 (0-1ft)	598SB00702 (3-5ft)	598SB00801 (0-1ft)	598SB00802 (3-5ft)	
DateCollected	7/20/2002	7/20/2002	7/20/2002	7/30/2002	
DateExtracted	7/24/2002	7/24/2002	7/24/2002	8/1/2002	
DateAnalyzed	8/2/2002	8/2/2002	8/2/2002	8/7/2002	
SDGNumber	63923	63923	63923	64461	
Parameter	Units				
Lead	mg/kg	135   J	119   J	112   J	26.8   J

Analytical Data Summary

03/20/2003 10:56 AM

StationID	E598SB009		E598SB009		E598SB010		E598SB010		
SampleID	598SB00901 (0-1ft)		598SB00902 (3-5ft)		598CB01001 (0-1ft)		598SB01001 (0-1ft)		
DateCollected	7/20/2002		7/20/2002		7/20/2002		7/20/2002		
DateExtracted	7/24/2002		7/24/2002		7/24/2002		7/24/2002		
DateAnalyzed	8/2/2002		8/2/2002		8/2/2002		8/2/2002		
SDGNumber	63923		63923		63923		63923		
Parameter	Units								
Lead	mg/kg	39.2	J	28.9	J	43.3	J	34.7	J

Analytical Data Summary

03/20/2003 10:06 AM

StationID	E598SB011		E599SB008		E599SB008		
SampleID	598SB01101 (0-1ft)		599CB00801 (0-1ft)		599SB00801 (0-1ft)		
DateCollected	7/20/2002		7/20/2002		7/20/2002		
DateExtracted	7/24/2002		7/24/2002		7/24/2002		
DateAnalyzed	7/25/2002		7/25/2002		7/25/2002		
SDGNumber	63923		63923		63923		
Parameter	Units						
Benzo(g,h,i)Perylene	ug/kg	1130	J	364	UJ	364	UJ
Naphthalene	ug/kg	459	=	364	U	364	U
Acenaphthylene	ug/kg	335	=	364	U	364	U
Acenaphthene	ug/kg	1130	=	364	U	364	U
Fluorene	ug/kg	552	=	364	U	364	U
Phenanthrene	ug/kg	3300	=	364	U	599	=
Anthracene	ug/kg	1340	=	364	U	364	U
Fluoranthene	ug/kg	5560	=	660	=	612	=
Pyrene	ug/kg	6850	J	1700	=	1460	J
Benzo(a)Anthracene	ug/kg	2030	J	364	U	364	UJ
Chrysene	ug/kg	2840	J	364	U	364	UJ
Benzo(b)Fluoranthene	ug/kg	149	UJ	364	UJ	444	UJ
Benzo(k)Fluoranthene	ug/kg	2800	J	595	J	364	UJ
Benzo(a)Pyrene	ug/kg	1650	J	1260	J	364	UJ
Indeno(1,2,3-c,d)pyrene	ug/kg	1030	J	364	U	364	UJ
Dibenz(a,h)anthracene	ug/kg	149	UJ	364	UJ	364	UJ



## Data Validation Summary - Charleston Naval Complex - Zone E, AOCs 598 and 599

**TO:** Tom Wiley/CH2M HILL/ATL

**FROM:** Amy Juchem/CH2M HILL/GNA  
Herb Kelly/CH2M HILL/GNA

**DATE:** August 28, 2002

The purpose of this memorandum is to present the results of the data validation process for the samples collected in Zone E, AOCs 598 and 599. The samples were collected between the dates of July 20 and 30, 2002.

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) and *National Functional Guidelines for Organic Data Review* (EPA 1999). 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 following analyses: SW-846 8270 Polyaromatic Hydrocarbons (PAHs) and Lead following SW-846 6010 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

SDG	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Upper Depth	Lower Depth	Date Collected	PAHs SW8270C	Lead SW6010B
63923	E598SB010	598SB01001	63923001	SO	N	0	1	07/20/02		X
63923	E598SB010	598CB01001	63923002	SO	FD	0	1	07/20/02		X
63923	E598SB007	598SB00701	63923003	SO	N	0	1	07/20/02		X
63923	E598SB007	598SB00702	63923004	SO	N	3	5	07/20/02		X
63923	E598SB008	598SB00801	63923005	SO	N	0	1	07/20/02		X
63923	E598SB009	598SB00901	63923006	SO	N	0	1	07/20/02		X
63923	E598SB009	598SB00902	63923007	SO	N	3	5	07/20/02		X
63923	E598SB011	598SB01101	63923008	SO	N	0	1	07/20/02	X	
63923	E599SB008	599SB00801	63923009	SO	N	0	1	07/20/02	X	
63923	E599SB008	599CB00801	63923010	SO	FD	0	1	07/20/02	X	
63923	LABQC	1200270029	1200270029	SQ	LB				X	
63923	LABQC	1200270030	1200270030	SQ	BS				X	
63923	E598SB011	598SB01101MS	1200270031	SQ	MS	0	1	07/20/02	X	
63923	E598SB011	598SB01101SD	1200270032	SQ	SD	0	1	07/20/02	X	
63923	LABQC	1200270179	1200270179	SQ	LB					X
63923	LABQC	1200270180	1200270180	SQ	BS					X
63923	E598SB010	598SB01001MS	1200270181	SQ	MS	0	1	07/20/02		X
63923	E598SB010	598SB01001SD	1200270182	SQ	SD	0	1	07/20/02		X
63924	FIELDQC	598EB007M1	63924001	WQ	EB			07/20/02	X	X
63924	LABQC	1200268754	1200268754	WQ	LB				X	
63924	LABQC	1200268755	1200268755	WQ	BS				X	
63924	LABQC	1200269477	1200269477	WQ	LB					X
63924	LABQC	1200269481	1200269481	WQ	BS					X
64461	E598SB008	598SB00802	64461001	SO	N	3	5	07/30/02		X
64461	LABQC	1200274799	1200274799	SQ	LB					X
64461	LABQC	1200274800	1200274800	SQ	BS					X
64461	E598SB008	598SB00802MS	1200274801	SO	MS	3	5	07/30/02		X
64461	E598SB008	598SB00802SD	1200274802	SO	SD	3	5	07/30/02		X

SDG	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Upper Depth	Lower Depth	Date Collected	PAHs SW8270C	Lead SW6010B
<b>MATRIX CODE</b>										
SO – Soil										
SQ – Soil QC Samples										
WQ – Water QC Samples										
<b>SAMPLE TYPE CODE</b>										
EB - Equipment Blank										
N - Native Sample										
FD - Field Duplicate										
BS – Blank Spike										
MS - Matrix Spike										
SD - Matrix Spike Duplicate										
<b>ANALYSIS CODE</b>										
PAHs – Polyaromatic Hydrocarbons										

## Organic Parameters

### Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks and equipment blanks 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.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples** – 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.
- **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.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.

## Polyaromatic Hydrocarbons (PAHs) Analyses

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

### Field Duplicate Samples

All Field Duplicate Samples were within acceptable quality control limits, except as noted in Table 2 below. No flags are applied due to Field Duplicate precision.

**TABLE 2**

Field Duplicate RPDs Out of QC Limits: PAHs

Charleston Naval Complex, Zone E, AOCs 598 and 599, Charleston, SC

SDG	Sample	Parameter	Native Concentration	Field Duplicate Concentration	RPD	RPD Limits
63923	599SB00801 / 599CB00801	Phenanthrene	ND	599 ug/Kg	200*	35
		Benzo(b)fluoranthene	44 ug/Kg	ND	200*	35
		Benzo(k)fluoranthene	ND	595 ug/Kg	200*	35
		Benzo(a)pyrene	ND	1260 ug/Kg	200*	35
* - out of control limits						

### Internal Standard Area

All internal standard areas were within QC limits, except as noted in Table 3 below.

**TABLE 3**

Internal Standard Area out of Criteria: PAHs

Charleston Naval Complex, Zone E, AOCs 598 and 599, Charleston, SC

SDG	Sample	Internal Standards	Flags applied to compounds associated with IS out
63923	598SB01101	IS#5-54%, IS#6-66%	Detects-J, Non-detects-UJ
63923	599SB00801	IS#5-51%, IS#6-62%	Detects-J, Non-detects-UJ
63923	599CB00801	IS#6-53%	Detects-J, Non-detects-UJ

## 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 blanks/continuing calibration blanks, and equipment blanks 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.

### Recoveries - MS/MSD and LCS

All Matrix Spike (MS), Matrix Spike Duplicate (MSD), and Laboratory Control Sample (LCS) recoveries were within acceptable quality control limits, except as noted in Table 4 below.

TABLE 4  
MS/MSD, and LCS Recoveries Out of QC Limits: Metals  
Charleston Naval Complex, Zone E, AOCs 598 and 599, Charleston, SC

SDG	Sample	Parameter	Recovery	Recovery Limits	Associated Samples	Flag
63923	598SB01001 MS/MSD	Lead	76.8* / 81.2*	80-120	63923 - All	Detects-J, non-detects-UJ
64461	598SB00802 MS/MSD	Lead	175.8* / 101.9	80-120	64461 - All	Detects only - J
* - out of control limits						

## Rejected Data

No data were rejected based upon the validation process for this sampling event.

## Conclusion

A review of the analytical data submitted regarding the investigation of Zone E, AOCs 598 and 599 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.

As discussed above, there were specific results that were rejected, in which the data cannot be used. With the exception of these results, the validation review demonstrated that the analytical systems were generally in control and the data can be used in the decision making process.

Attachment 1 - Change of Qualifiers and Results  
 Zone E, AOC 598 and 599 - Data Validation

SDG	Sample ID	Lab Sample ID	Matrix	Parameter Class	Analytical Method	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
63923	598SB01001	63923001	SO	METAL	SW6010B	LEAD	34.7	=	34.7	J	mg/kg	MS
63923	598CB01001	63923002	SO	METAL	SW6010B	LEAD	43.3	=	43.3	J	mg/kg	MS
63923	598SB00701	63923003	SO	METAL	SW6010B	LEAD	135	=	135	J	mg/kg	MS
63923	598SB00702	63923004	SO	METAL	SW6010B	LEAD	119	=	119	J	mg/kg	MS
63923	598SB00801	63923005	SO	METAL	SW6010B	LEAD	112	=	112	J	mg/kg	MS
63923	598SB00901	63923006	SO	METAL	SW6010B	LEAD	39.2	=	39.2	J	mg/kg	MS
63923	598SB00902	63923007	SO	METAL	SW6010B	LEAD	28.9	=	28.9	J	mg/kg	MS
64461	598SB00802	64461001	SO	METAL	SW6010B	LEAD	26.8	N*	26.8	J	mg/kg	MS
63923	598SB01101	63923008	SO	SVOA	SW8270C	BENZO(a)ANTHRACENE	2030	=	2030	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	BENZO(a)ANTHRACENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	BENZO(a)PYRENE	1650	=	1650	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	BENZO(a)PYRENE	364	U	364	UJ	ug/kg	IS
63923	599CB00801	63923010	SO	SVOA	SW8270C	BENZO(a)PYRENE	1260	=	1260	J	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	BENZO(b)FLUORANTHENE	149	U	149	UJ	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	BENZO(b)FLUORANTHENE	444	=	444	UJ	ug/kg	IS
63923	599CB00801	63923010	SO	SVOA	SW8270C	BENZO(b)FLUORANTHENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	BENZO(g,h,i)PERYLENE	1130	=	1130	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	BENZO(g,h,i)PERYLENE	364	U	364	UJ	ug/kg	IS
63923	599CB00801	63923010	SO	SVOA	SW8270C	BENZO(g,h,i)PERYLENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	BENZO(k)FLUORANTHENE	2800	=	2800	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	BENZO(k)FLUORANTHENE	364	U	364	UJ	ug/kg	IS
63923	599CB00801	63923010	SO	SVOA	SW8270C	BENZO(k)FLUORANTHENE	595	=	595	J	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	CHRYSENE	2840	=	2840	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	CHRYSENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	DIBENZ(a,h)ANTHRACENE	149	U	149	UJ	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	DIBENZ(a,h)ANTHRACENE	364	U	364	UJ	ug/kg	IS
63923	599CB00801	63923010	SO	SVOA	SW8270C	DIBENZ(a,h)ANTHRACENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	1030	=	1030	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	364	U	364	UJ	ug/kg	IS
63923	598SB01101	63923008	SO	SVOA	SW8270C	PYRENE	6850	=	6850	J	ug/kg	IS
63923	599SB00801	63923009	SO	SVOA	SW8270C	PYRENE	1460	=	1460	J	ug/kg	IS

CH2M HILL Chain of Custody/ Laboratory Analysis Form

Laboratory: GEL  
 Project Name: Charleston Navy Complex  
 Project Number: 158814.PM.04  
 Project Manager: Tom Beisel  
 Address: GNV: 3011 SW Williston Rd., Gainesville, FL 32605  
ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278  
 Send Report To: see last page of COC

Site Name: Zone E, AOCs 598 & 599  
 TAT: standard  
 QA Level: level 3

Lab Batch/SDG:  
soil 639239  
water 69249  
13

Sample ID	Station ID	Sample Description	Depth		Date & Time Collected	Matrix	# of containers	PAHs (SW8270C)	Lead (SW6010B)	PAHs (SW8270C)	Lead (SW6010B)	1 - 4 ounce jar	1 - 4ounce jar	2 - 1L amber	1 - 0.25L HDPE, HMO3							Comments	
			Begin	End																			
598SB01001	E598SB010	resample E598SB005	0	1	7/20/02 / 0805	SO		X															
598CB01001	E598SB010	resample E598SB005	0	1	7/20/02 / 0805	SO		X															
598SB00701	E598SB007	new soil boring	0	1	7/20/02 / 0735	SO		X															
598SB00702	E598SB007	new soil boring	3	5	7/20/02 / 0745	SO		X															
598SB00801	E598SB008	new soil boring	0	1	7/20/02 / 0840	SO		X															
598SB00802	E598SB008	new soil boring	3	5	7/20/02	SO		X															H.P. obstruction (metal)
598SB00901	E598SB009	new soil boring	0	1	7/20/02 / 0815	SO		X															
598SB00902	E598SB009	new soil boring	3	5	7/20/02 / 0820	SO		X															
598SB01101 ✓	E598SB011	resample E598SB002	0	1	7/20/02 / 0715	SO	X																
599SB00801 ✓	E599SB008	resample E599SB007	0	1	7/20/02 / 0650	SO	X																
599CB00801 ✓	E599SB008	resample E599SB007	0	1	7/20/02 / 0650	SO	X																
598EB007M1	E598EB007				7/20/02 / 0750	SQ				X	X												EB

598SB00702  
 598SB00802  
 598SB00902

Sampled By: Charles Deas / James Deas Date/Time: 7/20/02 11:00 AM Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Additional Samplers: \_\_\_\_\_  
 Received By Lab: John Bonlow Date/Time: 7-20-02 10:20 Relinquished by: Charles Deas Date/Time: 7/20/02 / 10:22

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

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

Receipt Signatures: \_\_\_\_\_

CH2M HILL Chain of Custody/ Laboratory Analysis Form

COC Tracking #: ZE569-062002-01 page 1 of 2

Laboratory: GEL

Project Name: Charleston Navy Complex Site Name: Zone E, AOCs 598 & 599

Project Number: 158814.PM.04 TAT: standard

Project Manager: Tom Beisel QA Level: level 3

Address: GNV: 3011 SW Williston Rd., Gainesville, FL 32605  
ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278

Lab Batch/SDG: \_\_\_\_\_

Send Report To: see last page of COC EDD: CNC format

Sample ID	Station ID	Sample Description	Depth		Date & Time Collected	Matrix
			Begin	End		
598SB01001	E598SB010	resample E598SB005	0	1	<del>7/20/02 10805</del>	SO
598CB01001	E598SB010	resample E598SB005	0	1	<del>7/20/02 10805</del>	SO
598SB00701	E598SB007	new soil boring	0	1	<del>7/20/02 10735</del>	SO
598SB00702	E598SB007	new soil boring	3	5	<del>7/20/02 10745</del>	SO
598SB00801	E598SB008	new soil boring	0	1	<del>7/20/02 10840</del>	SO
598SB00802	E598SB008	new soil boring	3	5	7/30/02 0900	SO
598SB00901	E598SB009	new soil boring	0	1	<del>7/20/02 10815</del>	SO
598SB00902	E598SB009	new soil boring	3	5	<del>7/20/02 10820</del>	SO
598SB01101	E598SB011	resample E598SB002	0	1	<del>7/20/02 10715</del>	SO
599SB00801	E599SB008	resample E599SB007	0	1	<del>7/20/02 10650</del>	SO
599CB00801	E599SB008	resample E599SB007	0	1	<del>7/20/02 10650</del>	SO
598EB007M1	E598EB007				7/20/02 10750	SQ

# of containers	1 - 4 ounce jar	1 - 4ounce jar	2 - 1L amber	1 - 0.25L HDPE, HNO3						
	PAHs (SW8270C)	Lead (SW6010B)	PAHs (SW8270C)	Lead (SW6010B)						
		X								
		X								
		X								
		X								
		X								
		X								
	X									
	X									
			X	X						

Comments

Already Sampled + Sent to Lab.

Only Sample Collected

Already Sampled and sent to Lab

EB

Sampled By: Charles Deas / James Deas Date/Time: 7/30/02 1600

Additional Samplers: CHARLES DEAS

Received By Lab: Paula A. Wendell Date/Time: 7/30/02 1640

Received By: \_\_\_\_\_ Date/Time: \_\_\_\_\_

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

Relinquished by: [Signature] Date/Time: 7-30-02/1640

Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Shipped Via: UPS FedEx Hand Other Tracking#: \_\_\_\_\_

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