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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT ADDENDUM CORRECTIVE MEASURES STUDY WORK PLAN AREA OF CONCERN 723 (AOC 723) ZONE E CNC CHARLESTON SC

6/9/2004

CH2M HILL

RFI REPORT ADDENDUM AND CMS WORK PLAN

AOC 723, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

June 2004

Contract N62467-99-C-0960

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CH2MHILL

June 9, 2004

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 0) – AOC 723, Zone E

Dear Mr. Scaturo:

Enclosed please find two copies of the RFI Report Addendum and CMS Work Plan (Revision 0) for AOC 723 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.

Please contact me at 352/335-5877, ext. 2280, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

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

RFI REPORT ADDENDUM AND CMS WORK PLAN

AOC 723, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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Revision 0
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158814.ZE.PR.29

Certification Page for RFI Report Addendum and CMS Work Plan (Revision 0) – AOC 723, 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.

6/7/2004

Date

Contents

Appendices

Acronyms and Abbreviations

AOC	area of concern
AST	aboveground storage tank
BCT	BRAC Cleanup Team
BEQ	benzo(a)pyrene equivalent
BRAC	Base Realignment and Closure Act
CA	corrective action
CDI	chronic daily intakes
CMS	corrective measures study
CNC	Charleston Naval Complex
COC	chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DAF	dilution attenuation factor
DCE	cis/trans-1,2-dichloroethene
ED	exposure duration
EF	exposure frequency
ELCR	excess lifetime cancer risk
EnSafe	EnSafe Inc.
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
HEAST	Health Effects Assessment Summary Tables

Acronyms and Abbreviations, Continued

HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime excess cancer risk
IM	interim measure
IR	ingestion rate
IRIS	Integrated Risk Information System
LUC	land use control
µg/L	micrograms per liter
MCL	maximum contaminant level
MCS	media cleanup standard
mg/kg	milligrams per kilogram
NAVBASE	Naval Base
NFA	no further action
NFI	no further investigation
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment

Acronyms and Abbreviations, Continued

RFI	RCRA Facility Investigation
RGO	remedial goal option
RI	remedial investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
UCL_{95}	95% Upper Confidence Limit
UST	underground storage tank
VOC	volatile organic compound

Section 1.0

1.0 Introduction

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 Area of Concern (AOC) 723 in Zone E of the CNC. The location of AOC 723 in Zone E is shown in Figure 1-1. Figure 1-2 shows an aerial photograph of the site.

1.1 Background

AOC 723 is a former paint booth in the southwestern corner of Building 177. Building 177 was built in 1955 and is a five-story structural steel-framed building with metal siding. It is located at 1865B Avenue B, at the corner of Fourth Street and Avenue B. An abandoned rail line enters the northern end of the building, where the flooring is partially brick. The remainder of the building has concrete flooring. The Navy conducted an RFI in 1996 for Zone E. At the time of the Zone E RFI, AOC 723 had not been identified as an AOC. After the Zone E RFI was completed, the presence of this former paint booth became known and it was identified as an AOC.

A review of the historical engineering drawings indicates that a cleaning and degreasing room and an oven room were next to the paint booth. Excerpts from these historical drawings depicting the location of the cleaning and degreasing room and oven room are provided in Appendix A.

The western half of Building 177 was previously used for parts cleaning. Currently Excel Apparatus Services, Inc. (Excel) uses the area where AOC 723 is located for repairing

electrical and electronic equipment, parts cleaning, paint stripping, paint spraying, electric motor rebuilding, machining metal parts, and treatment of aluminum components in a corrosion inhibitor bath (Iridite treatment). Excel uses the AOC 723 area for maintenance activities in support of the Detyens Shipyards. Engineering drawings prepared by the Navy during 1954 show the presence of several floor drains that may have been used to collect and convey wastes from the paint booth operation. Excerpts of these drawings are included in Appendix A. This area of Zone E is zoned M2 (industrial).

A RCRA Facility Assessment (RFA) and RFI Work Plan were prepared by the Navy/CH2M-Jones team and submitted to SCDHEC during May 2003. The RFA and RFI Work Plan were approved by SCDHEC during July 2003. The RFA identified volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals as contaminants of potential concern (COPCs) in soil and groundwater. The RFI Work Plan recommended soil and groundwater sampling for the COPCs as part of the RFI.

Soil and groundwater sampling activities associated with the RFI were conducted during July 2003 and October 2003, respectively, and are discussed in more detail in Section 3.0.

1.2 Purpose of the RFI Report Addendum

The purpose of this RFI Report Addendum is to document the results of RFI investigations conducted by the Navy/CH2M-Jones team at AOC 723. This RFI Report Addendum also discusses various closeout issues and the findings of previous investigations, existing site conditions, and surrounding area land use.

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

- Status of the RFI;
- Presence of metals (inorganics) in groundwater;
- Potential linkage to Solid Waste Management Unit (SWMU) 37, Investigated Sanitary Sewers at the CNC;
- Potential linkage to AOC 699, Investigated Storm Sewers at the CNC;
- Potential linkage of AOC 504, Investigated Railroad Lines at the CNC;
- Potential linkage to surface water bodies (Zone J);

- Potential contamination associated with oil/water separators (OWSs); and
- Relevance or need for land use controls (LUCs) at the site.

Information regarding these issues is provided in this RFI Report Addendum to expedite evaluation of closure of the site.

1.3 Report Organization

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

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

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

2.0 Description of RFI Activities for AOC 723 – Summarizes the RFI investigation activities conducted at AOC 723.

3.0 RFI Human Health Risk Assessment and COPC Refinement – Includes information on the assumptions and calculations of site-related risks and discussions of COPC/chemical of concern (COC) refinement.

4.0 Interim Measures and UST/AST Removals – Provides information regarding any interim measures (IMs) or tank removal activities performed at the site.

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

6.0 Recommendations – Provides recommendations for proceeding with site closure.

7.0 Corrective Measures Study Work Plan – Presents a focused Corrective Measures Study (CMS) Work Plan.

8.0 References – Lists the references used in this document.

Appendix A – Contains figures of excerpts from the historical engineering drawings of Building 177 showing the locations of the cleaning and degreasing rooms.

Appendix B – Contains Figures B1 and B2, which show shallow and deep groundwater elevation contours in the vicinity AOC 723.

Appendix C – Contains analytical data results and data validation summaries from the RFI sampling and a figure depicting the historical railroad lines near Building 177.

Appendix D – Contains risk assessment tables.

Appendix E – Contains worksheet used to calculate site-specific soil screening levels (SSLs).

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

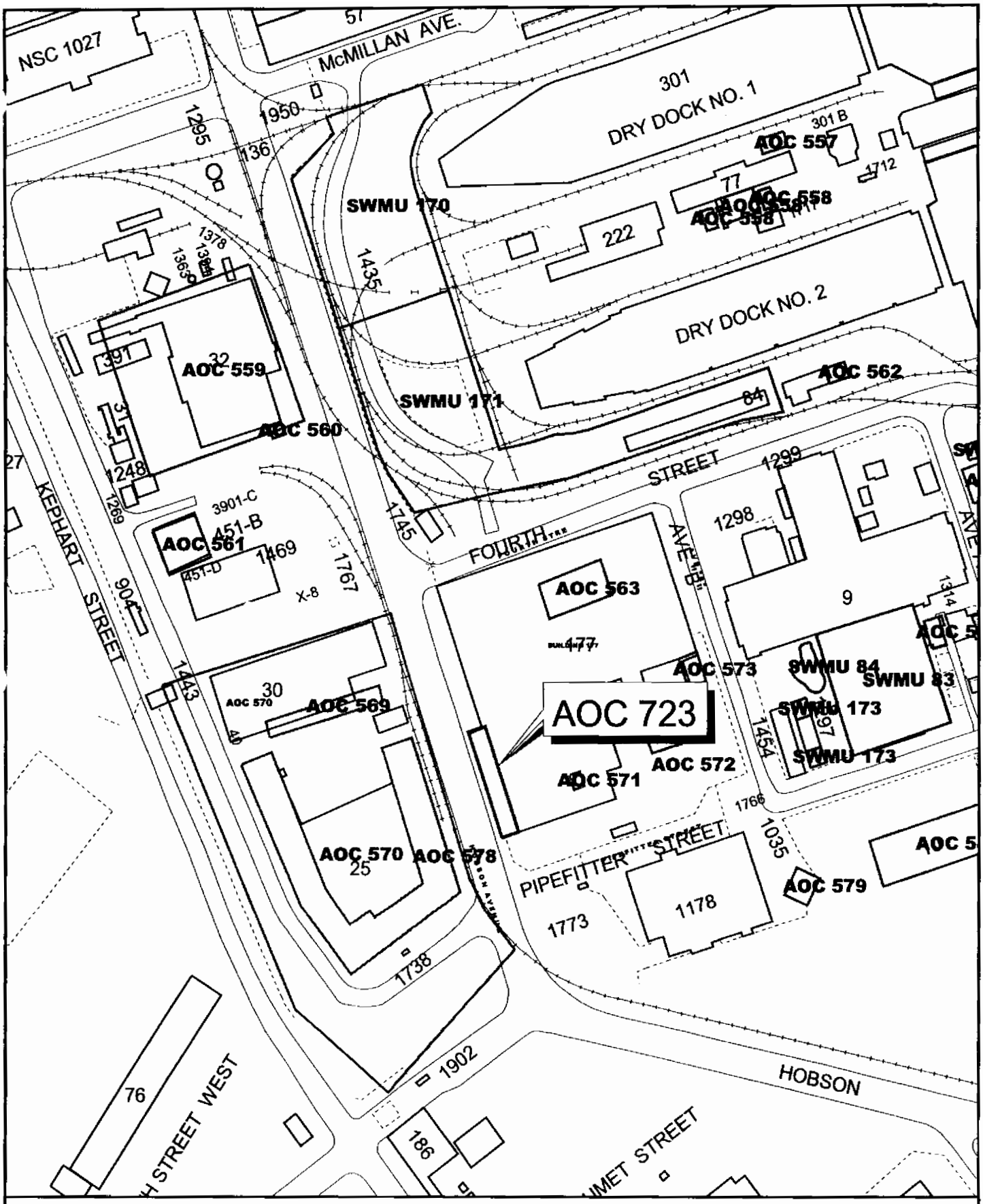

Figure 1-1
AOC 723 Site Location
Zone E
Charleston Naval Complex

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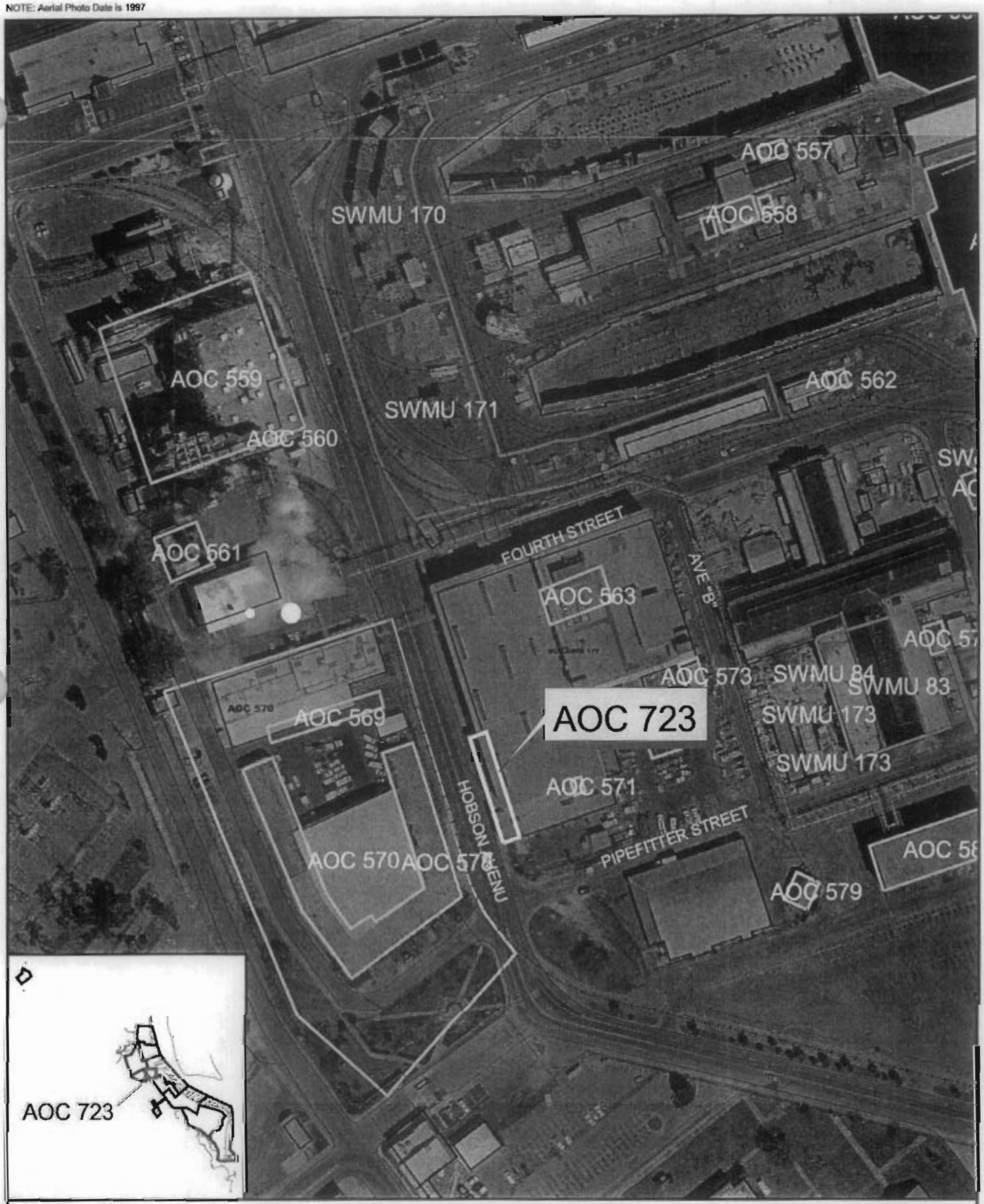

Figure 1-2
Site Map
AOC 723, Zone E
Charleston Naval Complex

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Section 2.0

2.0 Description of RFI Activities for AOC 723

This section presents information on the soil and groundwater investigations conducted at AOC 723 as part of the RFI. Based on the nature of past site activities at AOC 723 as indicated by historical engineering drawings, the RFA identified VOCs, SVOCs and metals as COPCs in soil and groundwater. Accordingly, soil and groundwater samples collected during the RFI were analyzed for VOCs, SVOCs and metals. There is no indication of historical use of polychlorinated biphenyl (PCBs) or pesticides at the site, and the soil and groundwater samples collected at AOC 723 were not analyzed for these parameters.

2.1 Soil Sampling and Analysis

The RFI Work Plan identified nine soil sampling locations at AOC 723, as shown in Figure 2-1. Surface and subsurface soil samples collected from these locations were analyzed for VOCs, SVOCs and metals.

An additional subsurface soil sample was collected outside the southwestern side of Building 177 to verify the presence of site constituents along a discharge line (possibly connected to the sewer line) from current operations being conducted by the tenant in this area of Building 177.

RFI activities at this site are described in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). Figure 2-1 shows the locations of the RFI soil borings. Analytical data reports and data validation summaries are included in Appendix C of this document.

2.1.1 Surface Soil

Based on the CNC BCT screening criteria, surface soil detections of VOCs were compared with their SSLs with a dilution-attenuation factor (DAF) of 1.0 and the U.S. Environmental Protection Agency (EPA) Region III risk-based concentrations (RBCs) (with a hazard index [HI]=0.1 for noncarcinogens). Surface soil SVOC and inorganic detections were compared with their SSLs (with a DAF=10) and the EPA Region III RBCs (with a HI=0.1 for noncarcinogens). Additionally, inorganic detections were compared with their maximum Zone E background concentrations. Benzo(a)pyrene equivalents (BEQs) were compared with the CNC BEQ sitewide reference concentrations for surface soils. Tables 2-1, 2-2, and 2-3 show the surface soil detections of organic and inorganic compounds.

Detected concentrations of organic and inorganic analytes exceeding their respective criteria were as follows:

- **VOCs:** Trichloroethene (TCE) concentrations in four samples exceeded the SSL (with a DAF=1). There were no other exceedances of the VOC screening criteria in any surface soil samples.
- **SVOCs:** One detection of carbazole exceeded the SSL (with a DAF=1). BEQ concentrations exceeded the CNC BCT sitewide reference concentration of 1.304 milligrams per kilogram (mg/kg) at three locations. There were no other exceedances of the SVOC screening criteria in surface soil samples.
- **Inorganics:** One detection of arsenic exceeded the maximum Zone E background concentration.

2.1.2 Subsurface Soil

Subsurface soil detections of organic compounds were compared with generic SSLs using a DAF=10. Subsurface soil detections of inorganic chemicals were compared with generic SSLs (using a DAF=10) and the maximum Zone E background concentrations. BEQ detections were compared with the CNC BEQ sitewide reference concentration for subsurface soils. Tables 2-1, 2-2 and 2-3 show the subsurface soil detections of organic and inorganic chemicals.

Detected concentrations of organic and inorganic chemicals exceeding their respective screening criteria are as follows:

- **VOCs:** One detection of 1,2-dichloroethene (1,2-DCE) exceeded the SSL (with a DAF=1). TCE concentrations in three samples exceeded the SSL (with a DAF=1). There were no other exceedances of the VOC screening criteria in surface soil samples.
- **SVOCs:** The BEQ concentration in one subsurface soil sample exceeded the CNC BEQ sitewide reference concentration. None of the other SVOC detections exceeded the screening criteria.
- **Inorganics:** One detection of chromium (total) at 26.4 mg/kg in the sample from E723SB008 exceeded the SSL (with a DAF=10) of 19 mg/kg, but was below the maximum Zone E subsurface soil background concentration of 75 mg/kg.

2.2 Groundwater

The RFI for AOC 723 included the installation of one shallow well (identified as E723GW001) and one deep monitoring well (identified as E723GW01D). Two additional existing shallow wells (E563GW004 and E569GW005) and two additional existing deep wells (E563GW04D and E569GW05D) were also sampled during the AOC 723 RFI groundwater sampling event. Figure 2-2 shows the locations of these monitoring wells.

Groundwater samples from the above wells were analyzed for VOCs, SVOCs and metals. Detections in shallow and deep groundwater samples were compared with the EPA Region III tap water RBCs, maximum contaminant levels (MCLs), and additionally (for inorganics), the respective maximum Zone E background concentrations. Table 2-4 shows the detections from the RFI groundwater sampling.

2.2.1 Shallow Groundwater

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

VOCs: Among detected analytes, TCE exceeded the MCL of 5 micrograms per liter (µg/L) in two samples, one from E723GW001 at 7.7 µg/L and the other from E563GW004 at 258 µg/L. No other VOC detections exceeded screening criteria.

SVOCs: There were no SVOC detections above laboratory detection limits.

Inorganics: Among detected inorganic analytes, one detection of antimony at 6.65 µg/L exceeded the MCL of 6 µg/L and EPA Region III tap water RBC (with a HI=0.1) of 1.5 µg/L.

2.2.2 Deep Groundwater

Analyte concentrations in deep groundwater samples were detected as follows at this site:

VOCs: Among detected VOCs, chloroform and cis-1,2-dichloroethene (cis-1,2-DCE), TCE and vinyl chloride exceeded the screening criteria.

- Chloroform, at a concentration of 5.3 µg/L at E723GW01D, exceeded its tap water RBC of 0.15 µg/L. There is no MCL published for chloroform.
- Cis-1,2-DCE, at a concentration of 169 µg/L at E563GW04D, exceeded its MCL of 70 µg/L.
- TCE, at a concentration of 1,880 µg/L at E563GW04D, exceeded its MCL of 5 µg/L.

- **SVOCs:** There were no detections of SVOC concentrations above laboratory detection limits.

Inorganics: Among detected inorganic analytes, none of the inorganic chemicals exceeded the CNC BCT screening criteria.

Further discussion of chemicals exceeding the screening criteria, is included in Section 3, Risk Assessment.

TABLE 2-1
Surface and Subsurface Soil Detections of VOCs, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=1) (mg/kg)	Zone E Range of Bkgd. Conc. (mg/kg)
SURFACE SOIL									
1,1-Dichloroethene	E723SB006	723SB00601	0.001	J	07/17/03	1.1	9.5	0.003	na
Acetone	E723SB008	E723SB00801	0.43	=	07/17/03	780	20,000	0.8	na
Ethylbenzene	E723SB009	E723SB00901	0.001	J	07/17/03	780	20,000	0.7	na
Toluene	E723SB009	E723SB00901	0.0004	J	07/17/03	1600	41,000	0.6	na
Trichloroethylene (TCE)	E723SB001	E723SB00101	**0.029**	J	07/17/03	58	520	0.003	na
	E723SB002	E723SB00201	**0.007**	J	07/17/03				
	E723SB003	E723SB00301	**1.280**	=	07/17/03				
	E723SB005	E723SB00501	**1.780**	=	07/17/03				
	E723SB006	E723SB00601	0.002	J	07/17/03				
	E723SB007	E723SB00701	0.001	J	07/17/03				
SUBSURFACE SOIL									
1,1-Dichloroethene	E723SB002	723SB00202	**0.006**	J	07/17/03	na	na	0.003	na
	E723SB005	723SB00502	0.001	J	07/17/03				
	E723SB006	723SB00602	0.001	J	07/17/03				
	E723SB010	E723SB01002	0.007	J	12/12/03				
Acetone	E723SB002	E723SB00202	0.01	J	07/17/03	na	na	0.8	na
Tetrachloroethylene (PCE)	E723SB010	E723SB01002	0.0008	J	12/12/03	na	na	0.003	na
Toluene	E723SB005	E723SB00502	0.0004	J	07/17/03	na	na	0.6	na
Trichloroethylene (TCE)	E723SB001	E723SB00102	0.002	J	07/17/03	na	na	0.003	na
	E723SB002	E723SB00202	**0.015**	J	07/17/03				
	E723SB003	E723SB00302	**0.032**	J	07/17/03				
	E723SB005	E723SB00502	**0.027**	=	07/17/03				
	E723SB006	E723SB00602	0.002	J	07/17/03				
	E723SB007	E723SB00702	0.003	J	07/17/03				
	E723SB010	E723SB01002	**0.010**	=	12/12/03				

mg/kg micrograms per kilogram
HI Hazard index
= Indicates that the analyte is detected at the concentration shown.
J Indicates an estimated value. A "J" qualifier may signify that the concentration is below the PQL, or that the "J" has been applied as a result of the data validation.
U Indicates analyte not detected above laboratory detection limit.
na not available/not applicable

1

TABLE 2-2
Surface and Subsurface Soil Detections of SVOCs, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bkgd. Conc. (mg/kg)
SURFACE SOIL									
2-Methylnaphthalene	E723SB003	E723SB00301	0.12	J	07/17/03	160	4100	42	na
	E723SB008	E723SB00801	0.04	J	07/17/03				
	E723SB009	E723SB00901	0.19	J	07/17/03				
Acenaphthene	E723SB003	E723SB00301	0.38	=	07/17/03	470	12000	290	na
	E723SB007	E723SB00701	0.04	J	07/17/03				
	E723SB008	E723SB00801	0.08	J	07/17/03				
	E723SB009	E723SB00901	0.67	=	07/17/03				
Acenaphthylene	E723SB005	E723SB00501	0.05	J	07/17/03	na	na	na	na
Anthracene	E723SB003	E723SB00301	0.48	=	07/17/03	2300	61000	5900	na
	E723SB006	E723SB00601	0.02	J	07/17/03				
	E723SB007	E723SB00701	0.09	J	07/17/03				
	E723SB008	E723SB00801	0.26	J	07/17/03				
	E723SB009	E723SB00901	0.95	=	07/17/03				
Benzo(g,h,i)Perylene	E723SB003	E723SB00301	0.41	=	07/17/03	na	na	na	na
	E723SB007	E723SB00701	0.26	J	07/17/03	na	na		
	E723SB008	E723SB00801	0.65	=	07/17/03	na	na		
	E723SB009	E723SB00901	0.71	J	07/17/03	na	na		
Carbazole	E723SB003	723SB00301	0.29	J		32	290	0.3	na
	E723SB007	723SB00701	0.03	J					
	E723SB008	723SB00801	0.04	J					
	E723SB009	723SB00901	**0.52**	J					
Dibenzofuran	E723SB003	E723SB00301	0.19	J	07/17/03	31	820	na	na
	E723SB008	E723SB00801	0.08	J	07/17/03				
	E723SB009	E723SB00901	0.26	J	07/17/03				
Diethyl Phthalate	E723SB004	E723SB00401	0.03	J	07/17/03	63,000	160,000	470	na
	E723SB005	E723CB00501	0.03	J	07/17/03				
Fluoranthene	E723SB001	E723SB00101	0.06	J	07/17/03	310	8200	2150	na
	E723SB002	E723SB00201	0.03	J	07/17/03				
	E723SB003	E723SB00301	2.63	=	07/17/03				
	E723SB004	E723SB00401	0.15	J	07/17/03				
	E723SB005	E723SB00501	0.06	J	07/17/03				
	E723SB006	E723SB00601	0.27	J	07/17/03				
	E723SB007	E723SB00701	1.03	=	07/17/03				
	E723SB008	E723SB00801	2.54	=	07/17/03				
	E723SB009	E723SB00901	4.62	=	07/17/03				
Fluorene	E723SB003	E723SB00301	0.27	J	07/17/03	310	8200	280	na
	E723SB004	E723SB00401	0.00	J	07/17/03				
	E723SB007	E723SB00701	0.02	J	07/17/03				
	E723SB008	E723SB00801	0.03	J	07/17/03				
	E723SB009	E723SB00901	0.45	=	07/17/03				
Naphthalene	E723SB003	E723SB00301	0.14	J	07/17/03	160	4100	42	na
	E723SB008	E723SB00801	0.04	J	07/17/03				
	E723SB009	E723SB00901	0.26	J	07/17/03				
Phenanthrene	E723SB001	E723SB00101	0.05	J	07/17/03	na	na	na	na
	E723SB003	E723SB00301	2.34	=	07/17/03				

TABLE 2-2
Surface and Subsurface Soil Detections of SVOCs, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bkgd. Conc. (mg/kg)
	E723SB004	E723SB00401	0.09	J	07/17/03				
	E723SB005	E723SB00501	0.02	J	07/17/03				
	E723SB006	E723SB00601	0.14	J	07/17/03				
	E723SB007	E723SB00701	0.45	=	07/17/03				
	E723SB008	E723SB00801	0.79	=	07/17/03				
	E723SB009	E723SB00901	4.28	=	07/17/03				
Pyrene	E723SB001	E723SB00101	0.08	J	07/17/03	230	6100	2100	na
	E723SB002	E723SB00201	0.04	J	07/17/03				
	E723SB003	E723SB00301	2.75	=	07/17/03				
	E723SB004	E723SB00401	0.19	J	07/17/03				
	E723SB005	E723SB00501	0.09	J	07/17/03				
	E723SB006	E723SB00601	0.25	J	07/17/03				
	E723SB007	E723SB00701	1.00	=	07/17/03				
	E723SB008	E723SB00801	3.26	=	07/17/03				
	E723SB009	E723SB00901DL	5.64	=	07/17/03				
BEQs	E723SB001	E723SB00101	0.25	=	07/17/03				1.304
	E723SB002	E723SB00201	0.41	=	07/17/03				
	E723SB003	E723SB00301	**2.19**	=	07/17/03				
	E723SB004	E723SB00401	0.30	=	07/17/03				
	E723SB005	E723SB00501	0.30	=	07/17/03				
	E723SB006	E723SB00601	0.39	=	07/17/03				
	E723SB007	E723SB00701	1.06	=	07/17/03				
	E723SB008	E723SB00801	**3.08**	=	07/17/03				
	E723SB009	E723SB00901	**3.68**	=	07/17/03				
SUBSURFACE SOIL									
2-Methylnaphthalene	E723SB008	E723SB00802	0.02	J	07/17/03	na	na	42	na
	E723SB009	E723SB00902	0.05	J	07/17/03				
Acenaphthene	E723SB004	E723SB00402	0.02	J	07/17/03	na	na	290	na
	E723SB008	E723SB00802	0.19	J	07/17/03				
	E723SB009	E723SB00902	0.21	J	07/17/03				
	E723SB010	E723SB01002	0.0193	J	12/12/03				
Anthracene	E723SB004	E723SB00402	0.04	J	07/17/03	na	na	5900	na
	E723SB006	E723SB00602	0.04	J	07/17/03				
	E723SB008	E723SB00802	0.58	=	07/17/03				
	E723SB009	E723SB00902	0.25	J	07/17/03				
	E723SB010	E723SB01002	0.0529	J	12/12/03				
Benzo(g,h,i)Perylene	E723SB004	E723SB00402	0.12	J	07/17/03	na	na	na	na
	E723SB005	E723SB00502	0.12	J	07/17/03	na	na		
	E723SB006	E723SB00602	0.20	J	07/17/03	na	na		
	E723SB007	E723SB00702	0.19	J	07/17/03	na	na		
	E723SB008	E723SB00802	0.42	=	07/17/03	na	na		
	E723SB009	E723SB00902	0.20	J	07/17/03	na	na		
	E723SB010	E723SB01002	0.343	J	12/12/03				
Benzoic acid	E723SB010	E723SB01002	0.472	J	12/12/03	na	na	200	na
bis(2-Ethylhexyl) Phthalate	E723SB010	E723SB01002	0.113	J	12/12/03	na	na	1800	na
Carbazole	E723SB004	723SB00402	0.04	J	07/17/03	na	na	0.3	na
	E723SB008	723SB00802	0.18	J	07/17/03	na	na		

TABLE 2-2
Surface and Subsurface Soil Detections of SVOCs, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bkgd. Conc. (mg/kg)
	E723SB009	723SB00902	0.11	J	07/17/03	na	na		
	E723SB010	723SB01002	0.03	J	12/12/03	na	na		
Dibenzofuran	E723SB008	E723SB00802	0.05	J	07/17/03	na	na	na	na
	E723SB009	E723SB00902	0.06	J	07/17/03				
Diethyl Phthalate	E723SB009	E723SB00902	0.02	J	07/17/03	na	na	470	na
Fluoranthene	E723SB002	E723SB00202	0.08	J	07/17/03	na	na	2150	na
	E723SB003	E723SB00302	0.08	J	07/17/03				
	E723SB004	E723SB00402	0.43	=	07/17/03				
	E723SB005	E723SB00502	0.14	J	07/17/03				
	E723SB006	E723SB00602	0.58	=	07/17/03				
	E723SB007	E723SB00702	0.26	J	07/17/03				
	E723SB008	E723SB00802	3.56	=	07/17/03				
	E723SB009	E723SB00902	1.09	=	07/17/03				
	E723SB010	E723SB01002	0.738	J	12/12/03				
Fluorene	E723SB004	E723SB00402	0.02	J	07/17/03			280	na
	E723SB006	E723SB00602	0.01	J	07/17/03				
	E723SB008	E723SB00802	0.13	J	07/17/03				
	E723SB009	E723SB00902	0.12	J	07/17/03				
	E723SB010	E723SB01002	0.0134	J	12/12/03				
Naphthalene	E723SB009	E723SB00902	0.05	J	07/17/03	na	na	42	na
Phenanthrene	E723SB002	E723SB00202	0.03	J	07/17/03	na	na	na	na
	E723SB003	E723SB00302	0.03	J	07/17/03				
	E723SB004	E723SB00402	0.25	J	07/17/03				
	E723SB005	E723SB00502	0.06	J	07/17/03				
	E723SB006	E723SB00602	0.21	J	07/17/03				
	E723SB007	E723SB00702	0.07	J	07/17/03				
	E723SB008	E723SB00802	2.20	=	07/17/03				
	E723SB009	E723SB00902	1.07	=	07/17/03				
	E723SB010	E723SB01002	0.326	J	12/12/03				
Pyrene	E723SB002	E723SB00202	0.09	J	07/17/03	na	na	2100	na
	E723SB003	E723SB00302	0.09	J	07/17/03				
	E723SB004	E723SB00402	0.40	=	07/17/03				
	E723SB005	E723SB00502	0.15	J	07/17/03				
	E723SB006	E723SB00602	0.53	=	07/17/03				
	E723SB007	E723SB00702	0.26	J	07/17/03				
	E723SB008	E723SB00802	3.57	=	07/17/03				
	E723SB009	E723SB00902	0.95	=	07/17/03				
	E723SB010	E723SB01002	0.67	J	12/12/03				
BEQs	E723SB001	E723SB00102	0.44	U	07/17/03	na	na		1.4
	E723SB002	E723SB00202	0.42	=	07/17/03				
	E723SB003	E723SB00302	0.30	=	07/17/03				
	E723SB004	E723SB00402	0.46	=	07/17/03				
	E723SB005	E723SB00502	0.39	=	07/17/03				
	E723SB006	E723SB00602	0.64	=	07/17/03				
	E723SB007	E723SB00702	0.57	=	07/17/03				
	E723SB008	E723SB00802	2.63	=	07/17/03				
	E723SB009	E723SB00902	0.84	=	07/17/03				
	E723SB010	E723SB01002	0.97		12/12/03				

TABLE 2-2
Surface and Subsurface Soil Detections of SVOCs, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bkgd. Conc. (mg/kg)

mg/kg	micrograms per kilogram
HI	Hazard index
=	Indicates that the analyte is detected at the concentration shown.
J	Indicates an estimated value. A "J" qualifier may signify that the concentration is below the PQL, or that the "J" has been applied as a result of the data validation.
U	Indicates analyte not detected above laboratory detection limit.
na	not available

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TABLE 2-3
Surface and Subsurface Soil Detections of Inorganics, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bgd. Conc. (mg/kg)
SURFACE SOIL									
Arsenic	E723SB001	E723SB00101	1.8	J	07/17/03	0.43	3.8	14.5	0.95 - 68
	E723SB002	E723SB00201	3.2	=	07/17/03				
	E723SB003	E723SB00301	9.5	=	07/17/03				
	E723SB004	E723SB00401	3.0	=	07/17/03				
	E723SB005	E723SB00501	7.3	=	07/17/03				
	E723SB006	E723SB00601	21.1	=	07/17/03				
	E723SB007	E723SB00701	6.3	=	07/17/03				
	E723SB008	E723SB00801	**106.0**	=	07/17/03				
	E723SB009	E723SB00901	10.1	=	07/17/03				
Barium	E723SB001	E723SB00101	30.1	J	07/17/03	547	14,308	800	1.8 - 1980
	E723SB002	E723SB00201	31.0	J	07/17/03				
	E723SB003	E723SB00301	39.2	J	07/17/03				
	E723SB004	E723SB00401	13.4	J	07/17/03				
	E723SB005	E723SB00501	53.0	=	07/17/03				
	E723SB006	E723SB00601	44.9	=	07/17/03				
	E723SB007	E723SB00701	41.1	J	07/17/03				
	E723SB008	E723SB00801	58.7	=	07/17/03				
	E723SB009	E723SB00901	45.6	J	07/17/03				
Cadmium	E723SB001	E723SB00101	0.1	J	07/17/03	7.8	204	4	0.06 - 1.5
	E723SB002	E723SB00201	0.1	U	07/17/03				
	E723SB003	E723SB00301	0.6	J	07/17/03				
	E723SB004	E723SB00401	0.3	J	07/17/03				
	E723SB005	E723SB00501	0.1	J	07/17/03				
	E723SB006	E723SB00601	0.2	J	07/17/03				
	E723SB007	E723SB00701	0.2	J	07/17/03				
	E723SB008	E723SB00801	0.5	J	07/17/03				
	E723SB009	E723SB00901	2.5	=	07/17/03				
Chromium, Total	E723SB001	E723SB00101	6.0	J	07/17/03	23.5	613	19	2.3 - 567
	E723SB002	E723SB00201	8.0	J	07/17/03				
	E723SB003	E723SB00301	14.9	J	07/17/03				
	E723SB004	E723SB00401	10.5	J	07/17/03				
	E723SB005	E723SB00501	18.8	J	07/17/03				
	E723SB006	E723SB00601	20.6	J	07/17/03				
	E723SB007	E723SB00701	20.6	J	07/17/03				
	E723SB008	E723SB00801	26.6	J	07/17/03				
	E723SB009	E723SB00901	26.6	J	07/17/03				
Lead	E723SB001	E723SB00101	7.9	=	07/17/03	400	1300	65	1 - 400
	E723SB002	E723SB00201	10.7	=	07/17/03				
	E723SB003	E723SB00301	34.9	=	07/17/03				
	E723SB004	E723SB00401	38.2	=	07/17/03				
	E723SB005	E723SB00501	33.6	=	07/17/03				
	E723SB006	E723SB00601	27.0	=	07/17/03				
	E723SB007	E723SB00701	36.4	=	07/17/03				
	E723SB008	E723SB00801	100.0	=	07/17/03				
	E723SB009	E723SB00901	95.2	=	07/17/03				
Mercury	E723SB001	E723SB00101	0.02	J	07/17/03	2.3	61	1	0.03 - 2.7
	E723SB002	E723SB00201	0.02	J	07/17/03				
	E723SB003	E723SB00301	0.09	J	07/17/03				
	E723SB004	E723SB00401	0.03	J	07/17/03				
	E723SB005	E723SB00501	0.53	=	07/17/03				
	E723SB006	E723SB00601	0.05	J	07/17/03				

TABLE 2-3
Surface and Subsurface Soil Detections of Inorganics, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bgd. Conc. (mg/kg)
	E723SB007	E723SB00701	0.08	J	07/17/03				
	E723SB008	E723SB00801	0.19	=	07/17/03				
	E723SB009	E723SB00901	0.21	=	07/17/03				
Selenium	E723SB005	E723SB00501	0.9	J	07/17/03	39	1022	2.5	0.57 - 4.0
	E723SB006	E723SB00601	1.2	=	07/17/03				
SUBSURFACE SOIL									
Arsenic	E723SB001	E723SB00102	4.4	=	07/17/03	na	na	14.5	0.83 - 26
	E723SB002	E723SB00202	2.5	=	07/17/03				
	E723SB003	E723SB00302	4.0	=	07/17/03				
	E723SB004	E723SB00402	5.2	=	07/17/03				
	E723SB005	E723SB00502	5.2	=	07/17/03				
	E723SB006	E723SB00602	5.2	=	07/17/03				
	E723SB007	E723SB00702	4.6	=	07/17/03				
	E723SB008	E723SB00802	11.3	=	07/17/03				
	E723SB009	E723SB00902	3.2	=	07/17/03				
	E723SB010	E723SB01002	3.74	=	12/12/03				
Barium	E723SB001	E723SB00102	23.4	J	07/17/03	na	na	800	6.1 - 91
	E723SB002	E723SB00202	39.2	J	07/17/03				
	E723SB003	E723SB00302	31.0	J	07/17/03				
	E723SB004	E723SB00402	18.7	J	07/17/03				
	E723SB005	E723SB00502	48.8	=	07/17/03				
	E723SB006	E723SB00602	38.1	J	07/17/03				
	E723SB007	E723SB00702	43.6	J	07/17/03				
	E723SB008	E723SB00802	29.1	J	07/17/03				
	E723SB009	E723SB00902	36.9	J	07/17/03				
	E723SB010	E723SB01002	49	J	12/12/03				
Cadmium	E723SB001	E723SB00102	0.1	U	07/17/03	na	na	4	0.13 - 0.96
	E723SB002	E723SB00202	0.1	U	07/17/03				
	E723SB003	E723SB00302	0.1	J	07/17/03				
	E723SB004	E723SB00402	0.3	J	07/17/03				
	E723SB005	E723SB00502	0.1	J	07/17/03				
	E723SB006	E723SB00602	0.1	J	07/17/03				
	E723SB007	E723SB00702	0.1	J	07/17/03				
	E723SB008	E723SB00802	0.2	J	07/17/03				
	E723SB009	E723SB00902	0.1	J	07/17/03				
	E723SB010	E723SB01002	2.33	=	12/12/03				
Chromium, Total	E723SB001	E723SB00102	16.3	J	07/17/03	na	na	19	1.6 - 7.5
	E723SB002	E723SB00202	15.5	J	07/17/03				
	E723SB003	E723SB00302	9.5	J	07/17/03				
	E723SB004	E723SB00402	13.6	J	07/17/03				
	E723SB005	E723SB00502	14.3	J	07/17/03				
	E723SB006	E723SB00602	12.8	J	07/17/03				
	E723SB007	E723SB00702	18.7	J	07/17/03				
	E723SB008	E723SB00802	**26.4**	J	07/17/03				
	E723SB009	E723SB00902	14.8	J	07/17/03				
	E723SB010	E723SB01002	11.3	=	12/12/03				
Lead	E723SB001	E723SB00102	7.7	=	07/17/03	na	na	400	1.8 - 322
	E723SB002	E723SB00202	10.5	=	07/17/03				
	E723SB003	E723SB00302	37.8	=	07/17/03				
	E723SB004	E723SB00402	38.5	=	07/17/03				
	E723SB005	E723SB00502	29.7	=	07/17/03				
	E723SB006	E723SB00602	11.1	=	07/17/03				
	E723SB007	E723SB00702	37.6	=	07/17/03				

TABLE 2-3
Surface and Subsurface Soil Detections of Inorganics, RFI Sampling
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Sampled	EPA Region III Resid. RBC (HI= 0.1) (mg/kg)	EPA Region III Indust. RBC (HI= 0.1) (mg/kg)	SSLs (DAF=10) (mg/kg)	Zone E Range of Bgd. Conc. (mg/kg)
	E723SB008	E723SB00802	35.4	=	07/17/03				
	E723SB009	E723SB00902	13.1	=	07/17/03				
	E723SB010	E723SB01002	63.2	J	12/12/03				
Mercury	E723SB001	E723SB00102	0.01	U	07/17/03	na	na	1	0.04 - 0.9
	E723SB002	E723SB00202	0.02	J	07/17/03				
	E723SB003	E723SB00302	0.08	J	07/17/03				
	E723SB004	E723SB00402	0.06	J	07/17/03				
	E723SB005	E723SB00502	0.07	J	07/17/03				
	E723SB006	E723SB00602	0.06	J	07/17/03				
	E723SB007	E723SB00702	0.12	=	07/17/03				
	E723SB008	E723SB00802	0.05	J	07/17/03				
	E723SB009	E723SB00902	0.07	J	07/17/03				
	E723SB010	E723SB01002	0.099	J	12/12/03				
Selenium	E723SB001	E723SB00102	0.9	J	07/17/03	na	na	2.5	0.59 - 2.4
	E723SB007	E723SB00702	0.9	J	07/17/03				
	E723SB008	E723SB00802	1.3	=	07/17/03				
Silver	E723SB010	E723SB01002	1.21	J	12/12/03	na	na	2.5	NA

mg/kg micrograms per kilogram
HI Hazard index
= Indicates that the analyte is detected at the concentration shown.
J Indicates an estimated value. A "J" qualifier may signify that the concentration is below the PQL, or that the "J" has been applied as a result of the data validation.
U Indicates analyte not detected above laboratory detection limit.
na not available

TABLE 2-4
Shallow and Deep Groundwater Detections of Organic and Inorganic Chemicals
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result	Qualifier	Date Sampled	MCL (µg/L)	EPA Region III Tap Water RBC (µg/L)	Zone E Range of Bkgd. Conc. (µg/L)
SHALLOW GROUNDWATER								
VOCs								
1,1-Dichloroethene	E563GW004	E563GW004N1	0.85	J	10/16/2003	7	0.044	
cis-1,2-Dichloroethylene	E563GW004	E563GW004N1	24.8	=	10/16/2003	70	6.1	
trans-1,2-Dichloroethene	E563GW004	E563GW004N1	5.6	=	10/16/2003	100	12	
1,2-Dichloroethene (total)	E563GW004	E563GW004N1	30.4	=	10/16/2003	70	5.5	
Trichloroethylene (TCE)	E723GW001	E723GW001N1	**7.7**	=	10/16/2003	5	1.6	
Trichloroethylene (TCE)	E563GW004	E563GW004N1	**258**	=	10/16/2003			
INORGANICS								
Aluminum	E563GW004	563GW004N1	2360	J	10/16/2003	NA	3650	19.1 - 16,100
Aluminum	E569GW005	569GW005N1	592	J	10/16/2003			19.1 - 16,100
Aluminum	E723GW001	723GW001N1	1810	J	10/16/2003			19.1 - 16,100
					10/16/2003			
Antimony	E723GW001	723GW001N1	**6.65**	J	10/16/2003	6	1.5	2.1 - 4.9
					10/16/2003			
Barium	E563GW004	563GW004N1	14.1	J	10/16/2003	2000	255	5.9 - 398
Barium	E569GW005	569GW005N1	21.3	J	10/16/2003			5.9 - 398
Barium	E723GW001	723GW001N1	26.2	J	10/16/2003			5.9 - 398
					10/16/2003			
Calcium	E563GW004	563GW004N1	18200	=	10/16/2003	NA	NA	1170 - 260,000

TABLE 2-4
Shallow and Deep Groundwater Detections of Organic and Inorganic Chemicals
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result	Qualifier	Date Sampled	MCL (µg/L)	EPA Region III Tap Water RBC (µg/L)	Zone E Range of Bkgd. Conc. (µg/L)
Calcium	E569GW005	569GW005N1	12100	=	10/16/2003			1170 - 260,000
Calcium	E723GW001	723GW001N1	18700	=	10/16/2003			1170 - 260,000
					10/16/2003			
Chromium, Total	E563GW004	563GW004N1	4.96	J	10/16/2003	100	11	0.84 - 31.4
Chromium, Total	E723GW001	723GW001N1	3.25	J	10/16/2003			0.84 - 31.4
					10/16/2003			
Cobalt	E563GW004	563GW004N1	6.19	J	10/16/2003	NA	219	0.91 - 43.70
Cobalt	E569GW005	569GW005N1	9.7	J	10/16/2003			0.91 - 43.70
Cobalt	E723GW001	723GW001N1	5.87	J	10/16/2003			0.91 - 43.70
					10/16/2003			
Iron	E563GW004	563GW004N1	3450	=	10/16/2003	NA	1095	144 - 76,600
Iron	E569GW005	569GW005N1	268	=	10/16/2003			144 - 76,600
Iron	E723GW001	723GW001N1	2930	=	10/16/2003			144 - 76,600
					10/16/2003			
Magnesium	E563GW004	563GW004N1	3720	J	10/16/2003	NA	NA	790 - 1,160,000
Magnesium	E569GW005	569GW005N1	3190	J	10/16/2003			790 - 1,160,000
Magnesium	E723GW001	723GW001N1	3310	J	10/16/2003			790 - 1,160,000
Manganese	E563GW004	563GW004N1	135	=	10/16/2003	NA	73	2.0 - 2650
Manganese	E569GW005	569GW005N1	178	=	10/16/2003			2.0 - 2650
Manganese	E723GW001	723GW001N1	133	=	10/16/2003			2.0 - 2650
Potassium	E563GW004	563GW004N1	2630	J	10/16/2003	NA	NA	1320 - 289,000
Potassium	E569GW005	569GW005N1	2040	J	10/16/2003			1320 - 289,000
Potassium	E723GW001	723GW001N1	2300	J	10/16/2003			1320 - 289,000
Sodium	E563GW004	563GW004N1	13000	=	10/16/2003	NA	NA	NA

TABLE 2-4
Shallow and Deep Groundwater Detections of Organic and Inorganic Chemicals
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result	Qualifier	Date Sampled	MCL (µg/L)	EPA Region III Tap Water RBC (µg/L)	Zone E Range of Bkgd. Conc. (µg/L)
Sodium	E569GW005	569GW005N1	12000	=	10/16/2003			NA
Sodium	E723GW001	723GW001N1	14100	=	10/16/2003			NA
Vanadium	E563GW004	563GW004N1	6.44	J	10/16/2003	NA	26	0.63 - 26
Vanadium	E723GW001	723GW001N1	5.28	J	10/16/2003			0.63 - 26
Zinc	E563GW004	563GW004N1	6.88	J	10/16/2003	NA	1095	4.6 - 141
Zinc	E569GW005	569GW005N1	11.8	J	10/16/2003			4.6 - 141
Zinc	E723GW001	723GW001N1	11.2	J	10/16/2003			4.6 - 141
DEEP GROUNDWATER								
VOCs								
1,1-Dichloroethene	E563GW04D	E563GW04DN1	1.9	J	10/16/2003	7	0.044	
Chloroethane	E563GW04D	E563GW04DN1	1.3	J	10/16/2003	3.6	NA	
Chloroform	E723GW01D	E723GW01DN1	5.3	=	10/16/2003	80	NA	
cis-1,2-dichoroethylene	E563GW04D	E563GW04DN1	**169**	J	10/16/2003	70	6.1	
trans-1,2-Dichloroethene	E563GW04D	E563GW04DN1	11.7	=	10/16/2003	100	12	
1,2-Dichloroethylene (total)	E563GW04D	E563GW04DN1	169	J	10/16/2003	70	5.5	
Trichloroethylene (TCE)	E563GW04D	E563GW04DN1	**1880**	=	10/16/2003	5	1.6	
Toluene	E563GW04D	E563GW04DN1	0.4	J	10/16/2003	75	75	

TABLE 2-4
Shallow and Deep Groundwater Detections of Organic and Inorganic Chemicals
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result	Qualifier	Date Sampled	MCL (µg/L)	EPA Region III Tap Water RBC (µg/L)	Zone E Range of Bkgd. Conc. (µg/L)
Vinyl chloride	E563GW04D	E563GW04DN1	17.7	=	10/16/2003	2	0.081	
INORGANICS								
Aluminum	E563GW04D	563GW04DN1	393	J	10/16/2003	NA	3650	18.5 - 461
Aluminum	E723GW01D	723GW01DN1	423	J	10/16/2003	NA	3650	18.5 - 461
Barium	E563GW04D	563GW04DN1	16.4	J	10/16/2003	2000	255	11.8 - 322
Barium	E569GW05D	569GW05DN1	20.3	J	10/16/2003			11.8 - 322
Barium	E723GW01D	723GW01DN1	17.1	J	10/16/2003			11.8 - 322
Calcium	E563GW04D	563GW04DN1	62500	=	10/16/2003	NA	NA	44,400 - 391,000
Calcium	E569GW05D	569GW05DN1	75000	=	10/16/2003			44,400 - 391,000
Calcium	E723GW01D	723GW01DN1	43200	=	10/16/2003			44,400 - 391,000
Chromium, Total	E723GW01D	723GW01DN1	3.33	J	10/16/2003	100	11	0.81 - 27.1
Iron	E563GW04D	563GW04DN1	473	=	10/16/2003	NA	1095	19.2 - 26,000
Iron	E569GW05D	569GW05DN1	1780	=	10/16/2003			19.2 - 26,000
Iron	E723GW01D	723GW01DN1	197	=	10/16/2003			19.2 - 26,000
Magnesium	E563GW04D	563GW04DN1	10000	=	10/16/2003	NA	NA	3190 - 1,370,000
Magnesium	E569GW05D	569GW05DN1	7020	=	10/16/2003			3190 - 1,370,000
Magnesium	E723GW01D	723GW01DN1	8520	=	10/16/2003			3190 - 1,370,000
Manganese	E563GW04D	563GW04DN1	60.9	=	10/16/2003	NA	73	1.3 - 1660

TABLE 2-4
Shallow and Deep Groundwater Detections of Organic and Inorganic Chemicals
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result	Qualifier	Date Sampled	MCL (µg/L)	EPA Region III Tap Water RBC (µg/L)	Zone E Range of Bkgd. Conc. (µg/L)
Manganese	E569GW05D	569GW05DN1	117	=	10/16/2003			1.3 - 1660
Manganese	E723GW01D	723GW01DN1	4.61	J	10/16/2003			1.3 - 1660
					10/16/2003			
Potassium	E563GW04D	563GW04DN1	4880	J	10/16/2003	NA	NA	3190 - 1,370,000
Potassium	E569GW05D	569GW05DN1	2610	J	10/16/2003			3190 - 1,370,000
Potassium	E723GW01D	723GW01DN1	7670	=	10/16/2003			3190 - 1,370,000
					10/16/2003			
Sodium	E563GW04D	563GW04DN1	64400	=	10/16/2003	NA	NA	NA
Sodium	E569GW05D	569GW05DN1	19900	=	10/16/2003			NA
Sodium	E723GW01D	723GW01DN1	191000	=	10/16/2003			NA
					10/16/2003			
Vanadium	E563GW04D	563GW04DN1	3.76	J	10/16/2003	NA	26	0.52 - 7.7
Vanadium	E723GW01D	723GW01DN1	12.2	J	10/16/2003			0.52 - 7.7
					10/16/2003			
Zinc	E723GW01D	723GW01DN1	7.06	J	10/16/2003	NA	1095	4.4 - 21.4

µg/L micrograms per liter
HI Hazard Index
= Indicates that the analyte is detected at the concentration shown.
J Indicates an estimated value. A "J" qualifier may signify that the concentration is below the PQL, or that the "J" has been applied as a result of the data validation.
U Indicates analyte not detected above laboratory detection limit.

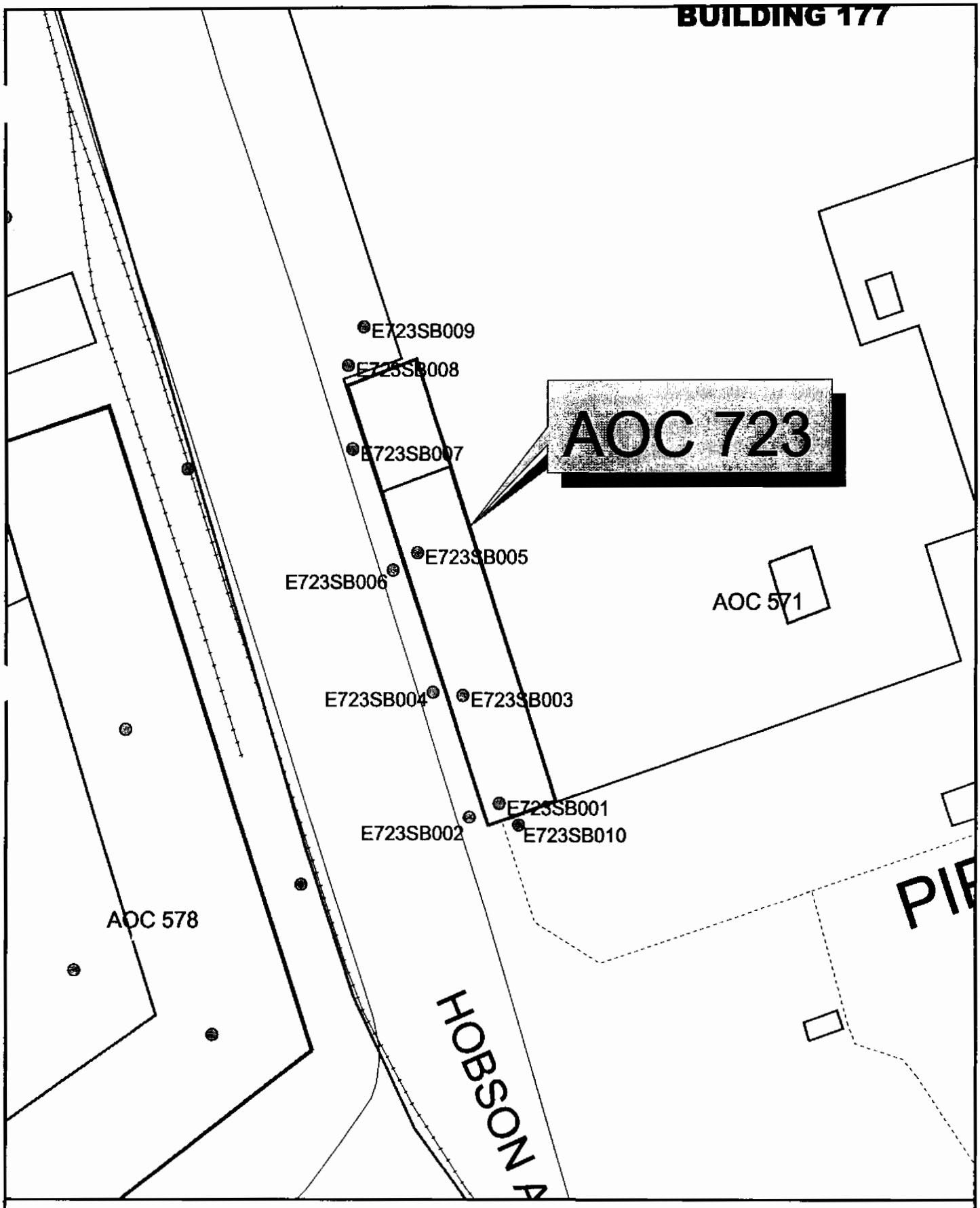

Figure 2-1
RFI Soil Boring Locations
AOC 723, Zone E
Charleston Naval Complex

CH2MHILL

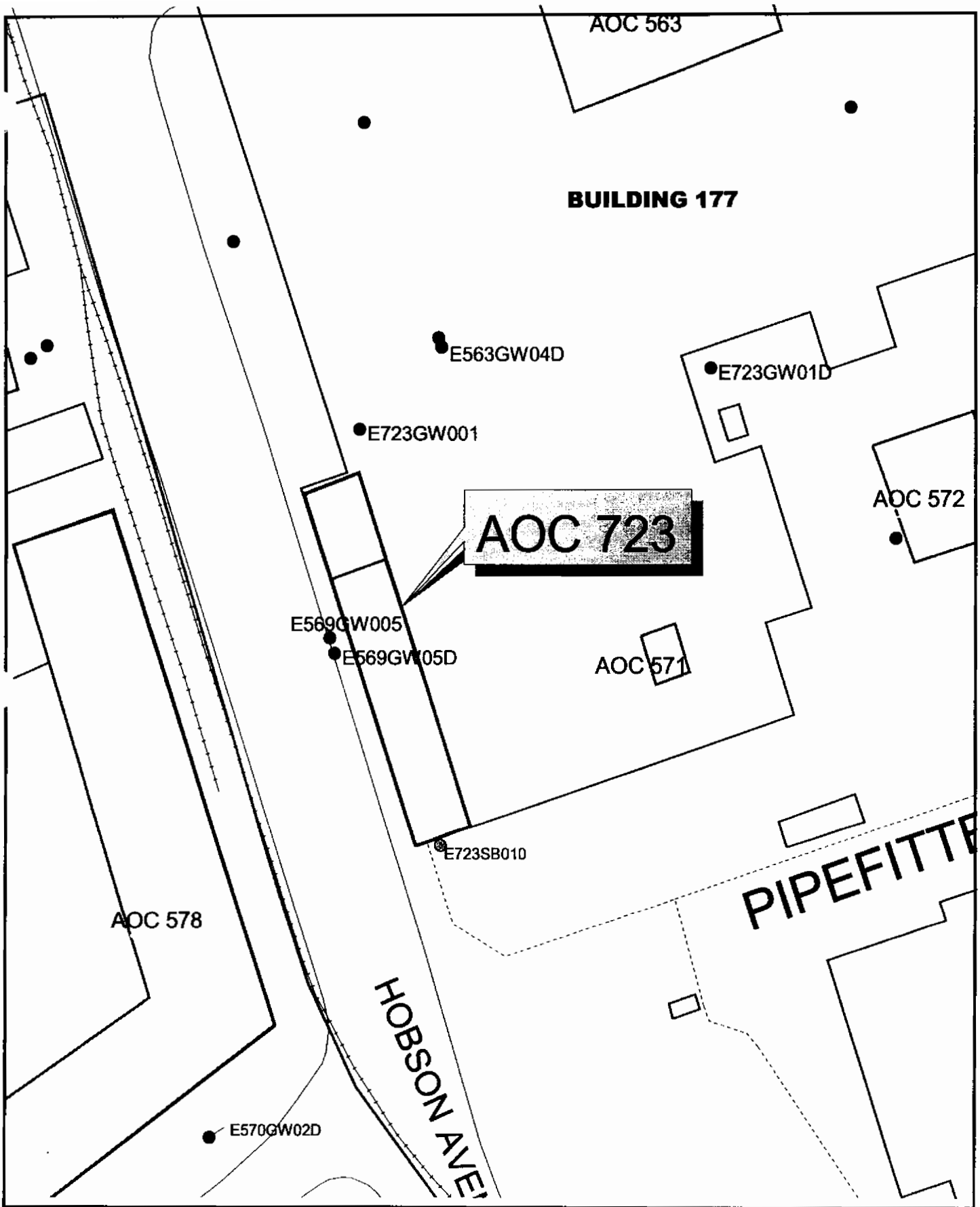

Figure 2-2
RFI Monitoring Well Locations
AOC 723, Zone E
Charleston Naval Complex

CH2MHILL

Section 3.0

3.0 RFI Human Health Risk Assessment and COPC Refinement

A baseline risk assessment was conducted for AOC 723, because a risk assessment was not previously conducted for this newly identified site. This baseline risk assessment refers to the risks characterized under an "as is" scenario, representing a condition where no remedial actions are conducted for the current and/or potential future land use. The assumptions used for the quantitative exposure and risk estimations are conservative and are the same as those previously used for other risk assessments at the CNC.

The risk assessment was completed in accordance with the pertinent EPA guidance documents indicated below.

- EPA, 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002.
- EPA, 1990. *Guidance for Data Usability in Risk Assessment*. EPA/540/G-90/008.
- EPA, 1991. *RAGS, Volume I, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"*. OSWER Directive 9285.6-03.
- EPA, 1997. *Exposure Factors Handbook*. EPA/600/P-95/002Fa.
- EPA, 2001. *RAGS, Volume I: Human Health Evaluation Manual*. Part E Supplemental Guidance for Dermal Risk Assessment) Interim.

Additionally, the procedures outlined in the CNC BCT Project Team Notebook and Instructions (CH2M-Jones, 2001) were also considered.

The human health risk assessment (HHRA) conducted for AOC 723 included the following four-step process:

- COPC selection
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

Each step is described below.

3.1 Selection of COPCs

Surface and subsurface soil detections from RFI sampling events at AOC 723 were screened by comparing the detected concentrations with the COPC screening criteria, as described in Section 2.0. Maximum detected concentrations for each chemical were screened against the EPA Region III RBC values, and for inorganic chemicals, the Zone E background values. Additionally, BEQs were screened against the CNC BEQ sitewide reference concentrations. If a chemical exceeded the established background value or a risk-based value (i.e., carcinogens at an excess lifetime cancer risk [ELCR]=1E-6 and non-carcinogens at HI=0.1) it was selected as a COPC. Chemicals detected above the leachability criteria (i.e., SSLs) were identified and are qualitatively discussed later in this section to determine their potential to impact groundwater.

3.1.1 Soils

Results of the COPC screening for surface and subsurface soil are presented in Tables 3-1 and 3-2. Four chemicals (arsenic, BEQs, carbazole and TCE) were selected as COPCs for surface soil, based on exceedances of human health risk screening criteria. BEQs were selected as a COPC for subsurface soil, based on human health risk criteria and exceedance of background concentrations.

In surface soils, TCE and carbazole detections exceeded leachability-based generic SSLs, but not the EPA Region III RBCs. In subsurface soils, 1,2-DCE and TCE detections exceeded SSLs, but not the RBCs. Since the chemicals above SSLs are not a direct exposure concern, they were not carried through a quantitative risk assessment. The fate and transport behavior and leachability potential of these chemicals is discussed later in this section. The soil COPCs carried forward in this HHRA are:

Surface Soil: Arsenic, and BEQ
Subsurface Soil: BEQs

3.1.2 Groundwater

Tables 3-3 and 3-4 include COPC screening tables for shallow and deep groundwater, respectively which were screened separately during the COPC identification process. The maximum detected concentration for each chemical was screened against the EPA Region III tap water RBC and, additionally for inorganics, the Zone E maximum background concentrations. If a chemical exceeded the RBC value (carcinogens at ELCR=1E-6 and non-carcinogens at HI=0.1) and the established background concentrations (for inorganics), it

was selected as a COPC. Though the MCLs are included in Tables 3-3 and 3-4 for comparisons, they were not used as the screening criteria for the risk-based COPC screening.

In shallow groundwater, antimony, benzene, 1,1-dichloroethene, 1,2-dichloroethene, and TCE have been identified as COPCs, due to the exceedance of the EPA Region III tap water RBCs.

In deep groundwater, the VOCs 1,1-dichloroethene, 1,2-dichloroethene, chloroform, TCE, and vinyl chloride have been identified as COPCs. No inorganic chemicals were identified as COPCs in deep groundwater.

Both soil and groundwater COPCs listed above have been further evaluated for direct exposure, in the risk assessment.

3.2 Exposure Assessment

This section presents the exposure evaluation for AOC 723, which includes a conceptual site model, contaminant persistence and leachability evaluation, exposure pathways, receptors and quantitation of potential exposures to the receptors identified.

3.2.1 Conceptual Site Model

The conceptual site model (CSM) qualitatively defines the potential contaminant sources, release mechanisms, potential for persistence and migration of contaminants, and exposure pathways and receptors for contaminants at the site. Based on the available site information, a flow chart presenting the potential migration pathways, exposure pathways, and potential human receptors identified for the AOC 723 is included on Figure 3-1.

Potential Contaminant Sources

The potential source area at AOC 723 is a historically used paint booth that occupied a portion of Building 177 and that is currently used for metal parts degreasing and cleaning operations by Excel. Excel uses the area for repairing electrical and electronic equipment, parts cleaning, paint stripping, paint spraying, electric motor rebuilding, machining metal parts, and treatment of aluminum components with iridium, which are support operations for the Detyens Shipyards. Soil and groundwater sampling activities associated with the RFI have indicated the presence of arsenic, polycyclic aromatic hydrocarbon (PAHs) (BEQs), and chlorinated VOCs (CVOCs) in soils and groundwater at the site.

Release Mechanisms

The release mechanisms for VOCs in soil include volatilization to air and downward migration to subsurface soil and ultimately to groundwater. Groundwater VOCs could potentially migrate laterally to downgradient locations and vertically to deeper aquifer zones. The soil samples with VOCs are located within the footprint of Building 177. Due to the presence of pavement and the building, which prevents rainwater leaching to soils, the VOCs in soils are likely to have limited leaching. VOC migration is likely driven by gravity and possibly via subsurface pathways such as pipeline conduits or water leaks from operations in Building 177. Residual VOC concentrations in soils may have been the source of the groundwater VOC contamination in the area through migration. Further evaluation of the soil VOC concentrations above the leachability criteria is included below in Section 3.2.2.

Compared to VOCs, inorganics (metals) and PAHs do not migrate in measurable amounts. The only inorganic chemical identified in soil as a COC is arsenic. The observed concentrations of arsenic are likely from facility maintenance-related arsenical pesticide applications and not historical operations specific to AOC 723. Likewise, the PAHs (BEQs) are likely from the extensive asphalt-paved parking lots and driveways that surround Building 177 and not from paint and maintenance-related operations specific to AOC 723. The arsenic and PAHs do not present a migration concern due to their low solubility in groundwater, and the presence of pavement or grass on the soil at the site limits the surface runoff potential.

Exposure Pathways and Receptors for Contaminants at the Site

The site is located within the industrialized areas in Zone E, and the potential human receptors at the site under the current land use include workers involved in support operations for the shipyard. Most of the area surrounding the building is paved with asphalt, with grass in the areas immediately adjacent to the north and west of Building 177. The site will remain in current use into the foreseeable future, since this area has been leased for industrial reuse. The groundwater at the site is not in use at the present time and is not likely to be used in the future; thus, no direct contact with the groundwater is expected at the site. However, in the future, if the pavement is removed, exposure to site soil could occur to a future industrial worker. As per the CNC BCT agreements, the future unrestricted land use scenario is also considered in the risk assessment as a conservative worst-case exposure evaluation.

The shallow groundwater flows in a northeasterly direction and the deep groundwater appears to flow generally towards the east with local variability. Shallow and deep groundwater ultimately discharge into the Cooper River. The potentiometric surface of the shallow and deep groundwater at the site measured in November 2002 are presented on Figures B-1 and B-2, included in Appendix B.

Both shallow and deep groundwater have some CVOCs at concentrations above RBCs and MCLs. Historical releases of solvents used at AOC 723 may have reached shallow groundwater and migrated vertically downward to the deeper aquifer. The VOCs detected in groundwater were screened against health-protective criteria, and those identified as COPCs were included for risk estimation.

3.2.2 AOC 723 Land Use and Potential Human Receptors

The site is located within Zone E, which is designated as a marine industrial (M2) land use area. Therefore, an ecological risk assessment was not conducted for AOC 723, since Zone E will remain in industrial use in the foreseeable future.

The potential human receptors for AOC 723 include industrial workers. No other human receptors are expected to be present at the site, as it is located within the industrial area of Zone E. A future residential exposure scenario was included for comparison purposes, as this pathway is often considered by regulatory agencies for evaluation of unrestricted land use.

The site soil and groundwater were evaluated for the future industrial worker exposure and future residential adult and child exposure scenarios. The exposure factors used are conservative exposure assumptions, using default exposure assumptions provided by EPA guidance. The routes of exposure evaluated include ingestion, dermal, and inhalation. Exposure factors are provided in the risk calculation sheets in Appendix D of this RFI Report Addendum.

Industrial workers were assumed to be indoor workers who are exposed to surface and subsurface soils around AOC 723 and who use site groundwater as a potable water source. Both the shallow and deep groundwater direct contact-related exposures were quantified. The industrial worker assumptions include a soil ingestion rate (IR) of 50 milligrams per day (mg/day) and a groundwater IR of 1 liter (L)/day. The exposure frequency (EF) used is 250 days per year (days/year), and the exposure duration (ED) is 25 years. The dermal exposure route assumptions were selected for all receptors based on the EPA dermal

exposure guidance, and the inhalation exposure assumptions are default exposure factors from EPA guidance, as included in tables in Appendix D.

The default exposure assumptions for residential adult and child were used, as listed in the EPA guidance. Some of the default exposure factors used are an EF of 350 days/year and an ED of 6 years for a child and an EF of 350 days/year and ED of 24 years for an adult. Thus, the total ED for a residential receptor is 30 years. The dermal exposure route assumptions were selected for all receptors from the EPA dermal exposure guidance, and the inhalation exposure assumptions are default exposure factors from EPA guidance for a residential adult and for a child receptor, as included in tables in Appendix D.

Intake Estimates

The intake estimates for each exposure route identified are listed along with the intake factors used for intake estimations in the Appendix D tables. For each receptor identified in the exposure assessment as having a complete exposure pathway, chemical- and media-specific intakes, known as chronic daily intakes (CDI), were estimated using the appropriate exposure factors and assumptions.

The chronic intake estimate (also referred to as dose) is expressed in terms of milligrams of chemicals contacting the body per kilogram of body weight per day (mg/kg/day). For the exposure routes to be evaluated, the following generic equation applies:

$$Exposure(mg/kg/day) = \frac{CxIRxEDxEF}{BWxAT}$$

where:

C = concentration of chemical in exposure medium or exposure point concentration (EPC)
IR = intake or ingestion rate
EF = exposure frequency
ED = exposure duration
BW = body weight
AT = averaging time (period over which exposure is averaged)

Appendix D includes tables of exposure factors for the potential receptors, exposure routes, and exposure pathways.

Exposure Point Concentration

The EPC is the 95% Upper Confidence Limit (UCL_{95}) of the mean concentration that a receptor is exposed to over the exposure period (EPA, 1989). The UCL_{95} was estimated using statistical guidance adopted by EPA and is based on the sample population distribution. Results of sample distribution testing and the estimated EPCs for COPCs used in the risk estimations are included in Table 3-5.

The UCL_{95} was calculated using the same tool that was previously used for risk assessment at other sites within the CNC. The estimated EPC values are listed in Table 3-5 for surface soil, subsurface soil, shallow groundwater and deep groundwater. In estimating the EPCs, one-half the detection limit was assumed for non-detects. When the estimated UCL_{95} value is higher than the maximum detected concentration, the maximum detected concentration is used as the EPC.

3.3 Toxicity Assessment

Toxicity factors were obtained from the Integrated Risk Information System (IRIS) website or alternative sources such as the Health Effects Assessment Summary Tables (HEAST, 1997), as appropriate. Toxicity factors, weight-of-evidence classification, and oral-to-dermal adjustment factors are provided in Table 3-6.

3.4 Risk Characterization

Table 3-7 includes a summary of the ELCR and the HI per exposure route and receptor. The details of the ELCR for each chemical and the hazard quotients (HQs) and HI are presented in Appendix D.

3.4.1 Industrial Worker

The ELCR for a hypothetical industrial worker from exposure to surface soil is estimated to be 4E-5. This is within the acceptable risk range of 1 in 1 million to 100 in 1 million for carcinogenic effects. The HI for a worker is 0.14, which is well below the target HI of 1.0 for non-carcinogenic effects. The subsurface soil exposure to a future industrial worker resulted in an ELCR of 1E-5 and there were no non-carcinogenic COPCs in subsurface soil. Overall, site soils do not present excessive health risks under conservative exposure assumptions to a worker.

The industrial worker shallow groundwater exposures result in an ELCR of 7E-4 and an HI of 9.0, where 99 percent of risk is from the presence of the maximum observed TCE concentrations at AOC 723. The deep groundwater exposure-related ELCR is 1.7E-3 and the HI is 40, with all of the risk and HI (99.8+ percent) being due to the presence of TCE in groundwater.

3.4.2 Residential Adult

The total ELCR from soil for a future hypothetical residential adult is estimated at 3E-4, which is slightly above the acceptable risk range, and 81 percent of the risk is due to arsenic in surface soil. The total HI from surface soil exposure for a resident is 0.4, which is below the acceptable HI of 1.0.

The shallow groundwater exposure to a residential adult is 3E-3, where 99 percent of the risk is from TCE in the shallow aquifer. The HI to a future residential adult from shallow groundwater use is 24, which is above a target value of 1.0, due to TCE. The deep groundwater ELCR for a residential adult is estimated at 1.4E-2, and the HI is 113, both due to the presence of TCE in deep groundwater.

3.4.3 Residential Child

The non-carcinogenic HI for a future hypothetical residential child from soil is 3.3, which is slightly above a value of 1.0 due to arsenic in soil. The shallow groundwater HI for a residential child is 58, due to ingestion and inhalation exposures to TCE in groundwater. The HI for a residential child from exposure to deep groundwater is 262, where 99.6 percent of the HI is due to oral, inhalation, and dermal exposures to TCE in groundwater.

3.5 Leachability Evaluation Summary and Soil COPC Refinement

As part of the fate and transport evaluation for the detected chemicals, the soil leachability potential is discussed further in this section. This section discusses the chemicals that exceeded the SSL criteria as presented in Tables 3-1 and 3-2. Seven chemicals were detected in one or more soil samples at concentrations that exceeded their respective generic SSLs. Individual exceedances of leaching criteria indicate a need for further evaluation, not necessarily that a chemical will leach to groundwater. The generic SSLs are target screening levels against leaching that were developed by the EPA based on the assumptions that the contaminated area is approximately a half acre in size and that the COCs are uniformly

distributed across this area. Therefore, average concentrations of COCs for the site, rather than individual COC concentrations, should be used for comparison against SSL values. Although the AOC 723 footprint is smaller than a half acre in area, the average chemical concentrations are a much better indicator of the leaching potential than individual detections. The calculated average soil concentrations are shown in Tables 3-1 and 3-2 in order to provide a comparison with the generic SSLs. Additionally, the groundwater results were reviewed to verify that the soil COCs with average concentrations below the SSL were not also present in groundwater above the groundwater screening criteria.

The following chemicals were present in one or more surface soil samples above their respective SSLs:

VOCs: 1,1-Dichloroethene (1,1-DCE) and TCE

SVOCs: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, and Carbazole

Inorganics: Arsenic and Chromium

3.5.1 VOCs

1,1-Dichloroethene (1,1-DCE)

1,1-DCE was detected above laboratory detection limits in four subsurface soil samples, with one detection at E723SB002 at 0.006 mg/kg, above its generic SSL (with a DAF=1) of 0.003 mg/kg. The site average subsurface soil concentration of 1,1-DCE was calculated to be 0.0025, which is below its generic SSL (with a DAF=1). 1,1-DCE was detected in one surface soil sample at a concentration below its SSL. Additionally, 1,1-DCE was not detected above its MCL in groundwater samples at the site. These observations indicate that 1,1-DCE does not pose a threat to groundwater quality via leaching. Based on these observations, 1,1-DCE is not considered a COC at this site.

Trichloroethene (TCE)

TCE was detected above its generic SSL (with a DAF=1) in both surface and subsurface soils. In surface soil, TCE was detected above its generic SSL (with a DAF=1) of 0.003 mg/kg in three samples, with concentrations ranging from 0.007 mg/kg to 1.78 mg/kg. In subsurface soils, four TCE detections exceeded the generic SSL (with a DAF=1), with concentrations ranging from 0.01 mg/kg to 0.032 mg/kg.

The average TCE concentrations for surface and subsurface soils were calculated to be 0.345 mg/kg and 0.01 mg/kg, respectively, both of which are above its generic SSL (with a DAF=1.0) of 0.003 mg/kg.

In accordance with previous agreements of the CNC BCT, site-specific SSLs were calculated for both the unpaved and paved scenarios. The site-specific SSLs for TCE were calculated to be 0.195 mg/kg for the unpaved scenario and 2.17 mg/kg for the paved scenario. Appendix E includes a copy of the worksheet used to calculate site-specific SSLs. None of the TCE detections exceeded the site-specific SSL for the paved scenario. Two out of the five exceedances of the site-specific SSL for the unpaved scenario are under the paved building floor. Based on exceedances of the unpaved site-specific SSL, TCE is retained as a COC.

From an exposure standpoint, TCE did not exceed the EPA Region III RBC (with a HI=0.1) of 58 mg/kg or the industrial RBC (with a HI=0.1) of 520 mg/kg.

3.5.2 SVOCs

Three SVOCs (benzo[a]anthracene, benzo[b]fluoranthene, and carbazole) were detected in surface and/or subsurface soil at concentrations that exceeded their respective SSLs.

Benzo(a)anthracene

Benzo(a)anthracene was detected in three surface soil samples and one subsurface soil sample above its generic SSL (with a DAF=10) of 0.80 mg/kg, with concentrations ranging from 1.59 mg/kg to 3.02 mg/kg. The site average concentration for benzo(a)anthracene in surface soil was calculated to be 0.91 mg/kg, slightly above its generic SSL. The site average concentration for benzo(a)anthracene in subsurface soil was calculated to be 0.43 mg/kg, below its generic SSL and significantly lower than the average concentrations in surface soil. This indicates that downward migration of the chemical is not significant.

Additionally, there were no detections of benzo(a)anthracene above laboratory detection limits in groundwater. Based on these observations, benzo(a)anthracene is not considered a leaching concern at AOC 723.

Benzo(b)fluoranthene

Benzo(b)fluoranthene was detected in four surface soil samples above the generic SSL (with a DAF=10) of 2 mg/kg, with concentrations ranging from 1.38 mg/kg to 5.05 mg/kg. There were no exceedances of the generic SSL in subsurface soil, and there were no detections above laboratory detection limits in groundwater, indicating that benzo(b)fluoranthene concentrations are not a leaching concern at AOC 723.

Benzo(a)pyrene and benzo(b)fluoranthene are among seven carcinogenic PAHs that are collectively identified as BEQs. Based on CNC BCT agreements, BEQ values are calculated for all site soil samples and screened against the CNC BCT sitewide reference concentrations. BEQ concentrations at AOC 723 were also screened against this reference concentration as indicated below.

BEQs

In surface soil samples, three detections of BEQs exceeded the CNC BEQ sitewide reference concentration of 1.304 mg/kg: 2.19 mg/kg at E723SB003, 3.08 mg/kg at E723SB008, and 3.68 mg/kg at E723SB009.

In subsurface soil samples, one detection of BEQs at E723SB008 (2.63 mg/kg) exceeded the CNC BEQ sitewide reference concentration of 1.4 mg/kg.

Based on the exceedances of the CNC BEQ sitewide reference concentrations in surface and subsurface soils, BEQs are considered a COC in surface and subsurface soil at AOC 723.

Carbazole

One detection of carbazole at 0.52 mg/kg in the surface soil sample from E723SB009 exceeded its generic SSL (with a DAF=10) of 0.3 mg/kg. There were no detections of carbazole above laboratory detection limits in groundwater, indicating that carbazole does not pose a threat to groundwater. There were no other detections of carbazole in surface or subsurface soil samples above the generic SSL (with a DAF=10) or the EPA Region III residential RBC of 32 mg/kg. The site average surface soil concentration for carbazole was calculated to be 0.20 mg/kg, which is below the generic SSL (with a DAF=10), indicating that the sitewide carbazole concentrations do not pose a leaching concern at AOC 723. Based on these observations, carbazole is not considered to be a COC in soil at this site.

3.5.3 Inorganics

Arsenic

Arsenic was detected in surface soil at concentrations of 21.1 mg/kg and 106 mg/kg, which are above its generic SSL (with a DAF=10) of 14.5 mg/kg. The site average arsenic concentration in surface soil was calculated to be 18.7 mg/kg, marginally above the SSL. The average concentration was higher due to the one high detection of arsenic at E723SB008 of 106 mg/kg. The arsenic detections at two nearby surface soil locations (E723SB007at 6.31 mg/kg and E723SB009 at 10.1 mg/kg) are below the SSL, indicating that elevated arsenic levels are not widespread, but limited to a localized area.

There were no exceedances of the generic SSL in subsurface soil.

The locations of the SSL exceedances in surface soil are outside Building 177, on the roadside along Hobson Avenue, where pesticide application likely took place in the past. This information suggests that the presence of arsenic above its SSL is limited and may be related to pesticide application instead of the paint booth or degreasing operations at AOC 723. The fact that arsenic has not been detected above its SSL in subsurface soil further supports that arsenic concentrations in surface soil are not likely to be a threat to shallow groundwater. Arsenic has not been detected in groundwater, which includes no detections at monitoring well E723GW001, located approximately 30 feet downgradient of soil boring E723SB008. The other surface soil SSL exceedance at soil boring E723SB006 is within 5 feet of shallow monitoring well E569GW005, which also has had no detections of arsenic. These data suggest that arsenic is not impacting shallow groundwater. Therefore, arsenic is not considered to be a leaching concern at AOC 723.

The surface soil arsenic detection of 106 mg/kg at E723SB008 exceeded the EPA Region III residential RBC of 0.43 mg/kg, the industrial RBC of 3.8 mg/kg, and the maximum Zone E surface soil background arsenic concentration of 68 mg/kg. Based on this exceedance, arsenic is considered to be a COC for the unrestricted land use.

For sites where background arsenic levels exceed RBCs, EPA Region IV typically considers arsenic concentrations in surface soil of up to 20 mg/kg and 270 mg/kg as acceptable for unrestricted and industrial land use, respectively (EPA, 2001). Based on these criteria, arsenic in surface soil is not considered to be a COC in soil for the industrial land use scenario.

Chromium

Chromium was detected in four surface soil samples and one subsurface soil sample above the generic SSL (with a DAF=10) of 19 mg/kg. The site average surface and subsurface soil total chromium concentrations were calculated to be 17 mg/kg and 15.3 mg/kg, respectively, which are both below the generic SSL. The SSL for chromium is based on the more soluble hexavalent form of chromium (Cr^{+6}). The hexavalent chromium SSL is used to provide a conservative screening; however the trivalent species (Cr^{+3}) is more abundant and stable than the hexavalent species. The average concentration of chromium in surface and subsurface soils is below this conservative SSL value, indicating that the leachability of chromium is not a sitewide concern. Also, chromium has not been detected above screening criteria in shallow groundwater. Therefore, the low level detections of chromium in soil are not considered to be a leachability concern at AOC 723.

3.5.4 Migration of VOCs in Groundwater

Based on the RFI soil and groundwater sampling events, the presence of CVOCs in soil and groundwater in the vicinity of monitoring wells E563GW001 and E563GW01D indicates that a release has occurred into soil that eventually migrated to groundwater. Low CVOC concentrations in groundwater in locations downgradient of E563GW004 do not indicate that the plume has migrated far under Building 177. The presence of higher concentrations of TCE in deep well E563GW01D indicates localized vertical migration of CVOCs. Additional groundwater assessment activities may be warranted during the corrective measures study phase to assist in planning active groundwater remediation at this site.

3.6 Groundwater COPC Refinement

3.6.1 Antimony

The sample from shallow monitoring well E723GW001 showed an antimony detection of 6.65 μg/L, which is slightly above its MCL of 6 μg/L. Since this is the first sampling event at this new well, no historical antimony detections are available to determine if antimony persists in the shallow groundwater at this location at concentrations above its MCL.

Antimony detections in upgradient well E569GW005 and downgradient well E569GW004 did not exceed laboratory detection limits, as shown in Table 2-4. Antimony is not a soil COC at this site. There is no indication from the information on past site uses that antimony is a material of concern. Based on these observations, it does not appear that antimony is a threat to groundwater at this site. Low turbidity readings in the groundwater sample do not indicate that this detection is due to entrainment of solids in the groundwater sample. Antimony will be retained as a groundwater COC for the present time and sampled during two additional sampling events at well E723GW001; the analytical results will be evaluated to determine if antimony should continue to be a shallow groundwater COC at this site.

3.6.2 1,2-Dichloroethene (1,2-DCE)

During the RFI for AOC 723, the sample from deep well E563GW04D, which is downgradient of AOC 723, showed a cis-1,2-DCE detection of 169 μg/L, which is above its MCL of 70 μg/L. Cis-1,2-DCE detections in the previous sampling event at this well during July 2003 showed a detection of 145 μg/L, indicating that low-level concentrations of cis-1,2-DCE appear to persist in the deep groundwater at this location. The groundwater in the vicinity of this well is being investigated as part of the RFI for AOC 723. Based on this

exceedance and the detection of TCE in the two sampling events conducted at this well so far, 1,2-DCE (which is a breakdown product of TCE degradation) will be considered a COC in deep groundwater at this site.

3.6.3 TCE

During the RFI for AOC 723, TCE detections above the MCL of 5 µg/L were detected in shallow wells E723GW001 and E563GW004 at 7.7 µg/L and 258 µg/L, respectively. The TCE detection in E563GW004 from the July 2003 sampling event was 71.3 µg/L, which is above the MCL.

TCE detections in deep well E563GW04D were 1,880 µg/L during the AOC 723 RFI and 1,700 µg/L during the July 2003 sampling event, indicating the presence of a low-level source area near this well.

Based on these exceedances of the MCL, TCE is considered to be a COC in shallow and deep groundwater at this site.

3.6.4 Vinyl Chloride

One detection of vinyl chloride at 17.7 µg/L in the sample from well E563GW04D exceeds its MCL of 2 µg/L. The December 2003 sampling event is the second event at this well. Vinyl chloride was not detected above laboratory detection limits during the first sampling event in November 2002. Vinyl chloride is a breakdown product of TCE, which is a COC at this site. Vinyl chloride will be retained as a COC in groundwater.

3.7 Summary of COCs

Based on the above discussions, the following COCs have been identified at AOC 723:

Soils: Arsenic (in surface soil for the unrestricted land use scenario only), TCE (unpaved scenario only, due to potential leachability), and BEQs in surface and subsurface soils.

Shallow Groundwater: Antimony and TCE

Deep Groundwater: Cis-1,2-DCE, TCE and vinyl chloride

The soil and groundwater COCs identified above will be addressed as part of a focused CMS. A CMS Work Plan is included in Section 8.0 of this report. No other COCs for any media or land use scenario have been identified at this site.

TABLE 3-1
Summary of Detected Chemicals in Surface Soil
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Analysis Group	Chemical	Number of Analysis	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Detect	Best Estimate of the Mean (1/2 RL for NDs)	Background	RBC (HI = 0.1) Residential	RBC (HI = 0.1) Industrial	SSL (DAF_{VOCs} = 1) (DAF_{other} = 10)
Metals	**Arsenic**	9	9	1.83	106	E723SB008	18.7	68	**0.43**	**3.8**	**14.5**
	Barium	9	9	13.4	58.7	E723SB008	39.7	1980	550	14000	800
	Cadmium	9	8	0.071	2.46	E723SB009	0.50	1.5	7.8	200	4
	Chromium, Total	9	9	5.97	26.6	E723SB008	17.0	567	**23 a**	610 a	**19 a**
	Lead	9	9	7.88	100	E723SB008	42.7	400	NA	1218 b	400
	Mercury	9	9	0.018	0.534	E723SB005	0.14	2.7	2.3 c	61 c	1
	Selenium	9	2	0.903	1.22	E723SB006	0.45	4.0	39	1000	2.5
SVOCs	2-Methylnaphthalene	9	3	0.0408	0.185	E723SB009	0.16	NA	160	4100	42 g
	Acenaphthene	9	4	0.042	0.672	E723SB009	0.22	NA	470	12000	285
	Acenaphthylene	9	1	0.0461	0.0461	E723SB005	0.17	NA	470 d	12000 d	285 d
	Anthracene	9	5	0.0232	0.953	E723SB009	0.28	NA	2300	61000	6000
	Benzo(a)Anthracene	9	3	1.59	3.02	E723SB009	0.91	NA	**0.87**	7.8	**1**
	Benzo(a)Pyrene	9	8	0.0269	2.6	E723SB009	0.82	NA	**0.087**	**0.78**	4
	Benzo(b)Fluoranthene	9	9	0.0433	5.05	E723SB009	1.56	NA	**0.87**	7.8	**2.5**
	Benzo(g,h,i)Perylene	9	4	0.257	0.706	E723SB009	0.33	NA	230 e	6100 e	2100 e
	Carbazole	9	4	0.0281	0.515	E723SB009	0.20	NA	2.3	29	**0.3**
	Chrysene	9	8	0.0377	2.89	E723SB009	0.92	NA	87	780	80
	Dibenzofuran	9	3	0.0752	0.26	E723SB009	0.18	NA	31	820	NA
	Diethyl Phthalate	9	1	0.0251	0.0251	E723SB004	0.17	NA	6300	160000	235
	Fluoranthene	9	9	0.0322	4.62	E723SB009	1.27	NA	310	8200	2150
	Fluorene	9	5	0.0044	0.45	E723SB009	0.17	NA	310	8200	280
	Indeno(1,2,3-c,d)pyrene	9	6	0.0671	0.714	E723SB009	0.31	NA	0.87	7.8	7
	Naphthalene	9	3	0.0408	0.26	E723SB009	0.17	NA	160	4100	42
	Phenanthrene	9	8	0.0231	4.28	E723SB009	0.93	NA	2300 f	61000 f	6000 f
	Pyrene	9	9	0.0407	5.64	E723SB009	1.48	NA	230	6100	2100
	BEQs	9	9	0.246	3.68	E723SB009	1.29	1.304 h	**0.087 i**	**0.78 i**	4 i
VOCs	1,1-Dichloroethene	9	1	0.00072	0.00072	E723SB006	0.057	NA	1.1	9.5	0.003
	Acetone	9	1	0.434	0.434	E723SB008	0.16	NA	780	20000	0.8
	Ethylbenzene	9	1	0.0014	0.0014	E723SB009	0.057	NA	780	20000	0.7
	Toluene	9	1	0.00036	0.00036	E723SB009	0.057	NA	1600	41000	0.6
	Trichloroethylene (TCE)	9	6	0.00084	1.78	E723SB005	0.35	NA	58	520	**0.003**

Units in mg/Kg.

a based on Cr+6
b Adult Lead Methodology (ALM) Derived Target Lead Concentrations for Industrial Land Use, Revision 1A, CH2M Hill, November 9, 2001
c mercuric chloride
d Acenaphthalene used as a surrogate
e pyrene used as a surrogate
f anthracene used as a surrogate (isometric).
g naphthalene used as a surrogate
h BEQ background concentration is from the Background PAHs Study Report, CH2M-Jones, February 2001.
i Benzo(a)pyrene used as a surrogate.

TABLE 3-2
Summary of Detected Chemicals in Subsurface Soil
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Analysis Group	Chemical	Number of Detects	Number of Results	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Detect	Best Estimate of the Mean (1/2 RL for NDs)	Background	Industrial RBC (HI = 0.1) (HI_{other} = 0.1)	SSL (DAF_{VOCs} = 1) (DAF_{other} = 10)
Metals	**Arsenic**	10	10	2.54	11.3	E723SB008	4.93	26	**3.8**	14.5
	Barium	10	10	18.7	49	E723SB010	35.8	91	14000	800
	Cadmium	8	10	0.097	2.33	E723SB010	0.35	0.96	200	4
	Chromium, Total	10	10	9.48	26.4	E723SB008	15.3	75	610 a	**19 a**
	Lead	10	10	7.69	63.2	E723SB010	28.5	322	1218 b	400
	Mercury	9	10	0.02	0.119	E723SB007	0.062	0.9	61 c	1
	Selenium	3	10	0.907	1.27	E723SB008	0.47	2.4	1000	2.5
	Silver	1	10	1.21	1.21	E723SB010	0.21	NA	1000	17
SVOCs	2-Methylnaphthalene	2	10	0.0211	0.0461	E723SB009	0.16	NA	4100	42 g
	Acenaphthene	4	10	0.0193	0.209	E723SB009	0.15	NA	12000	285
	Anthracene	5	10	0.0393	0.584	E723SB008	0.19	NA	61000	6000
	Benzo(a)Anthracene	2	10	0.41	2.37	E723SB008	0.43	NA	7.8	**1**
	Benzo(a)Pyrene	8	10	0.0712	1.77	E723SB008	0.41	NA	**0.78**	4
	Benzo(b)Fluoranthene	9	10	0.126	3.71	E723SB008	0.79	NA	7.8	**2.5**
	Benzo(g,h,i)Perylene	7	10	0.121	0.419	E723SB008	0.22	NA	6100 e	2100 e
	Benzoic acid	1	10	0.472	0.472	E723SB010	0.88	NA	820000	200
	bis(2-Ethylhexyl) Phthalate	1	10	0.113	0.113	E723SB010	0.18	NA	41	1800
	Carbazole	4	10	0.0292	0.176	E723SB008	0.15	NA	29	0.3
	Chrysene	9	10	0.0624	2.25	E723SB008	0.46	NA	780	80
	Dibenzofuran	2	10	0.0527	0.0606	E723SB009	0.16	NA	820	NA
	Diethyl Phthalate	1	10	0.0242	0.0242	E723SB009	0.17	NA	160000	235
	Fluoranthene	9	10	0.0809	3.56	E723SB008	0.72	NA	8200	2150
	Fluorene	5	10	0.0061	0.13	E723SB008	0.12	NA	8200	280
	Indeno(1,2,3-c,d)pyrene	8	10	0.0612	0.486	E723SB008	0.19	NA	7.8	7
	Naphthalene	1	10	0.0519	0.0519	E723SB009	0.18	NA	4100	42
	Phenanthrene	9	10	0.0251	2.2	E723SB008	0.44	NA	61000 f	6000 f
	Pyrene	9	10	0.0875	3.57	E723SB008	0.69	NA	6100	2100
	BEQs	9	10	0.301	2.63	E723SB008	0.725	**1.40 h**	**0.78 i**	4 i
VOCs	**1,1-Dichloroethene**	4	10	0.00068	0.0059	E723SB002	0.0024	NA	9.5	**0.003**
	Acetone	1	10	0.0087	0.0087	E723SB002	0.0054	NA	20000	0.8
	Tetrachloroethylene (PCE)	1	10	0.0008	0.0008	E723SB010	0.0023	NA	11	0.003
	Toluene	1	10	0.0004	0.0004	E723SB005	0.0023	NA	41000	0.6
	Trichloroethylene (TCE)	7	10	0.0016	0.0316	E723SB003	0.0097	NA	520	**0.003**

Units in mg/Kg.

a based on Cr+6
b Adult Lead Methodology (ALM) Derived Target Lead Concentrations for Industrial Land Use, Revision 1A, CH2M Hill, November 9, 2001
c mercuric chloride
d Acenaphthalene used as a surrogate
e pyrene used as a surrogate
f anthracene used as a surrogate (isometric).
g naphthalene used as a surrogate
h BEQ background concentration is from the Background PAHs Study Report, CH2M-Jones, February 2001.
i Benzo(a)pyrene used as a surrogate.

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TABLE 3-3
Summary of Detected Chemicals in Shallow Groundwater
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Analysis Group	Chemical	Number of Analysis	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Detect	Best Estimate of the Mean (1/2 RL for NDs)	Background	MCL	RBC (HI = 0.1) Tap Water
Metals	Aluminum	3	3	592	2360	E563GW004	1587	16100	NA	3700
	Antimony	3	1	6.65	6.65	E723GW001	3.48	5	**6**	**1.5**
	Barium	3	3	14.1	26.2	E723GW001	20.5	398	2000	260
	Calcium	3	3	12100	18700	E723GW001	16333	260000	EN	EN
	Chromium, Total	3	2	3.25	4.96	E563GW004	3.08	31	100	11 a
	Cobalt	3	3	5.87	9.7	E569GW005	7.25	44	NA	220
	Iron	4	4	268	3450	E563GW004	1930	76600	NA	**1100**
	Magnesium	3	3	3190	3720	E563GW004	3407	1160000	EN	EN
	Manganese	4	4	95.7	178	E569GW005	135	2650	NA	**73**
	Potassium	3	3	2040	2630	E563GW004	2323	289000	EN	EN
	Sodium	3	3	12000	14100	E723GW001	13033	NA	EN	EN
	Vanadium	3	2	5.28	6.44	E563GW004	4.32	26	NA	26
	Zinc	3	3	6.88	11.8	E569GW005	9.96	141	NA	1100
VOCs	**1,1-Dichloroethene**	6	1	0.85	0.85	E563GW004	2.23	NA	7	**0.044**
	1,2-Dichloroethene (total)	6	2	1.2	30.4	E563GW004	6.93	NA	70 h	**6.1 h**
	Benzene	6	1	0.41	0.41	E563GW004	2.15	NA	5	**0.32**
	cis-1,2-Dichloroethylene	6	2	1.2	24.8	E563GW004	6.00	NA	70	**6.1**
	Ethylbenzene	6	1	0.41	0.41	E563GW004	2.15	NA	700	130
	m+p Xylene	6	1	0.87	0.87	E563GW004	2.23	NA	10000 i	1200 i
	o-Xylene	6	1	0.28	0.28	E563GW004	2.13	NA	10000 i	1200
	Tetrachloroethylene (PCE)	6	3	0.65	1.1	E569GW005	1.66	NA	5	1.1
	trans-1,2-Dichloroethene	6	1	5.6	5.6	E563GW004	3.02	NA	100	12
	Trichloroethylene (TCE)	6	3	7.7	258	E563GW004	57.4	NA	**5**	**1.6**
	Xylenes, Total	6	1	1.2	1.2	E563GW004	2.28	NA	10000	1200

Units in µg/L.

a based on hexavalent chromium (Cr+6)
h based on cis-1,2-dichloroethene
i total xylenes
k 1,2-dichloroethane used as a surrogate
j total trihalomethanes

TABLE 3-4
Summary of Detected Chemicals in Deep Groundwater
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Analysis Group	Chemical	Number of Detects	Number of Results	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Detect	Best Estimate of the Mean (1/2 RL for NDs)	Background	MCL	RBC (HI = 0.1) Tap Water
Metals	Aluminum	2	3	393	423	E723GW01D	284	461	NA	3700
	Barium	3	3	16.4	20.3	E569GW05D	17.9	322	2000	260
	Calcium	3	3	43200	75000	E569GW05D	60233	391000	EN	EN
	Chromium, Total	1	3	3.33	3.33	E723GW01D	1.80	27	100	11 a
	Iron	4	4	82.5	1780	E569GW05D	633	26000	NA	**1100**
	Magnesium	3	3	7020	10000	E563GW04D	8513	1370000	EN	EN
	Manganese	4	4	4.61	117	E569GW05D	62.8	1660	NA	**73**
	Potassium	3	3	2610	7670	E723GW01D	5053	351000	EN	EN
	Sodium	3	3	19900	191000	E723GW01D	91767	NA	EN	EN
	Vanadium	2	3	3.76	12.2	E723GW01D	5.73	8	NA	26
	Zinc	1	3	7.06	7.06	E723GW01D	2.72	21	NA	1100
VOCs	**1,1-Dichloroethene**	1	6	1.9	1.9	E563GW04D	10.3	NA	7	**0.044**
	1,2-Dichloroethene (total)	2	6	145	169	E563GW04D	54.0	NA	**70 h**	**6.1 h**
	Chloroethane	1	6	1.3	1.3	E563GW04D	20.2	NA	5 k	3.6
	Chloroform	1	6	5.3	5.3	E723GW01D	10.9	NA	100 j	**0.15**
	cis-1,2-Dichloroethylene	2	6	145	169	E563GW04D	54.0	NA	**70**	**6.1**
	Toluene	1	6	0.4	0.4	E563GW04D	10.1	NA	1000	75
	trans-1,2-Dichloroethene	1	6	11.7	11.7	E563GW04D	12.0	NA	100	12
	Trichloroethylene (TCE)	2	6	1700	1880	E563GW04D	598	NA	**5**	**1.6**
	Vinyl chloride	1	6	17.7	17.7	E563GW04D	23.0	NA	**2**	**0.04**

Units in µg/L.
a based on hexavalent chromium (Cr+6)
h based on cis-1,2-dichloroethene
i total xylenes
k 1,2-dichloroethane used as a surrogate
j total trihalomethanes

TABLE 3-5
Exposure Point Concentrations (EPCs) for COPCs in Soil and Groundwater at AOC 723
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Chemical	Media	Units	Samples	Detects	Minimum Detect	Maximum Detect	Average Detect	Mean	W-Test	UCL95 normal	H-statistic	UCL96 lognormal	UCL95 bootstrap	EPC
Soil														
Arsenic	Surface Soil	mg/kg	9	9	1.83	106	18.7	18.7	LOGNORMAL	39.3	3.50	**76.7**	35.7	**76.7**
BEQs	Surface Soil	mg/kg	9	9	0.25	**3.68**	1.29	1.29	LOGNORMAL	2.13	3.50	5.36	1.99	**3.68**
BEQs	Subsurface Soil	mg/kg	10	9	0.30	2.63	0.782	0.725	LOGNORMAL	1.13	2.37	**1.22**	1.08	1.22
Groundwater														
Antimony	Shallow Groundwater	µg/L	3	1	6.65	**6.65**	6.65	3.48	LOGNORMAL	8.13	9.12	452	5.61	6.65
1,1-Dichloroethene	Shallow Groundwater	µg/L	6	1	0.85	**0.850**	0.850	2.23	NONPARAMETRIC	2.78	2.47	3.74	2.64	0.850
1,2-Dichloroethene (total)	Shallow Groundwater	µg/L	6	2	1.20	30.4	15.8	6.93	NONPARAMETRIC	16.4	4.30	54.0	**14.2**	14.2
cis-1,2-Dichloroethylene	Shallow Groundwater	µg/L	6	2	1.20	24.8	13.0	6.00	NONPARAMETRIC	13.6	4.30	41.1	**11.7**	11.7
Benzene	Shallow Groundwater	µg/L	6	1	0.410	**0.410**	0.410	2.15	NONPARAMETRIC	2.85	3.28	7.18	2.68	0.410
Trichloroethene (TCE)	Shallow Groundwater	µg/L	6	3	7.70	**258**	112	57.4	LOGNORMAL	141	8.07	119719	116	258
1,1-Dichloroethene	Deep Groundwater	µg/L	6	1	1.90	**1.90**	1.90	10.3	NONPARAMETRIC	26.3	5.21	159	22.5	1.90
1,2-Dichloroethene (total)	Deep Groundwater	µg/L	6	2	145	169	157	54.0	NONPARAMETRIC	120	8.07	217011	**102**	102
Cis-1,2-dichloroethylene	Deep Groundwater	µg/L	6	2	145	169	157	54.0	NONPARAMETRIC	120	8.07	217011	**102**	102
Chloroform	Deep Groundwater	µg/L	6	1	5.30	**5.30**	5.30	10.9	NONPARAMETRIC	26.7	4.30	96.4	22.6	5.30
Trichloroethylene (TCE)	Deep Groundwater	µg/L	6	2	1700	**1880**	1790	598	NONPARAMETRIC	1359	12.0	5.41E+11	1184	1880
Vinyl Chloride	Deep Groundwater	µg/L	6	1	17.7	**17.7**	17.7	23.0	NONPARAMETRIC	54.3	4.30	230	46.7	17.7

1

TABLE 3-6
Toxicity Factors for COPCs
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Chemical	EPA Carcinogen Group	Slope Factor (SF) Oral (Kg-day/mg)	Slope Factor (SF) Dermal (Kg-day/mg)	Slope Factor (SF) Inhalation (Kg-day/mg)	Reference Dose (RfD) Oral (mg/Kg-day)	Reference Dose (RfD) Dermal (mg/Kg-day)	Reference Dose (RfD) Inhalation (mg/Kg-day)	HI Target Organ	Source(s)
Antimony	NA	NA	NA	NA	4.00E-04	1.40E-05	NA	Blood	IRIS, 2004
Arsenic	A	1.50E+00	1.50E+00	4.00E-03	3.00E-04	3.00E-04	NA	Skin, Vascular	IRIS, 2004
Benzene		5.50E-02	3.67E-01	2.90E-02	3.00E-03	4.50E-04	1.70E-03	Blood	IRIS, 2004
Benzo(a)pyrene (BEQs)	B2	7.30E+00	7.30E+00	3.10E+00	NA	NA	NA	NA	IRIS, 2004
Chloroform	B2	NA	9.00E-04	NA	1.00E-02	1.26E-03	1.40E-02	Liver, Kidney, CNS	IRIS, 2004
1,1-Dichloroethene	C	6.00E-01	6.67E+01	1.75E-01	9.00E-03	1.26E-03	NA	Liver	IRIS, 2004
1,2-Dichloroethene (total) [a]	NA	NA	NA	NA	1.00E-02	1.26E-03	NA	Blood, Liver	IRIS, 2004
cis-1,2-Dichloroethene	NA	NA	NA	NA	1.00E-02	9.00E-04	NA	Blood	IRIS, 2004
Trichloroethene (TCE)	B2	4.00E-01	2.35E+00	4.00E-01	3.00E-04	5.10E-05	1.00E-02	CNS, Liver, Endocrine	NCEA, 2002
Vinyl Chloride (Adult), water	A	2.10E-05	4.20E-04	1.50E-02	3.00E-03	1.50E-04	2.9E-02	Liver	IRIS, 2004
Vinyl Chloride (Child), water	A	4.20E-05	8.40E-04	3.10E-02	3.00E-03	1.50E-04	2.9E-02	Liver	IRIS, 2004

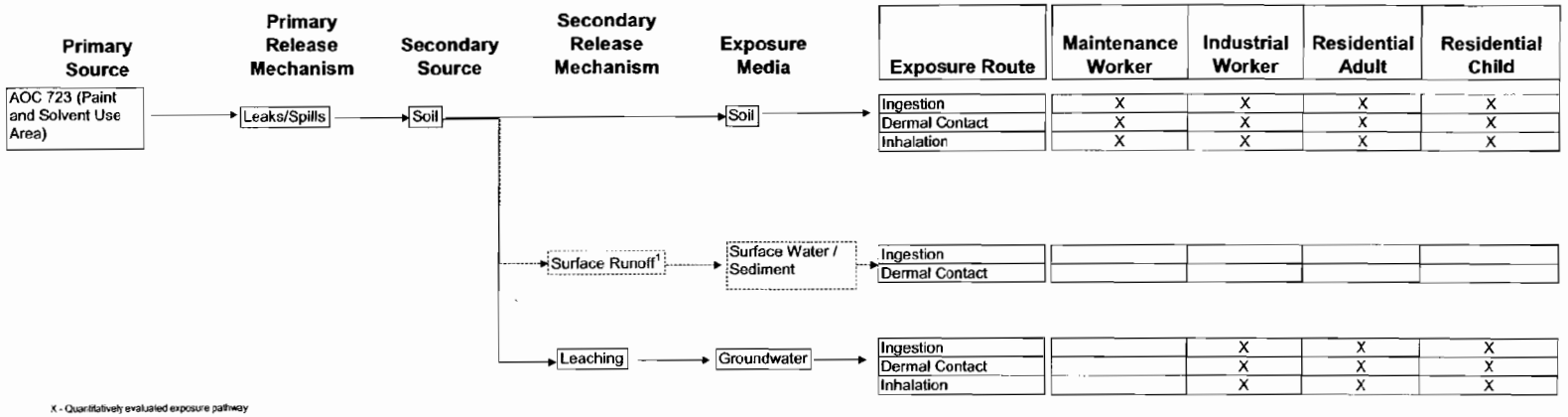
[a] RfD for cis-1,2-dichloroethene used for total 1,2-dichloroethene.

HI Hazard Index
mg/Kg milligrams per kilogram
NCEA National Center for Environmental Assessment
IRIS Integrated risk information system (EPA online database at http://www.epa.gov/iris/subst/index.html)

TABLE 3-7
Risk Summary
RFI Report Addendum and CMS Work Plan, AOC 723, Zone E, Charleston Naval Complex

Receptor	Media	Route	ELCR	HI
Industrial Worker	Surface Soil	Ingestion	2E-05	0.13
		Dermal	2E-05	0.01
		Inhalation	6E-10	NA
		S_{Media}	**4E-05**	**0.14**
	Subsurface Soil	Ingestion	2E-06	NA
		Dermal	8E-06	NA
		Inhalation	2E-10	NA
		S_{Media}	**1E-05**	**0.0**
	Shallow Groundwater	Ingestion	3.6E-04	8.6
		Dermal	4.8E-07	0.011
		Inhalation	3.6E-04	0.25
		S_{Media}	**7E-04**	**8.9**
	Deep Groundwater	Ingestion	1.7E-03	39
		Dermal	3.3E-06	0.078
		Inhalation	1.7E-03	1.2
		S_{Media}	**3E-03**	**40**
	$S_{Receptor}$		**4E-03**	**49**
Residential Adult	Surface Soil	Ingestion	2E-04	0.4
		Dermal	9E-05	0.019
		Inhalation	1E-09	NA
		S_{Media}	**3E-04**	**0.42**
	Shallow Groundwater	Ingestion	1.5E-03	24
		Dermal	6.7E-06	0.12
		Inhalation	1.5E-03	0.71
		S_{Media}	**3E-03**	**25**
	Deep Groundwater	Ingestion	7.1E-03	110
		Dermal	4.6E-05	0.81
		Inhalation	7.1E-03	3.3
		S_{Media}	**1E-02**	**114**
	$S_{Receptor}$		**2E-02**	**139**
Residential Child	Surface Soil	Ingestion	2E-04	3.3
		Dermal	4E-05	0.04
		Inhalation	7E-10	NA
		S_{Media}	**2E-04**	**3.3**
	Shallow Groundwater	Ingestion	5.7E-04	56
		Dermal	1.8E-06	0.18
		Inhalation	5.7E-04	1.7
		S_{Media}	**1E-03**	**57.9**
	Deep Groundwater	Ingestion	2.6E-03	250
		Dermal	1.3E-05	1.2
		Inhalation	2.6E-03	7.6
		S_{Media}	**5E-03**	**259**
	$S_{Receptor}$		**7E-03**	**320**

1



Exposure Route	Maintenance Worker	Industrial Worker	Residential Adult	Residential Child
Ingestion	X	X	X	X
Dermal Contact	X	X	X	X
Inhalation	X	X	X	X
Ingestion				
Dermal Contact				
Ingestion		X	X	X
Dermal Contact		X	X	X
Inhalation		X	X	X

Notes:
[1] Considered a minor pathway based on presence of pavement/grass cover at the site

FIGURE 3-1
Conceptual Site Model for AOC 723
AOC 723, Zone E
Charleston Naval Complex

Section 4.0

4.0 Summary of Interim Measures and UST/AST Removals at AOC723

4.1 UST/AST Removals

Historical records do not indicate the presence of underground storage tanks (USTs) or aboveground storage tanks (ASTs) at AOC 723.

4.2 Interim Measures

No RCRA Corrective Action IMs have been implemented at AOC 723.

Section 5.0

5.0 Summary of Information Related to Site Closeout Issues

5.1 RFI Status

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) addressed SWMUs and AOC within Zone E of the CNC, including AOC 723.

In accordance with the RFI completion process, if a determination of No Further Investigation (NFI) is made upon completion of the RFI, then a site may proceed to either No Further Action (NFA) status or to a CMS. The RFI for AOC 723 identified COCs for soil and groundwater. Based on the discussion presented in Section 5.0 of this report, the following are considered to be COCs at AOC 723: arsenic, BEQs, and TCE in surface soil; BEQs and TCE in subsurface soil; antimony and TCE in shallow groundwater; and 1,2-DCE, TCE, and vinyl chloride in deep groundwater.

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

5.2 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 thallium in shallow wells above the laboratory detection limits. There were no detections of arsenic above the MCL in samples from the shallow groundwater monitoring wells. One detection of antimony in the sample from E723GW001 at 6.65 µg/L exceeds the MCL of 6 µg/L. Based on this exceedance, antimony has been included as a shallow groundwater COC at the present time. The lack of antimony detections in neighboring wells above its MCL indicates the absence of a release of

antimony into the groundwater at this site. There were no detections of antimony in deep wells above the laboratory detection limits.

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

One subsurface soil sample was collected from soil boring E723SB010 on the south side of AOC 723. This sample was collected to investigate the potential impact to the sanitary sewers on the south side of AOC 723, and was analyzed for VOCs, SVOCs and metals. None of the detected analytes exceeded the screening criteria, as shown in Table 2-1.

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

5.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC

One DPT boring (LE699GP30A) located north was sampled during the Zone L RFI for VOCs, cyanide and metals. Figure 5-1 shows the location of this DPT boring near AOC 723. No VOCs or cyanide were detected above laboratory detection limits in the groundwater sample from this boring.

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

5.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC

There were historical railroad lines at the site, but no AOC 504 investigations were conducted at this site. Figure C-1 in Appendix C shows the presence of historical railroad lines at the site from the Public Works map of the CNC, dated December 15, 1939. Most of these railroad lines appear to have been paved over, as shown on Public Works maps from the mid-1950s and later, and currently remain paved over with concrete and asphalt.

5.6 Potential Migration Pathways to Surface Water Bodies at the CNC

The nearest surface water body to AOC 723 is the Cooper River, which lies approximately 1,000 feet northeast of the site. The only potential migration pathway from the site to surface water is via overland flow via stormwater runoff. The entire site is within a building under a concrete floor, which eliminates contact with stormwater. Similarly, runoff directed to the storm sewer system, which discharges to the Cooper River, does not contact the soils at this site. Further evaluation of this issue is not warranted.

5.7 Potential Contamination in Oil/Water Separators

There are no OWSs associated with AOC 723. Therefore, further evaluation of this issue is not warranted.

5.8 Land Use Control

The CNC BCT has agreed that all of Zone E will have at least some LUCs and restrictions. At a minimum, these LUCs are likely to include restrictions against unrestricted land use. The LUC issue will be addressed in the CMS work plan and CMS report.

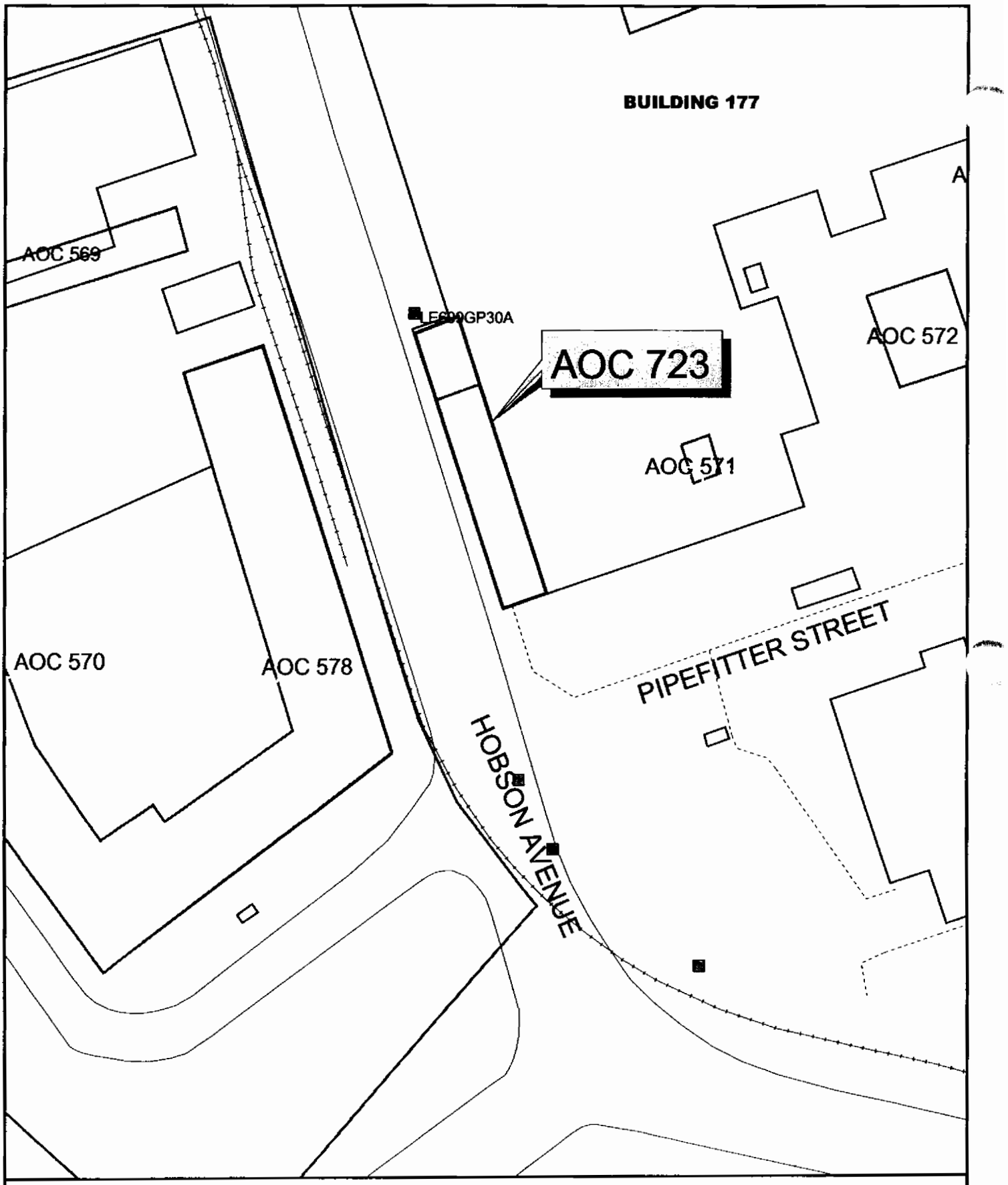


Figure 5-1
Zone L DPT Groundwater Sampling Locations
AOC 723, Zone E
Charleston Naval Complex

CH2MHILL

Section 6.0

6.0 Recommendations

AOC 723 is a former paint booth in the southwestern corner of Building 177. Building 177 was built in 1955 and is a five-story structural steel-framed building with metal siding. It is located at 1865B Avenue B, at the corner of Fourth Street and Avenue B. An abandoned rail line enters the northern end of the building, where the flooring is partially brick. The remainder of the building has concrete flooring. The Navy conducted an RFI in 1996 for Zone E. At the time of the Zone E RFI, AOC 723 had not been identified as an AOC. After the Zone E RFI was completed, the presence of this former paint booth became known and was identified as an AOC.

Based on the above discussions, the following COCs have been identified at AOC 723:

Soils: Arsenic (in surface soil for the unrestricted land use scenario only), TCE (unpaved scenario only, due to potential leachability) , and BEQs in surface and subsurface soils.

Shallow Groundwater: Antimony and TCE

Deep Groundwater: Cis-1,2-DCE, TCE and vinyl chloride

Groundwater at CNC is not in potable use at the present time. Thus, no current exposure pathways exist that may cause unacceptable exposure. This RFI Report Addendum recommends that a CMS be undertaken to address the COCs indicated above for AOC 723. No other COCs have been identified for any other media at this site. A work plan for conducting a CMS is provided in Section 7.0 of this report.

Section 7.0

7.0 CMS Work Plan

At AOC 723, arsenic in surface soil, TCE and BEQs in surface and subsurface soils, antimony and TCE in shallow groundwater, and cis-1,2-DCE, TCE, and vinyl chloride in deep groundwater have been identified as COCs. Currently there is no unacceptable exposure or risk from these COCs; however, it is feasible that in the future, should land use and/or site conditions change, some exposure could occur. Therefore, a CMS should be conducted to evaluate potential corrective measures and identify an appropriate remedy for the site.

This section presents a focused CMS work plan. Media cleanup standards are identified for COCs and potential remedies that should be evaluated are also presented.

7.1 Remedial Action Objectives

Remedial action objectives (RAOs) are medium-specific goals that the remedial actions are designed to accomplish in order to protect human health and the environment by preventing or reducing exposures under current and future land use conditions. The RAOs identified for soil and groundwater at AOC 723 are as follows: 1) to prevent ingestion and direct/dermal contact with soil or groundwater having unacceptable carcinogenic or non-carcinogenic risk, and 2) to restore the site soils and the aquifer to beneficial use.

7.2 Remedial Goal Options and Media Cleanup Standards

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

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

been achieved. Achieving these goals should promote the protection of human health and the environment, while achieving compliance with applicable state and federal standards.

The exposure media of concern for this site are surface soil contaminated with arsenic, TCE and BEQs; subsurface soil contaminated with TCE and BEQs; shallow groundwater contaminated with antimony and TCE; and deep groundwater contaminated with cis-1,2-DCE and TCE. Because this site is located within a highly developed area of the CNC and there are no surface water bodies in the immediate vicinity of the site, ecological exposures were not considered applicable for evaluation.

The proposed MCSs for the various COCs are summarized below:

COC	Medium	MCS	Comment
BEQ	Surface Soil	1.304 mg/kg	CNC Sitewide Reference Concentration
BEQ	Subsurface Soil	1.400 mg/kg	CNC Sitewide Reference Concentration
TCE	Surface and Subsurface Soil	0.195 mg/kg	Site Specific Unpaved SSL
Arsenic	Surface Soil	20 mg/kg	EPA Region IV Concentration Generally Acceptable For Unrestricted Land Use
TCE	Groundwater	5 µg/L	Drinking Water MCL
1,2-DCE	Groundwater	70 µg/L	Drinking Water MCL
Vinyl chloride	Groundwater	2 µg/L	Drinking Water MCL
Antimony	Groundwater	6 µg/L	Drinking Water MCL

7.3 Potential Remedies to Evaluate

The presumptive remedies that will be evaluated as part of the CMS include:

1. **Soil**
   - Soil and pavement excavation and disposal
   - LUCs
2. **Groundwater**
   - Natural attenuation with LUCs
   - In situ treatment

7.4 Focused CMS Approach

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

1. The corrective measure alternatives described above will be screened using several criteria and decision factors.
2. A preferred corrective measure alternative will be selected.
3. The CMS and preferred corrective measure alternative will be documented in the CMS report.

7.5 Approach to Evaluating Corrective Measure Alternatives

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

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

Each of the five standards is defined in more detail below.

1. **Protecting human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this standard may or may not be independent of its ability to achieve the other four standards. For example, an alternative may be protective of human health, but may not be able to attain the MCSs if the MCSs are not directly tied to protecting human health.
2. **Attaining media cleanup standards (RGOs).** The alternatives will be evaluated on the basis of their ability to achieve the RGOs defined in this CMS Work Plan. Another

aspect of this standard is the timeframe to achieve the RGOs. Estimates of the timeframe for the alternatives to achieve RGOs will be provided.

3. **Controlling the source of releases.** This standard deals with the control of releases of contamination from the source (the area in which the contamination originated).

4. **Complying with applicable standards for management of wastes.** This standard deals with the management of wastes derived from implementing the alternatives, for example, treatment or disposal of excavated material. The soil removal alternative will be designed to comply with all applicable standards for management of remediation wastes. Consequently, this standard will not be explicitly included in the detailed evaluation presented in the CMS but will be part of a work plan, specific to the removal action should a removal action become the chosen alternative.

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

   a. Long-term reliability and effectiveness

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

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

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

   c. Short-term effectiveness

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

   d. Implementability

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

e. Cost

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

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

7.6 Focused CMS Report

A focused CMS Report will be prepared to present the identification, development, and evaluation of potential corrective measures for this site. A proposed outline of the report, shown in Table 7-1, provides an example of the report format and content.

Section 8.0

8.0 References

CH2M-Jones. *Technical Information for Development of Background BEQ Values*. February 2001.

CH2M-Jones. *Project Team Notebook and Instructions - Charleston Naval Complex, Environmental Restoration Project, Revision 1A*. December 2001.

South Carolina Department of Health and Environmental Control, Final RCRA Part B Permit No. SC0 170 022 560.

EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston*. November 1997.

EnSafe/Allen & Hoshall. *Final RCRA Facility Assessment, Naval Base Charleston*. June 1995.

U.S. Environmental Protection Agency (EPA). EPA Region 4 Memorandum from Dann Spariosu to Mihir Mehta, Remedial Goals for Arsenic in Soil, March 30, 2001, with attachment of memorandum from Ted Simon to Dann Spariosu, Remediation Goals for Arsenic in Soil at DOD Facilities, dated March 29, 2001.

Appendix A

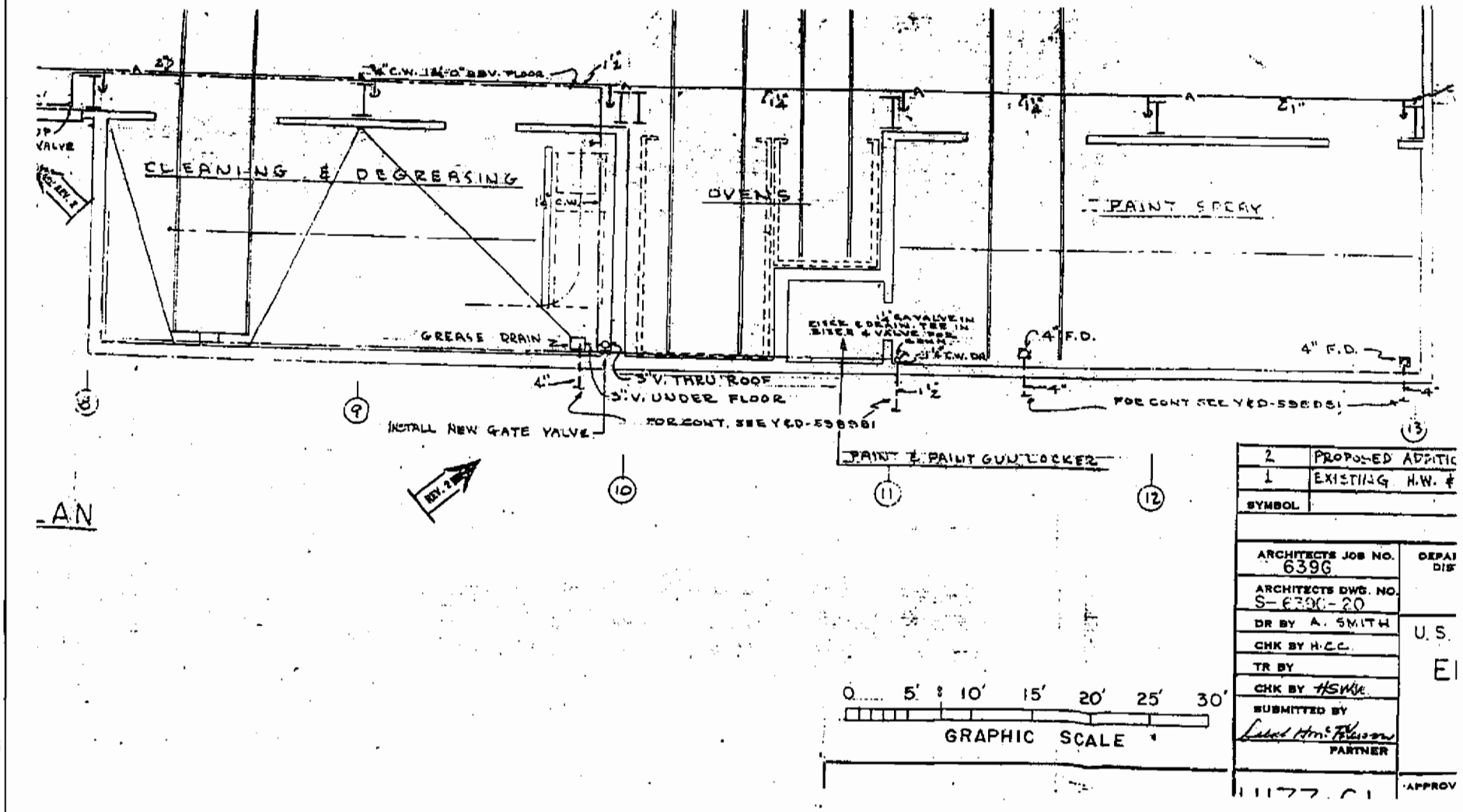
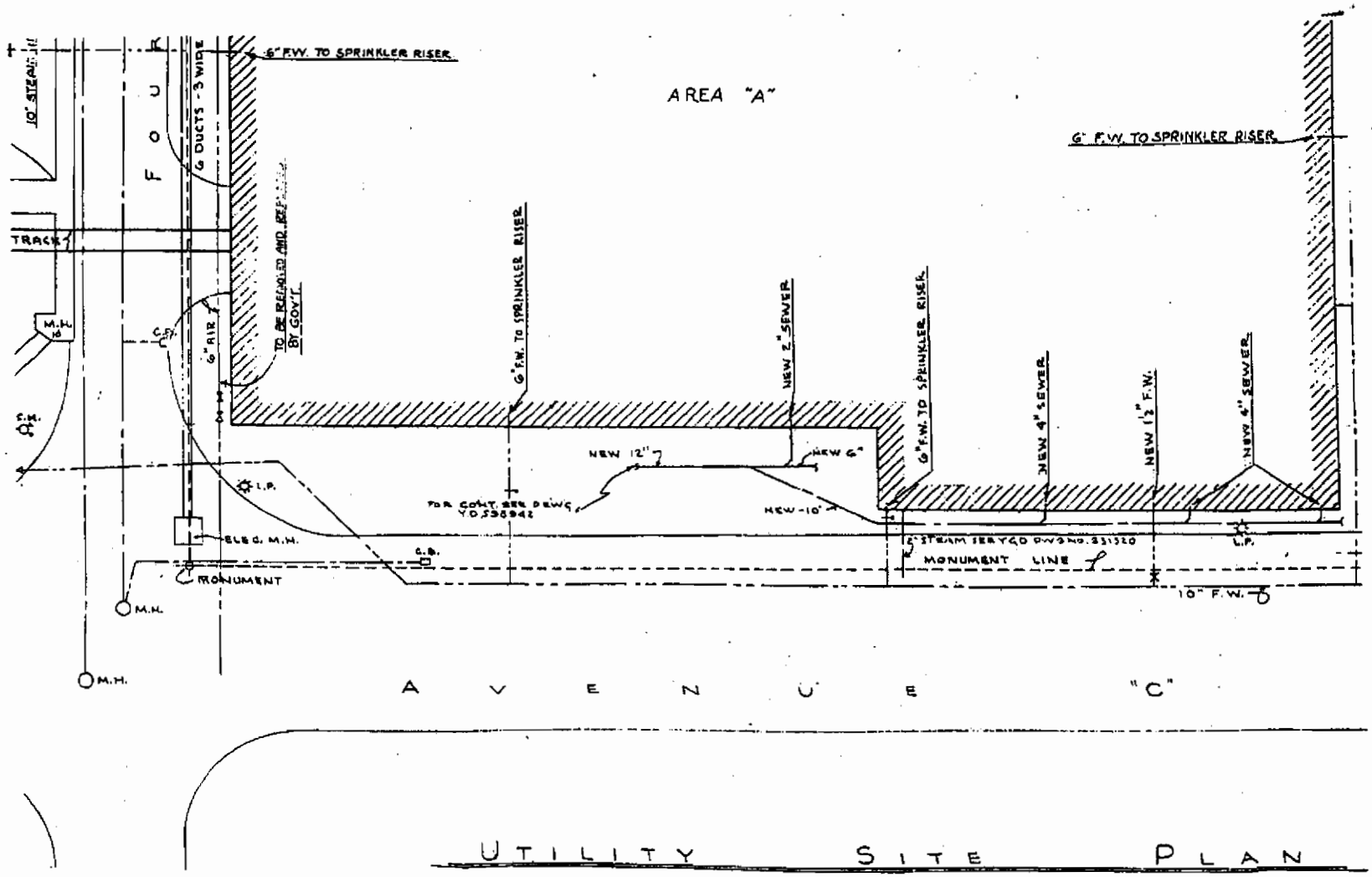
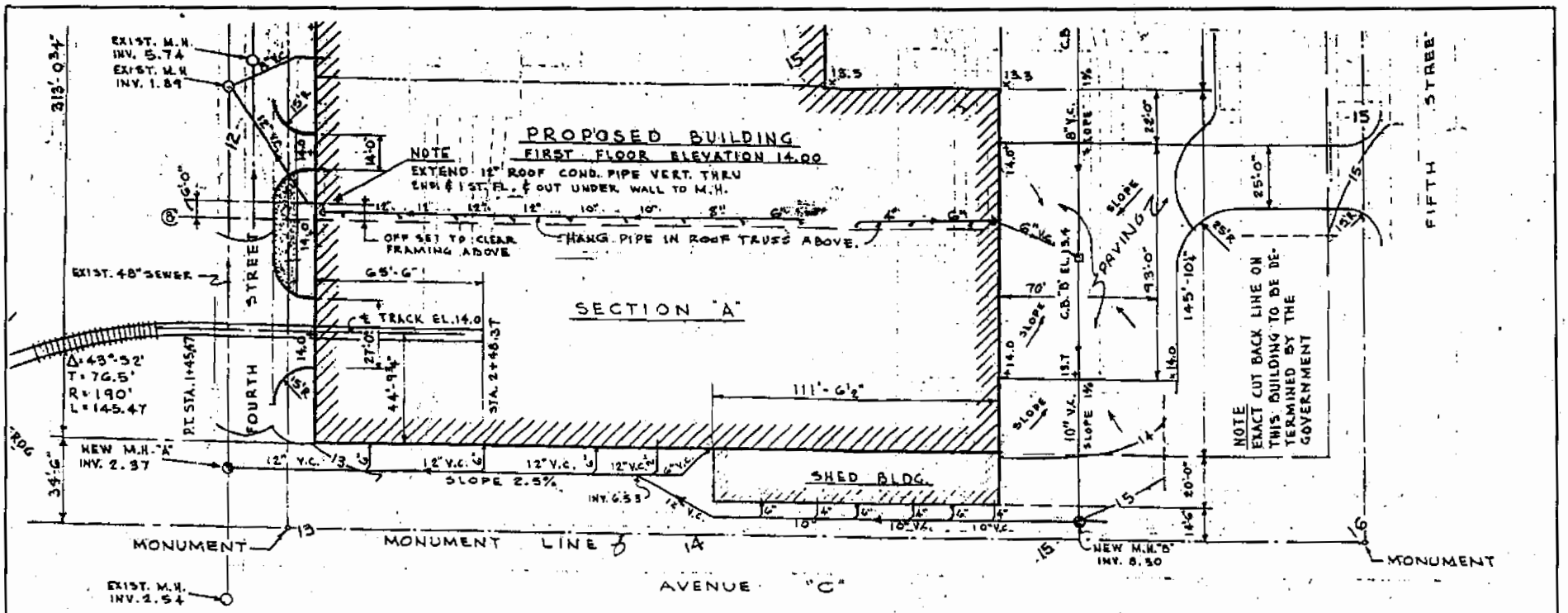


Figure A-1
Excerpt from US Navy Drawing No. 599000
Dated 19 December, 1952



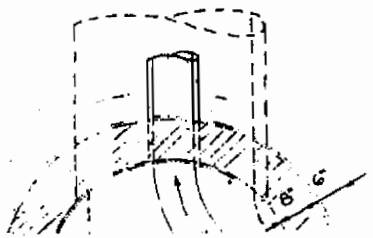
UTILITY SITE PLAN

Figure A-2
Excerpt from US Navy Drawing No. 599981
Dated 19 December, 1952



SITE PLAN

SCALE: 1" = 40'



NOTES

- ELEVATIONS SHOWN REFERENCED TO ESTABLISHED SHIPYARD BENCH MARK.
- EXISTING MANHOLES IN PAVED AREA TO BE RAISED OR LOWERED, AS THE CASE MAY BE, TO MEET NEW FINISH ELEVATIONS.
- EXISTING BUILDINGS, TRACKS, CONCRETE PADS, ETC. IN BUILDING AREA WILL BE REMOVED BY THE GOVERNMENT.
- PAVING SHOWN TO BE BITUMINOUS SURFACING.- 6" BASE + 1½" ASPHALTIC CONC. SURFACE COURSE.
- PATCH AND REPLACE CONCRETE CURB AND SIDEWALK ON NORTH END OF BUILDING.
- PAVING AND V-GUTTER WHERE TRACKS ARE REMOVED TO BE REPAIRED TO MATCH EXISTING WORK.

Figure A-3
Excerpt from US Navy Drawing No. 598942

Appendix B

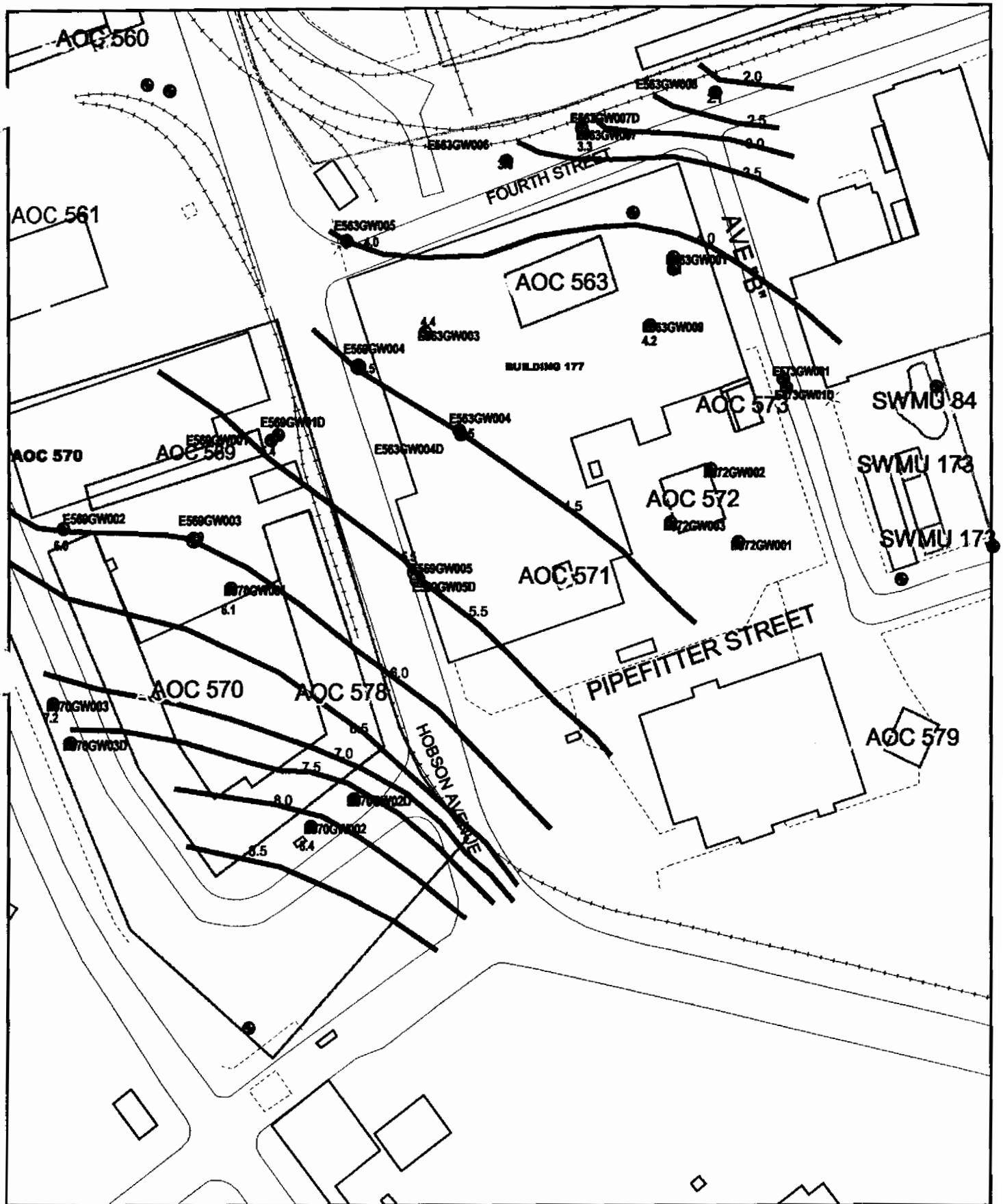


Figure B-1
Shallow Groundwater Elevation Contours (Nov 2002)
AOC 723 Area, Zone E
Charleston Naval Complex

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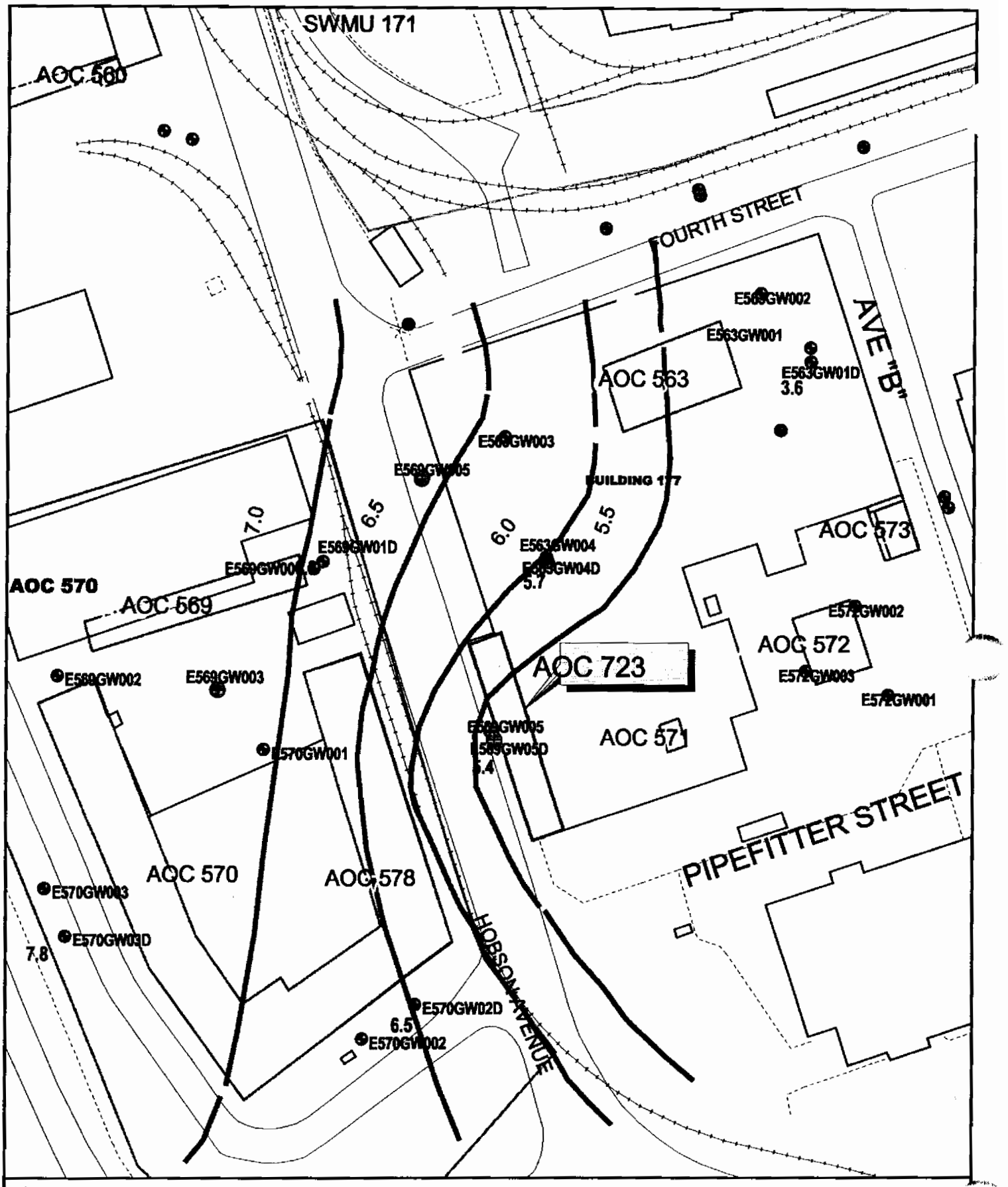

Figure B-2
Deep Groundwater Elevation Contours (Nov. 2002)
AOC 723 Area, Zone E
Charleston Naval Complex

Appendix C

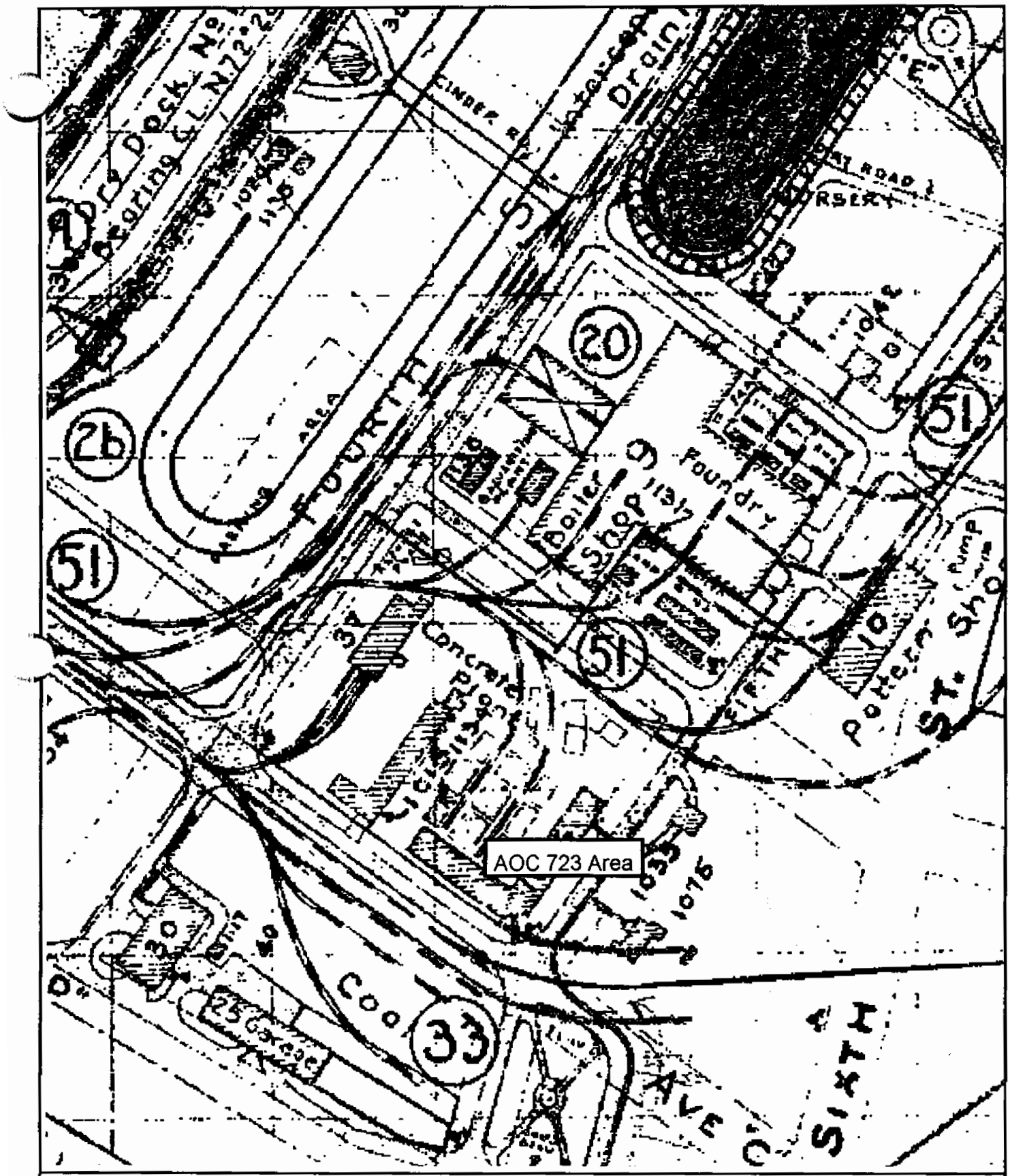

Figure C-1
Historical Railroad Lines near Building 177
AOC 723 Area, Zone E
Charleston Naval Complex

Image from Public Works drawing h606-40(b) December 15, 1939

CH2MHILL

File Path: C:\18gis\Projects\Zone_E\aoc-553-2-cnc-egis.apr, Date: 11 Jul 2002 14:06, User: TWILEY

	StationID	E723SB010	
	SampleID	723SB01002 (3-5ft)	
	DateCollected	12/12/2003	
	DateExtracted	12/12/2003	
	DateAnalyzed	12/23/2003	
	SDGNumber	103608	
Parameter	**Units**		
Chloromethane	ug/kg	12.5	U
Vinyl chloride	ug/kg	12.5	U
Bromomethane	ug/kg	12.5	U
Chloroethane	ug/kg	12.5	U
1,1-Dichloroethene	ug/kg	0.74	J
Acetone	ug/kg	12.5	U
Carbon Disulfide	ug/kg	6.2	U
Methylene Chloride	ug/kg	6.2	U
trans-1,2-Dichloroethene	ug/kg	6.2	U
1,1-Dichloroethane	ug/kg	6.2	U
Vinyl acetate	ug/kg	12.5	U
Methyl ethyl ketone (2-Butanone)	ug/kg	12.5	U
cis-1,2-Dichloroethylene	ug/kg	6.2	U
1,2-Dichloroethene (total)	ug/kg	6.2	U
Chloroform	ug/kg	6.2	U
1,1,1-Trichloroethane	ug/kg	6.2	U
Carbon Tetrachloride	ug/kg	6.2	U
1,2-Dichloroethane	ug/kg	6.2	U
Benzene	ug/kg	6.2	U
Trichloroethylene (TCE)	ug/kg	9.6	=
1,2-Dichloropropane	ug/kg	6.2	U
Bromodichloromethane	ug/kg	6.2	U
2-Chloroethyl vinyl ether	ug/kg	12.5	U
cis-1,3-Dichloropropene	ug/kg	6.2	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/kg	12.5	U
Toluene	ug/kg	6.2	U
trans-1,3-Dichloropropene	ug/kg	6.2	U
1,1,2-Trichloroethane	ug/kg	6.2	U
2-Hexanone	ug/kg	12.5	U
Tetrachloroethylene (PCE)	ug/kg	0.8	J

	StationID	E723SB010	
	SampleID	723SB01002 (3-5ft)	
	DateCollected	12/12/2003	
	DateExtracted	12/12/2003	
	DateAnalyzed	12/23/2003	
	SDGNumber	103608	
Parameter	**Units**		
Dibromochloromethane	ug/kg	6.2	U
Chlorobenzene	ug/kg	6.2	U
Ethylbenzene	ug/kg	6.2	U
m+p Xylene	ug/kg	6.2	U
o-Xylene	ug/kg	6.2	U
Xylenes, Total	ug/kg	6.2	U
Styrene	ug/kg	6.2	U
Bromoform	ug/kg	6.2	U
1,1,2,2-Tetrachloroethane	ug/kg	6.2	U
1,3-Dichlorobenzene	ug/kg	6.2	U
1,4-Dichlorobenzene	ug/kg	6.2	U
1,2-Dichlorobenzene	ug/kg	6.2	U
1,2,4-Trichlorobenzene	ug/kg	6.2	U
1,2,3-Trichlorobenzene	ug/kg	6.2	U

	StationID	E723SB010	
	SampleID	723SB01002 (3-5ft)	
	DateCollected	12/12/2003	
	DateExtracted	12/31/2003	
	DateAnalyzed	12/31/2003	
	SDGNumber	103608	
Parameter	**Units**		
2,4,5-Trichlorophenol	ug/kg	1800	UJ
2,4,6-Trichlorophenol	ug/kg	372	UJ
2,4-Dichlorophenol	ug/kg	372	UJ
2,4-Dimethylphenol	ug/kg	372	UJ
2,4-Dinitrophenol	ug/kg	1800	UJ
2,4-Dinitrotoluene	ug/kg	338	UJ
2,6-Dinitrotoluene	ug/kg	372	UJ
2-Chloronaphthalene	ug/kg	372	UJ
2-Chlorophenol	ug/kg	372	UJ
2-Methylnaphthalene	ug/kg	372	UJ
2-Methylphenol (o-Cresol)	ug/kg	372	UJ
2-Nitroaniline	ug/kg	1800	UJ
2-Nitrophenol	ug/kg	372	UJ
3,3'-Dichlorobenzidine	ug/kg	743	UJ
3-Methylphenol/4-Methylphenol (mp-Cresol)	ug/kg	372	UJ
3-Nitroaniline	ug/kg	1800	UJ
4,6-Dinitro-2-methylphenol	ug/kg	1800	UJ
4-Bromophenyl Phenyl Ether	ug/kg	372	UJ
4-Chloro-3-methylphenol	ug/kg	338	UJ
4-Chloroaniline	ug/kg	372	UJ
4-Chlorophenyl Phenyl Ether	ug/kg	372	UJ
4-Nitroaniline	ug/kg	1800	UJ
4-Nitrophenol	ug/kg	1800	UJ
Acenaphthene	ug/kg	19.3	J
Acenaphthylene	ug/kg	372	UJ
Anthracene	ug/kg	52.9	J
Benzo(a)Anthracene	ug/kg	410	J
Benzo(a)Pyrene	ug/kg	436	J
Benzo(b)Fluoranthene	ug/kg	801	J
Benzo(g,h,i)Perylene	ug/kg	343	J

	StationID	E723SB010	
	SampleID	723SB01002 (3-5ft)	
	DateCollected	12/12/2003	
	DateExtracted	12/31/2003	
	DateAnalyzed	12/31/2003	
	SDGNumber	103608	
Parameter	**Units**		
Benzo(k)Fluoranthene	ug/kg	372	UJ
Benzoic acid	ug/kg	472	J
Benzyl alcohol	ug/kg	372	UJ
Benzyl Butyl Phthalate	ug/kg	372	UJ
bis(2-Chloroethoxy) Methane	ug/kg	372	UJ
bis(2-Chloroethyl) ether (2-Chloroethyl Ether)	ug/kg	372	UJ
Bis(2-Chloroisopropyl)Ether	ug/kg	372	UJ
bis(2-Ethylhexyl) Phthalate	ug/kg	113	J
Carbazole	ug/kg	29.2	J
Chrysene	ug/kg	427	J
Dibenz(a,h)anthracene	ug/kg	372	UJ
Dibenzofuran	ug/kg	372	UJ
Diethyl Phthalate	ug/kg	372	UJ
Dimethyl Phthalate	ug/kg	372	UJ
Di-n-butyl Phthalate	ug/kg	372	UJ
Di-n-octylphthalate	ug/kg	372	UJ
Diphenylamine	ug/kg	372	UJ
Fluoranthene	ug/kg	738	J
Fluorene	ug/kg	13.4	J
Hexachlorobenzene	ug/kg	372	UJ
Hexachlorobutadiene	ug/kg	372	UJ
Hexachlorocyclopentadiene	ug/kg	372	UJ
Hexachloroethane	ug/kg	372	UJ
Indeno(1,2,3-c,d)pyrene	ug/kg	334	J
Isophorone	ug/kg	372	UJ
Naphthalene	ug/kg	372	UJ
Nitrobenzene	ug/kg	372	UJ
N-Nitrosodi-n-propylamine	ug/kg	372	UJ
Pentachlorophenol	ug/kg	1800	UJ
Phenanthrene	ug/kg	326	J

	StationID	E723SB010	
	SampleID	723SB01002 (3-5ft)	
	DateCollected	12/12/2003	
	DateExtracted	12/31/2003	
	DateAnalyzed	12/31/2003	
	SDGNumber	103608	
Parameter	**Units**		
Phenol	ug/kg	372	UJ
Pyrene	ug/kg	670	J

	StationID	E723SB010		E723SB010	
	SampleID	723SB01002 (3-5ft)		723SB01002 (3-5ft)	
	DateCollected	12/12/2003		12/12/2003	
	DateExtracted	12/18/2003		12/19/2003	
	DateAnalyzed	12/19/2003		12/22/2003	
	SDGNumber	103608		103608	
Parameter	**Units**				
Arsenic	mg/kg			3.74	=
Barium	mg/kg			49	J
Cadmium	mg/kg			2.33	=
Chromium, Total	mg/kg			11.3	=
Lead	mg/kg			63.2	J
Selenium	mg/kg			0.487	U
Silver	mg/kg			1.21	J
Mercury	mg/kg	0.099	J		

Data Validation Summary - Charleston Naval Complex - Zone E, AOC 723, Soil

TO: Sam Naik/CH2M HILL/ATL

FROM: Amy Juchem/CH2M HILL/GNV
Herb Kelly/CH2M HILL/GNV

DATE: January 27, 2004

The purpose of this memorandum is to present the results of the data validation process for the soil samples collected in Zone E, AOC 723. The samples were collected on July 16 and 17, 2003.

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

The Quality Control areas that were reviewed 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 2002) 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 8260 Volatile Organic Compounds (VOC), SW-846 8270 Semivolatile Organic Compounds (SVOC), and Metals following SW-846 6010/7000 Series methodology.

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

Table 2 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

Code	Definition
2S	Second Source
2C	Second Column Confirmation
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
TD	Total vs Dissolved
TN	Tune

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

84385	E723SB001	723SB00101	84385001	SO	N		0	1	07/17/03	X	X	X	X
84385	E723SB001	723SB00102	84385002	SO	N		3	5	07/17/03	X	X	X	X
84385	E723SB002	723SB00201	84385003	SO	N		0	1	07/17/03	X	X	X	X
84385	E723SB002	723SB00202	84385004	SO	N		3	5	07/17/03	X	X	X	X
84385	E723SB003	723SB00301	84385005	SO	N		0	1	07/17/03	X	X	X	X
84385	E723SB003	723SB00302	84385006	SO	N		3	5	07/17/03	X	X	X	X
84385	E723SB004	723SB00401	84385007	SO	N		0	1	07/17/03	X	X	X	X
84385	E723SB004	723SB00402	84385008	SO	N		3	5	07/17/03	X	X	X	X
84385	E723SB005	723SB00501	84385009	SO	N		0	1	07/17/03	X	X	X	X
84385	E723SB005	723CB00501	84385010	SO	FD		0	1	07/17/03	X	X	X	X
84385	LABQC	1200458265	1200458265	SQ	LB								X
84385	LABQC	1200458266	1200458266	SQ	BS								X
84385	E723SB001	723SB00101MS	1200458267	SO	MS		0	1	07/17/03				X
84385	E723SB001	723SB00101SD	1200458268	SO	SD		0	1	07/17/03				X
84385	LABQC	1200458426	1200458426	SQ	LB						X		
84385	LABQC	1200458427	1200458427	SQ	BS						X		
84385	LABQC	1200458897	1200458897	SQ	LB							X	
84385	LABQC	1200458898	1200458898	SQ	BS							X	
84385	LABQC	1200460177	1200460177	SQ	LB					X			
84385	LABQC	1200460180	1200460180	SQ	BS					X			

84385	LABQC	1200460184	1200460184	SQ	LB					X			
84385	LABQC	1200462724	1200462724	SQ	LB					X			
84385	LABQC	1200462725	1200462725	SQ	BS					X			
84387	E723SB005	723SB00502	84387001	SO	N		3	5	07/17/03	X	X	X	X
84387	E723SB006	723SB00601	84387002	SO	N		0	1	07/17/03	X	X	X	X
84387	E723SB006	723SB00602	84387003	SO	N		3	5	07/17/03	X	X	X	X
84387	E723SB007	723SB00701	84387004	SO	N		0	1	07/17/03	X	X	X	X
84387	E723SB007	723SB00702	84387005	SO	N		3	5	07/17/03	X	X	X	X
84387	E723SB008	723SB00801	84387006	SO	N		0	1	07/17/03	X	X	X	X
84387	E723SB008	723SB00802	84387007	SO	N		3	5	07/17/03	X	X	X	X
84387	E723SB008	723CB00802	84387008	SO	FD		3	5	07/17/03	X	X	X	X
84387	E723SB009	723SB00901	84387009	SO	N		0	1	07/17/03	X	X	X	X
84387	E723SB009	723SB00901DL	84387009	SO	LR	DL	0	1	07/17/03		X		
84387	E723SB009	723SB00902	84387010	SO	N		3	5	07/17/03	X	X	X	X
84387	LABQC	1200458277	1200458277	SQ	LB								X
84387	LABQC	1200458278	1200458278	SQ	BS								X
84387	E723SB009	723SB00902MS	1200458279	SO	MS		3	5	07/17/03				X
84387	E723SB009	723SB00902SD	1200458280	SO	SD		3	5	07/17/03				X
84387	LABQC	1200458433	1200458433	SQ	LB						X		
84387	LABQC	1200458434	1200458434	SQ	BS						X		
84387	LABQC	1200458897	1200458897	SQ	LB							X	
84387	LABQC	1200458898	1200458898	SQ	BS							X	

84387	E723SB009	723SB00902MS	1200458899	SO	MS		3	5	07/17/03			X	
84387	E723SB009	723SB00902SD	1200458900	SO	SD		3	5	07/17/03			X	
84387	E723SB009	723SB00902MS	1200460178	SO	MS		3	5	07/17/03	X			
84387	E723SB009	723SB00902SD	1200460179	SO	SD		3	5	07/17/03	X			
84387	LABQC	1200460755	1200460755	SQ	LB						X		
84387	LABQC	1200460760	1200460760	SQ	BS						X		
84387	LABQC	1200460921	1200460921	SQ	LB					X			
84387	LABQC	1200460922	1200460922	SQ	BS					X			
84387	E723SB009	723SB00902MS	1200461044	SO	MS		3	5	07/17/03		X		
84387	E723SB009	723SB00902SD	1200461045	SO	SD		3	5	07/17/03		X		
84388	FIELDQC	723EB002N1	84388001	WQ	EB				07/17/03	X	X	X	X
84388	FIELDQC	723TB001N1	84388002	WQ	TB				07/16/03	X			
84388	LABQC	1200458345	1200458345	WQ	LB					X			
84388	LABQC	1200458346	1200458346	WQ	BS					X			
84388	LABQC	1200458790	1200458790	WQ	LB						X		
84388	LABQC	1200458791	1200458791	WQ	BS						X		
84388	LABQC	1200460655	1200460655	WQ	LB							X	
84388	LABQC	1200460656	1200460656	WQ	BS							X	
84388	LABQC	1200461006	1200461006	WQ	LB								X
84388	LABQC	1200461007	1200461007	WQ	BS								X

MATRIX CODE

SO – Soil
SQ – Soil QC Sample
WQ – Water QC Sample

SAMPLE TYPE CODE

BS - Blank Spike
EB - Equipment Blank
TB – Trip Blank
N - Native Sample
FD – Field Duplicate
LB - Laboratory Blank
LR – Laboratory Replicate
MS – Matrix Spike
SD – Matrix Spike Duplicate

LR Type CODE

DL – Dilution

ANALYSIS CODE

VOC – Volatile Organic Compounds
SVOC - Semivolatile Organic Compounds

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, equipment blanks, and trip 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.

Volatile Organic Compounds (VOC) Analyses

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

Recoveries - Surrogate, MS/MSD and LCS

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

TABLE 2
Surrogate, MS/MSD, and LCS Recoveries Out of QC Limits: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84385	1200460180 LCS	Vinyl acetate	137.6*	70-130	84385001 through 84385007, 84385009, 84385010	Detects only - J
84385	1200462725 LCS	Vinyl acetate	144.8*	70-130	84385008	Detects only - J
84385	723SB00101	Bromofluorobenzene	116*	59-113	723SB00101 (84385001)	Detects only - J
84385	723SB00202	Bromofluorobenzene	120*	59-113	723SB00202 (84385004)	Detects only - J
84385	723SB00302	Bromofluorobenzene	119*	59-113	723SB00302 (84385006)	Detects only - J
84385	723SB00201	Bromofluorobenzene	119*	59-113	723SB00201 (84385003)	Detects only - J
84385	723SB00401	Bromofluorobenzene	120*	59-113	723SB00401 (84385007)	Detects only - J
84385	723SB00402	Bromofluorobenzene	123*	59-113	723SB00402 (84385008)	Detects only - J
84387	723SB00902 MS/MSD	2-Chloroethyl vinyl ether	69.2* / 68.0*	70-130	723SB00902 (84387010)	Detects-J, non-detects-UJ
		Styrene	69.4* / 66.8*			
		1,3-Dichlorobenzene	65.6* / 66.6*			
		1,4-Dichlorobenzene	64.8* / 65.4*			
		1,2-Dichlorobenzene	64.8* / 66.0*			
		1,2,4-Trichlorobenzene	44.8* / 43.4*			
		1,2,3-Trichlorobenzene	43.8* / 41.6*			

TABLE 2
Surrogate, MS/MSD, and LCS Recoveries Out of QC Limits: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84387	723SB00902 MS/MSD	Vinyl acetate	0* / 0*	70-130	723SB00902 (84387010)	Detects-J, non-detects-R
* - out of control limits						

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in [redacted].

TABLE 3
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

VOA5-CCAL-07/22/03, 0725	Vinyl acetate	37.6% high	84385001 through 84385007, 84385009, 84385010
VOA5-CCAL-07/23/03, 0836	Chloromethane	22.6% high	84385008
	Acetone	21.1% high	
	Vinyl acetate	44.8% high	
	o-Xylene	21.9% high	
	Bromoform	22.3% high	
	1,3-Dichlorobenzene	21.9% high	
VOA2-CCAL-07/25/03, 0801	Vinyl acetate	23.0% high	84387 – All
	2-Chloroethyl vinyl ether	33.9% low	
	Bromoform	20.5% high	

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was low in the continuing calibration standards, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.

- When the percent difference (%D) was high in the continuing calibration standards, detected compounds were flagged "J", as estimated. Non-detected compounds were not flagged.

Internal Standard Area

All internal standard areas were within QC limits, except as noted in Table 4 below.

TABLE 4
Internal Standard Area out of Criteria: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84385	84385007	1,4-Dichlorobenzene-d4 – 51.1% low	Detects-J, non-detects-UJ

Semivolatile Organic Compounds (SVOC) Analyses

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

Blanks

The SVOC target parameters detected in blank samples are listed in Table 5.

TABLE 5
Blank Contamination: SVOCs
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84385	1200458426	1200458426	LB	bis(2-Ethylhexyl)phthalate	74.5	µg/Kg	745 µg/Kg
84385	723EB002N1	84388001	EB	bis(2-Ethylhexyl)phthalate	3.4	µg/L	1122 µg/Kg
84387	1200460755	1200460755	LB	bis(2-Ethylhexyl)phthalate	80.6	µg/Kg	806 µg/Kg
84387	723EB002N1	84388001	EB	bis(2-Ethylhexyl)phthalate	3.4	µg/L	1122 µg/Kg

If a target parameter determined to be a common contaminant was reported in a field sample, and the concentration was below the level determined to be due to blank contamination, the following actions were taken:

- If the concentration was above the reporting limit, the numeric result was unchanged, but it was flagged "U", as undetected.

- If the concentration was below the reporting limit, the numeric result was changed to the value of the reporting limit, and it was flagged "U", as undetected.

The results qualified due to blank contamination are listed in [redacted].

Recoveries - Surrogate, MS/MSD and LCS

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

TABLE 6
Surrogate, MS/MSD, and LCS Recoveries Out of QC Limits: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84387	723SB00902 MS/MSD	Phenol	86 / 99*	26-90	723SB00902 (84387010)	Detects only - J
		2,4-Dinitrotoluene	94* / 100*	28-89		
		4-Nitrophenol	121* / 127*	11-114		
84387	723SB00802	2-Fluorobiphenyl	23*	30-115	723SB00802 (84387007)	No flags applied – all other surrogates in criteria
* - out of control limits						

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in [redacted].

TABLE 7
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

MSD4-ICAL-06/22/03, 1906	2,4-Dinitrophenol	R^2 =0.985	84385 – All
	2-Methyl-4,6-Dinitrophenol	R^2 =0.989	84387 – All
	3,3-Dichlorobenzidine	R^2 =0.982	
	Indeno(1,2,3-cd)pyrene	R^2 =0.984	
	Dibenzo(a,h)anthracene	R^2 =0.982	

TABLE 7
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

MSD4-CCAL-07/24/03, 0805	2,4-Dinitrophenol	21.6% low	84385001, 84385002
	Indeno(1,2,3-cd)pyrene	23.9% high	
	Dibenzo(a,h)anthracene	22.1% high	
	Benzo(g,h,I)perylene	31.4% high	
MSD4-CCAL-07/29/03, 1321	Bis(2-Chloroisopropyl)ether	22.1% high	84385003, 84385004
	4-Nitrophenol	23.3% high	
	Benzo(g,h,I)perylene	25.7% high	
	m-Nitroaniline	27.7% high	
	p-Nitroaniline	39.0% high	
	3,3-Dichlorobenzidine	29.9% low	
MSD4-CCAL-07/31/03, 0737	Bis(2-Chloroisopropyl)ether	25.6% high	84385005, 84385006, 84385008, 84385009
	Benzoic acid	27.0% low	
	4-Nitrophenol	25.7% high	
	m-Nitroaniline	28.6% high	
	p-Nitroaniline	31.0% high	
	3,3-Dichlorobenzidine	24.7% low	
MSD4-CCAL-07/31/03, 2041	Bis(2-Chloroisopropyl)ether	20.6% high	84385007, 84385010
	Pyrene	40.0% high	
MSD4-CCAL-07/22/03, 2357	Hexachlorocyclopentadiene	28.1% high	84387001 through 84387009
	2,4-Dinitrophenol	31.8% high	
	4-Nitrophenol	36.3% high	
	2-Methyl-4,6-Dinitrophenol	26.5% high	
	m-Nitroaniline	20.2% high	
MSD4-CCAL-07/23/03, 1457	2,4-Dinitrophenol	21.5% low	84387009DL
MSD4-CCAL-07/28/03, 1600	m-Nitroaniline	22.5% high	84387010
	p-Nitroaniline	30.9% high	

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent Relative Standard Deviation (%RSD) or correlation coefficient (R^2) was out in the initial calibration, all associated samples were qualified. Detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.
- When the percent difference (%D) was high in the continuing calibration standards, detected compounds were flagged "J", as estimated. Non-detected compounds were not flagged.
- When the percent difference (%D) was low in the continuing calibration standards, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.

Internal Standard Area

All internal standard areas were within QC limits, except as noted in [redacted] below.

TABLE 8
Internal Standard Area out of Criteria: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84387	84387009	Perylene-d12 – 70.0% low	Detects-J, non-detects-UJ

Field Duplicate Samples

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

TABLE 9
Field Duplicate RPDs Out of QC Limits: SVOC
Charleston Naval Complex, , Zone E, AOC 723, Charleston, SC

84387	723SB00802 / 723CB00802	Phenanthrene	2200 ug/Kg	101 ug/Kg	182.4*	35
		Anthracene	584 ug/Kg	26.2 ug/Kg	182.8*	35
		Fluoranthene	3560 ug/Kg	246 ug/Kg	174.1*	35
		Pyrene	3570 ug/Kg	289 ug/Kg	170.0*	35
		Benzo(a)anthracene	2370 ug/Kg	192 ug/Kg	170.0*	35
		Chrysene	2250 ug/Kg	182 ug/Kg	170.1*	35
		Benzo(b)fluoranthene	3710 ug/Kg	337 ug/Kg	166.7*	35
		Benzo(a)pyrene	1770 ug/Kg	177 ug/Kg	163.6*	35

TABLE 9
Field Duplicate RPDs Out of QC Limits: SVOC
Charleston Naval Complex, , Zone E, AOC 723, Charleston, SC

84387	723SB00802 / 723CB00802	Indeno(1,2,3-cd)pyrene	486 ug/Kg	102 ug/Kg	130.6*	35
		Benzo(g,h,I)perylene	419 ug/Kg	Non-detect (407 U)	200.0*	35
* - out of control limits						

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.

Blanks

The metals target parameters detected in blank samples are listed in Table 10.

TABLE 10
Blank Contamination: Metals
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84385	CCB		CCB	Barium	0.524	µg/L	0.131 mg/Kg
84385	CCB		CCB	Selenium	3.53	µg/L	0.8825 mg/Kg
84387	CCB		CCB	Barium	0.524	µg/L	0.131 mg/Kg
84387	CCB		CCB	Selenium	3.53	µg/L	0.8825 mg/Kg

If a target parameter was reported in a field sample, and the concentration was below the level determined to be due to blank contamination (5 times the concentration in the associated QC blank samples), it was flagged as "U", not detected. Initial and continuing calibration blanks were also evaluated for possible contamination.

The results qualified due to blank contamination are listed in Attachment I.

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 below.

- Chromium was recovered in the MS/MSD sample associated with both SDG's 84385 and 84387 at 194.5% and 114%, respectively, with limits of 80-120%. RPD criteria was also not met at 39.3% RPD with a 35% limit. All chromium detects were qualified as estimated, 'J'. Non-detects were not flagged.

Field Duplicate Samples

All Field Duplicate Samples were within acceptable quality control limits, except as noted in Table 11 below. No flags are applied due to Field Duplicate precision.

TABLE 11
Field Duplicate RPDs Out of QC Limits: Metals
Charleston Naval Complex, , Zone E, AOC 723, Charleston, SC

84385	723SB00501 / 723CB00501	Lead	33.6 mg/Kg	135 mg/Kg	120.3*	35
* - out of control limits						

Rejected Data

The majority of rejected data were associated with re-runs and dilutions (there can only be a single valid result per parameter per sample). However, there was one result qualified as "R", rejected, due to associated QC parameters out of criteria as discussed above, such that there is not a valid result for that parameter in that sample. The rejected data is summarized in [redacted] below.

TABLE 12
Data Qualification Summary: Rejected Data
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

84387	723SB00902	VOA	Vinyl acetate	9.5	U	9.5	R	µg/L	MS

Conclusion

A review of the analytical data submitted regarding the investigation of soils at Zone E, AOC 723 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 was a specific result that was rejected, in which the data cannot be used. With the exception of this result, 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 - Chang Qualifiers and Results
Zone E, AOC 723 - Data Validation

ETAL	SW6010B	ARSENIC	84385	723SB00101	84385001	SO	1.83	B	1.83	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00101	84385001	SO	30.1	B	30.1	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00102	84385002	SO	23.4	B	23.4	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00201	84385003	SO	31	B	31	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00202	84385004	SO	39.2	B	39.2	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00301	84385005	SO	39.2	B	39.2	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00302	84385006	SO	31	B	31	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00401	84385007	SO	13.4	B	13.4	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84385	723SB00402	84385008	SO	18.7	B	18.7	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00602	84387003	SO	38.1	B	38.1	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00701	84387004	SO	41.1	B	41.1	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00702	84387005	SO	43.6	B	43.6	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00802	84387007	SO	29.1	B	29.1	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723CB00802	84387008	SO	30.2	B	30.2	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00901	84387009	SO	45.6	B	45.6	J	mg/kg	IB
ETAL	SW6010B	BARIUM	84387	723SB00902	84387010	SO	36.9	B	36.9	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00101	84385001	SO	0.071	B	0.071	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00301	84385005	SO	0.625	B	0.625	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00302	84385006	SO	0.149	B	0.149	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00401	84385007	SO	0.272	B	0.272	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00402	84385008	SO	0.318	B	0.318	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723SB00501	84385009	SO	0.139	B	0.139	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84385	723CB00501	84385010	SO	0.119	B	0.119	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00502	84387001	SO	0.117	B	0.117	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00601	84387002	SO	0.241	B	0.241	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00602	84387003	SO	0.097	B	0.097	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00701	84387004	SO	0.172	B	0.172	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00702	84387005	SO	0.103	B	0.103	J	mg/kg	IB

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Soil - Data Validation

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETAL	SW6010B	CADMIUM	84387	723SB00801	84387006	SO	0.527	B	0.527	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00802	84387007	SO	0.222	B	0.222	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723CB00802	84387008	SO	0.359	B	0.359	J	mg/kg	IB
ETAL	SW6010B	CADMIUM	84387	723SB00902	84387010	SO	0.123	B	0.123	J	mg/kg	IB
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00101	84385001	SO	5.97	N*	5.97	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00102	84385002	SO	16.3	N*	16.3	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00201	84385003	SO	8.03	N*	8.03	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00202	84385004	SO	15.5	N*	15.5	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00301	84385005	SO	14.9	N*	14.9	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00302	84385006	SO	9.48	N*	9.48	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00401	84385007	SO	10.5	N*	10.5	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00402	84385008	SO	13.6	N*	13.6	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723SB00501	84385009	SO	18.8	N*	18.8	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84385	723CB00501	84385010	SO	17.7	N*	17.7	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00502	84387001	SO	14.3	N*	14.3	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00601	84387002	SO	20.6	N*	20.6	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00602	84387003	SO	12.8	N*	12.8	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00701	84387004	SO	20.6	N*	20.6	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00702	84387005	SO	18.7	N*	18.7	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00801	84387006	SO	26.6	N*	26.6	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00802	84387007	SO	26.4	N*	26.4	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723CB00802	84387008	SO	24.7	N*	24.7	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00901	84387009	SO	26.6	N*	26.6	J	mg/kg	MS, MD
ETAL	SW6010B	CHROMIUM, TOTAL	84387	723SB00902	84387010	SO	14.8	N*	14.8	J	mg/kg	MS, MD
ETAL	SW7471A	MERCURY	84385	723SB00101	84385001	SO	0.018	B	0.018	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84385	723SB00201	84385003	SO	0.024	B	0.024	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84385	723SB00202	84385004	SO	0.02	B	0.02	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84385	723SB00301	84385005	SO	0.093	B	0.093	J	mg/kg	IB

ETAL	SW7471A	MERCURY	84385	723SB00302	84385006	SO	0.078	B	0.078	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84385	723SB00401	84385007	SO	0.031	B	0.031	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84385	723SB00402	84385008	SO	0.063	B	0.063	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00502	84387001	SO	0.069	B	0.069	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00601	84387002	SO	0.05	B	0.05	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00602	84387003	SO	0.057	B	0.057	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00701	84387004	SO	0.077	B	0.077	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00802	84387007	SO	0.045	B	0.045	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723CB00802	84387008	SO	0.045	B	0.045	J	mg/kg	IB
ETAL	SW7471A	MERCURY	84387	723SB00902	84387010	SO	0.066	B	0.066	J	mg/kg	IB
ETAL	SW6010B	SELENIUM	84385	723SB00102	84385002	SO	0.94	B	0.94	J	mg/kg	IB
ETAL	SW6010B	SELENIUM	84385	723SB00201	84385003	SO	0.534	B	0.534	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84385	723SB00301	84385005	SO	0.453	B	0.453	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84385	723SB00401	84385007	SO	0.411	B	0.411	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84385	723SB00501	84385009	SO	0.903	B	0.903	J	mg/kg	IB
ETAL	SW6010B	SELENIUM	84385	723CB00501	84385010	SO	0.469	B	0.469	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84387	723SB00602	84387003	SO	0.701	B	0.701	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84387	723SB00701	84387004	SO	0.864	B	0.864	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84387	723SB00702	84387005	SO	0.907	B	0.907	J	mg/kg	IB
ETAL	SW6010B	SELENIUM	84387	723SB00801	84387006	SO	0.706	B	0.706	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84387	723SB00901	84387009	SO	0.587	B	0.587	U	mg/kg	BL
ETAL	SW6010B	SELENIUM	84387	723SB00902	84387010	SO	0.514	B	0.514	U	mg/kg	BL
VOA	SW8270C	2,4,5-TRICHLOROPHENOL	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	2,4,6-TRICHLOROPHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2,4-DICHLOROPHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2,4-DIMETHYLPHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00101	84385001	SO	1710	U	1710	UJ	ug/kg	IC, CC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00102	84385002	SO	1830	U	1830	UJ	ug/kg	IC, CC

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Soil - Data Validation

			SDG									
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00201	84385003	SO	1760	U	1760	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00202	84385004	SO	1780	U	1780	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00301	84385005	SO	1830	U	1830	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00302	84385006	SO	1810	U	1810	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00401	84385007	SO	1730	U	1730	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00402	84385008	SO	1760	U	1760	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723SB00501	84385009	SO	1800	U	1800	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84385	723CB00501	84385010	SO	1790	U	1790	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00502	84387001	SO	1820	U	1820	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00601	84387002	SO	1830	U	1830	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00602	84387003	SO	1790	U	1790	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00701	84387004	SO	1910	U	1910	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00702	84387005	SO	1940	U	1940	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00801	84387006	SO	1930	U	1930	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00802	84387007	SO	1960	U	1960	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723CB00802	84387008	SO	1970	U	1970	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00901	84387009	SO	1880	U	1880	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	2,4-DINITROPHENOL	84387	723SB00902	84387010	SO	1910	U	1910	UJ	ug/kg	IC
VOA	SW8270C	2,4-DINITROTOLUENE	84387	723SB00901DL	84387009	SO	707	U	707	R	ug/kg	DL
VOA	SW8270C	2,6-DINITROTOLUENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2-CHLOROETHYL ETHER	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2-CHLORONAPHTHALENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2-CHLOROPHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2-METHYLNAPHTHALENE	84387	723SB00901DL	84387009	SO	175	JD	175	R	ug/kg	DL
VOA	SW8270C	2-METHYLPHENOL (o-CRESOL)	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	2-NITROANILINE	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	2-NITROPHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL

VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00101	84385001	SO	706	U	706	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00102	84385002	SO	754	U	754	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00201	84385003	SO	726	U	726	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00202	84385004	SO	733	U	733	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00301	84385005	SO	754	U	754	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00302	84385006	SO	747	U	747	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00401	84385007	SO	715	U	715	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00402	84385008	SO	725	U	725	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723SB00501	84385009	SO	744	U	744	UJ	ug/kg	IC, CC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84385	723CB00501	84385010	SO	740	U	740	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00502	84387001	SO	749	U	749	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00601	84387002	SO	756	U	756	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00602	84387003	SO	737	U	737	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00701	84387004	SO	787	U	787	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00702	84387005	SO	800	U	800	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00801	84387006	SO	796	U	796	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00802	84387007	SO	807	U	807	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723CB00802	84387008	SO	813	U	813	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00901	84387009	SO	777	U	777	UJ	ug/kg	IC
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00901DL	84387009	SO	1550	U	1550	R	ug/kg	DL
VOA	SW8270C	3,3'-DICHLOROBENZIDINE	84387	723SB00902	84387010	SO	788	U	788	UJ	ug/kg	IC
VOA	SW8270C	3-NITROANILINE	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00101	84385001	SO	1710	U	1710	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00102	84385002	SO	1830	U	1830	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00201	84385003	SO	1760	U	1760	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00202	84385004	SO	1780	U	1780	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00301	84385005	SO	1830	U	1830	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00302	84385006	SO	1810	U	1810	UJ	ug/kg	IC

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VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00401	84385007	SO	1730	U	1730	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00402	84385008	SO	1760	U	1760	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723SB00501	84385009	SO	1800	U	1800	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84385	723CB00501	84385010	SO	1790	U	1790	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00502	84387001	SO	1820	U	1820	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00601	84387002	SO	1830	U	1830	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00602	84387003	SO	1790	U	1790	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00701	84387004	SO	1910	U	1910	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00702	84387005	SO	1940	U	1940	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00801	84387006	SO	1930	U	1930	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00802	84387007	SO	1960	U	1960	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723CB00802	84387008	SO	1970	U	1970	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00901	84387009	SO	1880	U	1880	UJ	ug/kg	IC
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	84387	723SB00902	84387010	SO	1910	U	1910	UJ	ug/kg	IC
VOA	SW8270C	4-BROMOPHENYL PHENYL ETHER	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	4-CHLORO-3-METHYLPHENOL	84387	723SB00901DL	84387009	SO	707	U	707	R	ug/kg	DL
VOA	SW8270C	4-CHLOROANILINE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	4-CHLOROPHENYL PHENYL ETHER	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	4-NITROANILINE	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	4-NITROPHENOL	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	ACENAPHTHENE	84387	723SB00901DL	84387009	SO	684	JD	684	R	ug/kg	DL
VOA	SW8270C	ACENAPHTHYLENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	ANTHRACENE	84387	723SB00901DL	84387009	SO	967	D	967	R	ug/kg	DL
VOA	SW8270C	BENZO(a)ANTHRACENE	84387	723SB00901DL	84387009	SO	3230	D	3230	R	ug/kg	DL
VOA	SW8270C	BENZO(a)PYRENE	84387	723SB00901	84387009	SO	2600	=	2600	J	ug/kg	IS
VOA	SW8270C	BENZO(a)PYRENE	84387	723SB00901DL	84387009	SO	2610	D	2610	R	ug/kg	DL
VOA	SW8270C	BENZO(b)FLUORANTHENE	84387	723SB00901	84387009	SO	5450	E	5450	R	ug/kg	LR

VOA	SW8270C	BENZO(g,h,i)PERYLENE	84387	723SB00901	84387009	SO	706	=	706	J	ug/kg	IS
VOA	SW8270C	BENZO(g,h,i)PERYLENE	84387	723SB00901DL	84387009	SO	895	D	895	R	ug/kg	DL
VOA	SW8270C	BENZO(k)FLUORANTHENE	84387	723SB00901	84387009	SO	389	U	389	UJ	ug/kg	IS
VOA	SW8270C	BENZO(k)FLUORANTHENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	Benzoic acid	84385	723SB00301	84385005	SO	1830	U	1830	UJ	ug/kg	CC
VOA	SW8270C	Benzoic acid	84385	723SB00302	84385006	SO	1810	U	1810	UJ	ug/kg	CC
VOA	SW8270C	Benzoic acid	84385	723SB00402	84385008	SO	1760	U	1760	UJ	ug/kg	CC
VOA	SW8270C	Benzoic acid	84385	723SB00501	84385009	SO	1800	U	1800	UJ	ug/kg	CC
VOA	SW8270C	Benzoic acid	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	Benzyl alcohol	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	BENZYL BUTYL PHTHALATE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	bis(2-CHLOROETHOXY) METHANE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	Bis(2-Chloroisopropyl)Ether	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00101	84385001	SO	95.9	JB	354	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00102	84385002	SO	91.3	JB	377	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00201	84385003	SO	160	JB	363	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00202	84385004	SO	89.4	JB	367	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00301	84385005	SO	101	JB	377	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00302	84385006	SO	95.5	JB	374	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00401	84385007	SO	124	JB	358	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723SB00402	84385008	SO	96.6	JB	363	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84385	723CB00501	84385010	SO	143	JB	370	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00601	84387002	SO	90.1	J	379	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00602	84387003	SO	85.2	J	369	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00701	84387004	SO	99	J	394	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00702	84387005	SO	104	J	400	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723CB00802	84387008	SO	131	J	407	U	ug/kg	BL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00901	84387009	SO	186	J	389	U	ug/kg	BL

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VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00901DL	84387009	SO	271	JD	271	R	ug/kg	DL
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	84387	723SB00902	84387010	SO	109	J	394	U	ug/kg	BL
VOA	SW8270C	CARBAZOLE	84387	723SB00901	84387009	SO	515	=	515	J	ug/kg	IS
VOA	SW8270C	CARBAZOLE	84387	723SB00901DL	84387009	SO	510	JD	510	R	ug/kg	DL
VOA	SW8270C	CHRYSENE	84387	723SB00901DL	84387009	SO	2900	D	2900	R	ug/kg	DL
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00101	84385001	SO	354	U	354	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00102	84385002	SO	377	U	377	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00201	84385003	SO	363	U	363	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00202	84385004	SO	367	U	367	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00301	84385005	SO	377	U	377	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00302	84385006	SO	374	U	374	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00401	84385007	SO	358	U	358	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00402	84385008	SO	363	U	363	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723SB00501	84385009	SO	372	U	372	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84385	723CB00501	84385010	SO	370	U	370	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00502	84387001	SO	375	U	375	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00601	84387002	SO	379	U	379	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00602	84387003	SO	369	U	369	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00701	84387004	SO	394	U	394	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00702	84387005	SO	400	U	400	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00801	84387006	SO	398	U	398	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00802	84387007	SO	404	U	404	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723CB00802	84387008	SO	407	U	407	UJ	ug/kg	IC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00901	84387009	SO	389	U	389	UJ	ug/kg	IC, IS
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	84387	723SB00902	84387010	SO	394	U	394	UJ	ug/kg	IC
VOA	SW8270C	DIBENZOFURAN	84387	723SB00901DL	84387009	SO	255	JD	255	R	ug/kg	DL
VOA	SW8270C	DIETHYL PHTHALATE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL

VOA	SW8270C	DIMETHYL PHTHALATE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	DI-n-BUTYL PHTHALATE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	DI-n-OCTYLPHTHALATE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	Diphenylamine	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	FLUORANTHENE	84387	723SB00901DL	84387009	SO	4850	D	4850	R	ug/kg	DL
VOA	SW8270C	FLUORENE	84387	723SB00901DL	84387009	SO	467	JD	467	R	ug/kg	DL
VOA	SW8270C	HEXACHLOROBENZENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	HEXACHLOROBUTADIENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	HEXACHLOROCYCLOPENTADIENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	HEXACHLOROETHANE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00101	84385001	SO	354	U	354	UJ	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00102	84385002	SO	377	U	377	UJ	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00201	84385003	SO	363	U	363	UJ	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00202	84385004	SO	367	U	367	UJ	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00301	84385005	SO	412	=	412	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00302	84385006	SO	61.2	J	61.2	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00401	84385007	SO	67.1	J	67.1	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00402	84385008	SO	91.9	J	91.9	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723SB00501	84385009	SO	372	U	372	UJ	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84385	723CB00501	84385010	SO	103	J	103	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00502	84387001	SO	87.4	J♥	87.4	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00601	84387002	SO	77.6	J	77.6	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00602	84387003	SO	167	J	167	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00701	84387004	SO	254	J	254	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00702	84387005	SO	163	J	163	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00801	84387006	SO	680	=	680	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00802	84387007	SO	486	=	486	J	ug/kg	IC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723CB00802	84387008	SO	102	J	102	J	ug/kg	IC

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VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00901	84387009	SO	714	=	714	J	ug/kg	IC, IS
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00901DL	84387009	SO	906	D	906	R	ug/kg	DL
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	84387	723SB00902	84387010	SO	181	J	181	J	ug/kg	IC
VOA	SW8270C	ISOPHORONE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	m,p-Cresols	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	NAPHTHALENE	84387	723SB00901DL	84387009	SO	250	JD	250	R	ug/kg	DL
VOA	SW8270C	NITROBENZENE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	N-NITROSODI-n-PROPYLAMINE	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	PENTACHLOROPHENOL	84387	723SB00901DL	84387009	SO	3760	U	3760	R	ug/kg	DL
VOA	SW8270C	PHENANTHRENE	84387	723SB00901DL	84387009	SO	4430	D	4430	R	ug/kg	DL
VOA	SW8270C	PHENOL	84387	723SB00901DL	84387009	SO	778	U	778	R	ug/kg	DL
VOA	SW8270C	PYRENE	84385	723SB00401	84385007	SO	185	J	185	J	ug/kg	CC
VOA	SW8270C	PYRENE	84385	723CB00501	84385010	SO	157	J	157	J	ug/kg	CC
VOA	SW8270C	PYRENE	84387	723SB00901	84387009	SO	5480	E	5480	R	ug/kg	LR
OA	SW8260B	1,1,2,2-TETRACHLOROETHANE	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,1-DICHLOROETHENE	84385	723SB00202	84385004	SO	5.9	=	5.9	J	ug/kg	SS
OA	SW8260B	1,2,3-Trichlorobenzene	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,2,3-Trichlorobenzene	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
OA	SW8260B	1,2,4-TRICHLOROBENZENE	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,2,4-TRICHLOROBENZENE	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
OA	SW8260B	1,2-DICHLOROBENZENE	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,2-DICHLOROBENZENE	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
OA	SW8260B	1,3-DICHLOROBENZENE	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,3-DICHLOROBENZENE	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
OA	SW8260B	1,4-DICHLOROBENZENE	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
OA	SW8260B	1,4-DICHLOROBENZENE	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
OA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00502	84387001	SO	9.3	U	9.3	UJ	ug/kg	CC
OA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00601	84387002	SO	10	U	10	UJ	ug/kg	CC

VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00602	84387003	SO	10	U	10	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00701	84387004	SO	9.2	U	9.2	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00702	84387005	SO	9.5	U	9.5	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00801	84387006	SO	9.6	U	9.6	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00802	84387007	SO	10.5	U	10.5	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723CB00802	84387008	SO	9.8	U	9.8	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00901	84387009	SO	9.8	U	9.8	UJ	ug/kg	CC
VOA	SW8260B	2-Chloroethyl vinyl ether	84387	723SB00902	84387010	SO	9.5	U	9.5	UJ	ug/kg	CC, MS
VOA	SW8260B	ACETONE	84385	723SB00202	84385004	SO	8.7	J	8.7	J	ug/kg	SS
VOA	SW8260B	BROMOFORM	84385	723SB00401	84385007	SO	5.1	U	5.1	UJ	ug/kg	IS
VOA	SW8260B	STYRENE	84387	723SB00902	84387010	SO	4.7	U	4.7	UJ	ug/kg	MS
VOA	SW8260B	TRICHLOROETHYLENE (TCE)	84385	723SB00101	84385001	SO	29	=	29	J	ug/kg	SS
VOA	SW8260B	TRICHLOROETHYLENE (TCE)	84385	723SB00201	84385003	SO	6.9	=	6.9	J	ug/kg	SS
VOA	SW8260B	TRICHLOROETHYLENE (TCE)	84385	723SB00202	84385004	SO	15.3	=	15.3	J	ug/kg	SS
OA	SW8260B	TRICHLOROETHYLENE (TCE)	84385	723SB00302	84385006	SO	31.6	=	31.6	J	ug/kg	SS
OA	SW8260B	Vinyl acetate	84387	723SB00902	84387010	SO	9.5	U	9.5	R	ug/kg	MS

Data Validation Summary - Charleston Naval Complex - Zone E, AOC 723, Groundwater

TO: Sam Naik/CH2M HILL/ATL

FROM: Amy Juchem/CH2M HILL/GNV
Herb Kelly/CH2M HILL/GNV

DATE: January 26, 2004

The purpose of this memorandum is to present the results of the data validation process for the groundwater samples collected in Zone E, AOC 723. The samples were collected on October 16, 2003.

The specific samples and analytical fractions reviewed are summarized below in Table1.

The Quality Control areas that were reviewed 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 2002) 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 8260 Volatile Organic Compounds (VOC), SW-846 8270 Semivolatile Organic Compounds (SVOC), and Metals following SW-846 6010/7000 Series methodology.

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

[redacted] 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

Code	Definition
2S	Second Source
2C	Second Column Confirmation
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
TD	Total vs Dissolved
TN	Tune

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

100208	FIELDQC	723TW001N1	100208001	WQ	TB		10/16/03	X			
100208	FIELDQC	723EW001N1	100208002	WQ	EB		10/16/03	X	X	X	X
100208	E723GW001	723GW001N1	100208003	WG	N		10/16/03	X	X	X	X
100208	E723GW01D	723GW01DN1	100208004	WG	N		10/16/03	X	X	X	X
100208	E723GW01D	723GW01DN1RE	100208004	WG	LR	RE	10/16/03		X		
100208	E563GW004	563GW004N1	100208005	WG	N		10/16/03	X	X	X	X
100208	E563GW004	563GW004N1DL	100208005	WG	LR	DL	10/16/03	X			
100208	E563GW004	563HW004N1	100208006	WG	FD		10/16/03	X	X	X	X
100208	E563GW004	563HW004N1DL	100208006	WG	LR	DL	10/16/03	X			
100208	E563GW04D	563GW04DN1	100208007	WG	N		10/16/03	X	X	X	X
100208	E563GW04D	563GW04DN1DL	100208007	WG	LR	DL	10/16/03	X			
100208	E569GW005	569GW005N1	100208008	WG	N		10/16/03	X	X	X	X
100208	E569GW05D	569GW05DN1	100208009	WG	N		10/16/03	X	X	X	X
100208	LABQC	1200510878	1200510878	WQ	LB					X	
100208	LABQC	1200510879	1200510879	WQ	BS					X	
100208	E723GW001	723GW001N1MS	1200510880	WQ	MS		10/16/03			X	
100208	E723GW001	723GW001N1SD	1200510881	WQ	SD		10/16/03			X	
100208	LABQC	1200511460	1200511460	WQ	LB						X
100208	LABQC	1200511461	1200511461	WQ	BS						X
100208	E723GW001	723GW001N1MS	1200511462	WQ	MS		10/16/03				X
100208	E723GW001	723GW001N1SD	1200511463	WQ	SD		10/16/03				X
100208	LABQC	1200511957	1200511957	WQ	LB				X		

100208	LABQC	1200511958	1200511958	WQ	BS				X		
100208	E723GW001	723GW001N1MS	1200511959	WQ	MS		10/16/03		X		
100208	E723GW001	723GW001N1SD	1200511960	WQ	SD		10/16/03		X		
100208	LABQC	1200513662	1200513662	WQ	LB				X		
100208	LABQC	1200513663	1200513663	WQ	BS				X		
100208	LABQC	1200516325	1200516325	WQ	LB			X			
100208	LABQC	1200516326	1200516326	WQ	BS			X			
100208	E723GW001	723GW001N1MS	1200516327	WQ	MS		10/16/03	X			
100208	E723GW001	723GW001N1SD	1200516328	WQ	SD		10/16/03	X			
100208	LABQC	1200516723	1200516723	WQ	LB			X			
100208	LABQC	1200516724	1200516724	WQ	BS			X			

MATRIX CODE

WG – Groundwater
WQ – Water QC Sample

SAMPLE TYPE CODE

BS - Blank Spike
EB - Equipment Blank
TB – Trip Blank
N - Native Sample
FD – Field Duplicate
LB - Laboratory Blank
LR – Laboratory Replicate
MS – Matrix Spike
SD – Matrix Spike Duplicate

LR Type CODE

DL – Dilution
RE – Re-extract and/or re-analysis

ANALYSIS CODE

VOC – Volatile Organic Compounds
SVOC - Semivolatile Organic Compounds

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, equipment blanks, and trip 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.

Volatile Organic Compounds (VOC) Analyses

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

Blanks

The VOC target parameters detected in blank samples are listed below.

- Acetone was detected in the equipment blank, 723EW001N1, in SDG 100208 at 4.2 µg/L. Acetone was not detected in any of the field samples. Therefore, no flags were applied.

Recoveries - Surrogate, MS/MSD and LCS

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

TABLE 2
Surrogate, MS/MSD, and LCS Recoveries Out of QC Limits: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

100208	723GW001N1 MS/MSD	2-Chloroethyl vinyl ether	0* / 0*	70-130	723GW001N1	Detects-J, non-detects-R
100208	1200516326 LCS	2-Chloroethyl vinyl ether	298*	70-130	100208001, 100208002, 100208003, 100208004, 100208005, 100208006 100208007	Detects only - J
100208	1200516724 LCS	2-Chloroethyl vinyl ether	270*	70-130	100208008, 100208009, 100208005DL, 100208006DL, 100208007DL	Detects only - J

* - out of control limits

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in [redacted].

TABLE 3
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: VOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

VOA1-ICAL-09/25/03, 1751	Chloromethane	R^2 =0.983	100208 – All
	2-Chloroethyl vinyl ether	0.019 Ave RRF	
VOA1-CCAL-10/28/03, 0852	Acetone	23.4% high	100208001, 100208002, 100208003, 100208004, 100208005, 100208006 100208007
	Carbon tetrachloride	28.8% high	
	2-chloroethyl vinyl ether	198.0% high	
	O-Xylene	20.7% high	
	Styrene	22.6% high	
VOA1-CCAL-10/29/03, 0807	Acetone	21.5% high	100208008, 100208009, 100208005DL, 100208006DL, 100208007DL
	Carbon tetrachloride	23.4% high	
	2-Chloroethyl vinyl ether	171.0% high	

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was high in the continuing calibration standards, detected compounds were flagged "J", as estimated. Non-detected compounds were not flagged.
- When the Average Relative Response Factor (RRF) was low in the initial calibration, detected compounds were flagged "J", and non-detected compounds were flagged "UJ", as estimated.
- When the percent Relative Standard Deviation (%RSD) or correlation coefficient (R^2) was out in the initial calibration, all associated samples were qualified. Detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.

Semivolatile Organic Compounds (SVOC) Analyses

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

Holding Times

All holding times were met except for sample 100208004RE (723GW01DN1RE). This sample was re-extracted 1 day beyond the 7 day holding time. The sample was re-extracted due to low surrogate recovery in the original analysis. The surrogate recovery did not cause flagging in the original sample, therefore, the re-extracted analysis was not used. No flags were applied.

Blanks

The SVOC target parameters detected in blank samples are listed below.

- Naphthalene was detected in the method blank associated with sample 723GW01DN1RE in SDG 100208. The analytical results of this re-extract were not used in favor of the original sample analysis. Therefore, no flags were applied to the re-extract for blank contamination.

Recoveries - Surrogate, MS/MSD and LCS

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

- Surrogate 2-fluorophenol was recovered below criteria at 18% with limits of 21-110%, in sample 723GW01DN1. All other surrogates were within criteria. No flags were applied.

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in [redacted].

TABLE 4
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

MSD2-ICAL-09/28/03, 1817	m-Nitroaniline	R^2 =0.986	100208 – All
	p-Nitroaniline	R^2 =0.986	
MDS2-CCAL-10/21/03, 1951	Hexachlorocyclopentadiene	31.6% high	100208002, 100208003, 100208004, 100208005, 100208006, 100208008, 100208009
	Indeno(1,2,3-cd)pyrene	22.9% low	
	Dibenzo(a,h)anthracene	21.5% low	
	Benzo(g,h,I)perylene	28.1% low	
	o-Nitroaniline	21.1% high	
	Carbazole	28.2% high	
MSD2-CCAL-10/22/03, 1054	o-Nitroaniline	21.3% high	100208007
	3,3'-Dichlorobenzidine	20.1% high	
	Carbazole	26.2% high	
MSD2-CCAL-10/24/03, 1953	Benzoic acid	22.7% low	100208004RE
	Hexachlorocyclopentadiene	24.0% high	

TABLE 4
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: SVOC
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

MSD2-CCAL-10/24/03, 1953	Pyrene	23.0% high	100208004RE
	Benzo(k)fluoranthene	21.8% high	

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent Relative Standard Deviation (%RSD) or correlation coefficient (R^2) was out in the initial calibration, all associated samples were qualified. Detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.
- When the percent difference (%D) was high in the continuing calibration standards, detected compounds were flagged "J", as estimated. Non-detected compounds were not flagged.
- When the percent difference (%D) was low in the continuing calibration standards, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.

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.

Blanks

The metals target parameters detected in blank samples are listed in Table 5.

TABLE 5
Blank Contamination: Metals
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

100208	CCB		CCB	Antimony	11.3	µg/L	56.5 µg/L
100208	CCB		CCB	Arsenic	3.96	µg/L	19.8 µg/L
100208	CCB		CCB	Barium	0.702	µg/L	3.51 µg/L
100208	CCB		CCB	Beryllium	0.332	µg/L	1.66 µg/L
100208	CCB		CCB	Calcium	23.7	µg/L	118.5 µg/L
100208	CCB		CCB	Copper	5.58	µg/L	27.9 µg/L
100208	CCB		CCB	Lead	2.26	µg/L	11.3 µg/L
100208	CCB		CCB	Nickel	4.64	µg/L	23.2 µg/L
100208	CCB		CCB	Potassium	53.5	µg/L	267.5 µg/L
100208	CCB		CCB	Selenium	4.63	µg/L	23.15 µg/L
100208	CCB		CCB	Silver	2.48	µg/L	12.4 µg/L
100208	CCB		CCB	Sodium	44.4	µg/L	222 µg/L
100208	CCB		CCB	Thallium	8.6	µg/L	43 µg/L
100208	1200510878	1200510878	LB	Antimony	5.55	µg/L	27.75 µg/L
100208	1200510878	1200510878	LB	Arsenic	2.91	µg/L	14.55 µg/L
100208	1200510878	1200510878	LB	Calcium	14.9	µg/L	74.5 µg/L
100208	1200510878	1200510878	LB	Copper	3.85	µg/L	19.25 µg/L
100208	1200510878	1200510878	LB	Potassium	28.8	µg/L	144 µg/L
100208	723EW001N1	100208002	EB	Barium**	20.9	µg/L	104.5 µg/L**
100208	723EW001N1	100208002	EB	Calcium**	20600.0	µg/L	103000 µg/L**
100208	723EW001N1	100208002	EB	Copper**	3.18	µg/L	15.9 µg/L**

TABLE 5
Blank Contamination: Metals
Charleston Naval Complex, Zone E, AOC 723, Charleston, SC

100208	723EW001N1	100208002	EB	Magnesium**	2130	µg/L	10650 µg/L**
100208	723EW001N1	100208002	EB	Manganese**	2.01	µg/L	10.05 µg/L**
100208	723EW001N1	100208002	EB	Potassium**	2450.0	µg/L	12250 µg/L**
100208	723EW001N1	100208002	EB	Sodium**	10600.0	µg/L	53000 µg/L**

** Results from equipment blank 723EW001N1 (100208002) were not used to qualify data for blank contamination. Potable water was used for the equipment blank sample, therefore the results were considered to be anomalous and not consistent with analyte levels typically found in equipment blank samples.

If a target parameter was reported in a field sample, and the concentration was below the level determined to be due to blank contamination (5 times the concentration in the associated QC blank samples), it was flagged as "U", not detected. Initial and continuing calibration blanks were also evaluated for possible contamination.

The results qualified due to blank contamination are listed in Attachment 1.

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 below.

- Aluminum was recovered in the MS/MSD samples in SDG 100208 at 120.8% and 126.4%, respectively, with limits of 80-120%. All aluminum detects were qualified as estimated, 'J'. Non-detects were not flagged.

Field Duplicate Samples

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

TABLE 6
Field Duplicate RPDs Out of QC Limits: Metals
Charleston Naval Complex, , Zone E, AOC 723, Charleston, SC

100208	563GW004N1 / 563HW004N1	Aluminum	2360 ug/L	7120 ug/L	100.4*	20
		Iron	3450 ug/L	10800 ug/L	103.2*	20
* - out of control limits						

Rejected Data

The majority of rejected data were associated with re-runs and dilutions (there can only be a single valid result per parameter per sample). However, there was one result qualified as "R", rejected, due to associated QC parameters out of criteria as discussed above, such that there is not a valid result for that parameter in that sample. The rejected data is summarized in [redacted] below.

TABLE 7
Data Qualification Summary: Rejected Data
Charleston Naval Complex, Zone H, Charleston, SC

100208	723GW001N1	VOA	2-Chloroethyl vinyl ether	10	U	10	R	µg/L	MS

Conclusion

A review of the analytical data submitted regarding the investigation of Zone E, AOC 723 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 was a specific result that was rejected, in which the data cannot be used. With the exception of this result, the validation review demonstrated that the analytical systems were generally in control and the data can be used in the decision making process.

METAL	SW6010B	ALUMINUM	100208	723GW001N1	100208003	WG	1810	N	1810	J	ug/L	MS
METAL	SW6010B	ALUMINUM	100208	723GW01DN1	100208004	WG	423	N	423	J	ug/L	MS
METAL	SW6010B	ALUMINUM	100208	563GW004N1	100208005	WG	2360	N	2360	J	ug/L	MS
METAL	SW6010B	ALUMINUM	100208	563HW004N1	100208006	WG	7120	N	7120	J	ug/L	MS
METAL	SW6010B	ALUMINUM	100208	563GW04DN1	100208007	WG	393	N	393	J	ug/L	MS
METAL	SW6010B	ALUMINUM	100208	569GW005N1	100208008	WG	592	N	592	J	ug/L	MS
METAL	SW6010B	ANTIMONY	100208	723GW001N1	100208003	WG	6.65	B	6.65	J	ug/L	IB
METAL	SW6010B	ANTIMONY	100208	563GW04DN1	100208007	WG	5.23	B	5.23	U	ug/L	BL
METAL	SW6010B	ANTIMONY	100208	569GW005N1	100208008	WG	4.31	B	4.31	U	ug/L	BL
METAL	SW6010B	ARSENIC	100208	723GW001N1	100208003	WG	3.72	B	3.72	U	ug/L	BL
METAL	SW6010B	ARSENIC	100208	563GW004N1	100208005	WG	2.47	B	2.47	U	ug/L	BL
METAL	SW6010B	ARSENIC	100208	563HW004N1	100208006	WG	9.31	B	9.31	U	ug/L	BL
METAL	SW6010B	ARSENIC	100208	563GW04DN1	100208007	WG	7.89	B	7.89	U	ug/L	BL
METAL	SW6010B	BARIUM	100208	723GW001N1	100208003	WG	26.2	B	26.2	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	723GW01DN1	100208004	WG	17.1	B	17.1	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	563GW004N1	100208005	WG	14.1	B	14.1	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	563HW004N1	100208006	WG	25.1	B	25.1	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	563GW04DN1	100208007	WG	16.4	B	16.4	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	569GW005N1	100208008	WG	21.3	B	21.3	J	ug/L	IB
METAL	SW6010B	BARIUM	100208	569GW05DN1	100208009	WG	20.3	B	20.3	J	ug/L	IB
METAL	SW6010B	BERYLLIUM	100208	723GW001N1	100208003	WG	0.321	B	0.321	U	ug/L	BL
METAL	SW6010B	BERYLLIUM	100208	563HW004N1	100208006	WG	0.466	B	0.466	U	ug/L	BL
METAL	SW6010B	BERYLLIUM	100208	569GW005N1	100208008	WG	0.647	B	0.647	U	ug/L	BL
METAL	SW6010B	CHROMIUM, TOTAL	100208	723GW001N1	100208003	WG	3.25	B	3.25	J	ug/L	IB
METAL	SW6010B	CHROMIUM, TOTAL	100208	723GW01DN1	100208004	WG	3.33	B	3.33	J	ug/L	IB
METAL	SW6010B	CHROMIUM, TOTAL	100208	563GW004N1	100208005	WG	4.96	B	4.96	J	ug/L	IB
METAL	SW6010B	COBALT	100208	723GW001N1	100208003	WG	5.87	B	5.87	J	ug/L	IB
METAL	SW6010B	COBALT	100208	563GW004N1	100208005	WG	6.19	B	6.19	J	ug/L	IB

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Groundwater - Data Validation

ETAL	SW6010B	COBALT	100208	563HW004N1	100208006	WG	6.67	B	6.67	J	ug/L	IB
ETAL	SW6010B	COBALT	100208	569GW005N1	100208008	WG	9.7	B	9.7	J	ug/L	IB
ETAL	SW6010B	COPPER	100208	723GW001N1	100208003	WG	3.95	B	3.95	U	ug/L	BL
ETAL	SW6010B	COPPER	100208	723GW01DN1	100208004	WG	3.84	B	3.84	U	ug/L	BL
IETAL	SW6010B	COPPER	100208	563GW004N1	100208005	WG	6.42	B	6.42	U	ug/L	BL
ETAL	SW6010B	COPPER	100208	563HW004N1	100208006	WG	9.45	B	9.45	U	ug/L	BL
ETAL	SW6010B	COPPER	100208	563GW04DN1	100208007	WG	3.53	B	3.53	U	ug/L	BL
IETAL	SW6010B	COPPER	100208	569GW005N1	100208008	WG	7.72	B	7.72	U	ug/L	BL
IETAL	SW6010B	COPPER	100208	569GW05DN1	100208009	WG	3.74	B	3.74	U	ug/L	BL
IETAL	SW6010B	LEAD	100208	563GW004N1	100208005	WG	2.35	B	2.35	U	ug/L	BL
IETAL	SW6010B	LEAD	100208	563HW004N1	100208006	WG	7.74	=	7.74	U	ug/L	BL
IETAL	SW6010B	MAGNESIUM	100208	723GW001N1	100208003	WG	3310	B	3310	J	ug/L	IB
IETAL	SW6010B	MAGNESIUM	100208	563GW004N1	100208005	WG	3720	B	3720	J	ug/L	IB
IETAL	SW6010B	MAGNESIUM	100208	563HW004N1	100208006	WG	4370	B	4370	J	ug/L	IB
IETAL	SW6010B	MAGNESIUM	100208	569GW005N1	100208008	WG	3190	B	3190	J	ug/L	IB
IETAL	SW6010B	MANGANESE	100208	723GW01DN1	100208004	WG	4.61	B	4.61	J	ug/L	IB
IETAL	SW6010B	NICKEL	100208	723GW001N1	100208003	WG	7.39	B	7.39	U	ug/L	BL
IETAL	SW6010B	NICKEL	100208	563GW004N1	100208005	WG	3.41	B	3.41	U	ug/L	BL
IETAL	SW6010B	NICKEL	100208	563HW004N1	100208006	WG	5.01	B	5.01	U	ug/L	BL
IETAL	SW6010B	NICKEL	100208	569GW005N1	100208008	WG	9.9	B	9.9	U	ug/L	BL
IETAL	SW6010B	POTASSIUM	100208	723GW001N1	100208003	WG	2300	B	2300	J	ug/L	IB
IETAL	SW6010B	POTASSIUM	100208	563GW004N1	100208005	WG	2630	B	2630	J	ug/L	IB
IETAL	SW6010B	POTASSIUM	100208	563HW004N1	100208006	WG	2990	B	2990	J	ug/L	IB
IETAL	SW6010B	POTASSIUM	100208	563GW04DN1	100208007	WG	4880	B	4880	J	ug/L	IB
IETAL	SW6010B	POTASSIUM	100208	569GW005N1	100208008	WG	2040	B	2040	J	ug/L	IB
IETAL	SW6010B	POTASSIUM	100208	569GW05DN1	100208009	WG	2610	B	2610	J	ug/L	IB
IETAL	SW6010B	VANADIUM	100208	723GW001N1	100208003	WG	5.28	B	5.28	J	ug/L	IB
IETAL	SW6010B	VANADIUM	100208	723GW01DN1	100208004	WG	12.2	B	12.2	J	ug/L	IB

METAL	SW6010B	VANADIUM	100208	563GW004N1	100208005	WG	6.44	B	6.44	J	ug/L	IB
METAL	SW6010B	VANADIUM	100208	563HW004N1	100208006	WG	19	B	19	J	ug/L	IB
METAL	SW6010B	VANADIUM	100208	563GW04DN1	100208007	WG	3.76	B	3.76	J	ug/L	IB
METAL	SW6010B	ZINC	100208	723GW001N1	100208003	WG	11.2	B	11.2	J	ug/L	IB
METAL	SW6010B	ZINC	100208	723GW01DN1	100208004	WG	7.06	B	7.06	J	ug/L	IB
METAL	SW6010B	ZINC	100208	563GW004N1	100208005	WG	6.88	B	6.88	J	ug/L	IB
METAL	SW6010B	ZINC	100208	563HW004N1	100208006	WG	12.6	B	12.6	J	ug/L	IB
METAL	SW6010B	ZINC	100208	569GW005N1	100208008	WG	11.8	B	11.8	J	ug/L	IB
SVOA	SW8270C	2,4,5-TRICHLOROPHENOL	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	2,4,6-TRICHLOROPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2,4-DICHLOROPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2,4-DIMETHYLPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2,4-DINITROPHENOL	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	2,4-DINITROTOLUENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2,6-DINITROTOLUENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-CHLOROETHYL ETHER	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-CHLORONAPHTHALENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-CHLOROPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-METHYLNAPHTHALENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-METHYLPHENOL (o-CRESOL)	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	2-NITROANILINE	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	2-NITROPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	3,3'-DICHLOROBENZIDINE	100208	723GW01DN1RE	100208004	WG	23.5	U	23.5	R	ug/L	RE
SVOA	SW8270C	3-NITROANILINE	100208	723GW001N1	100208003	WG	62.5	U	62.5	UJ	ug/L	IC
SVOA	SW8270C	3-NITROANILINE	100208	723GW01DN1	100208004	WG	66.7	U	66.7	UJ	ug/L	IC
SVOA	SW8270C	3-NITROANILINE	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	3-NITROANILINE	100208	563GW004N1	100208005	WG	55.6	U	55.6	UJ	ug/L	IC
SVOA	SW8270C	3-NITROANILINE	100208	563HW004N1	100208006	WG	51	U	51	UJ	ug/L	IC

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Groundwater - Data Validation

SVOA	SW8270C	3-NITROANILINE	100208	563GW04DN1	100208007	WG	51	U	51	UJ	ug/L	IC
SVOA	SW8270C	3-NITROANILINE	100208	569GW005N1	100208008	WG	50	U	50	UJ	ug/L	IC
SVOA	SW8270C	3-NITROANILINE	100208	569GW05DN1	100208009	WG	50	U	50	UJ	ug/L	IC
SVOA	SW8270C	4,6-DINITRO-2-METHYLPHENOL	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	4-BROMOPHENYL PHENYL ETHER	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	4-CHLORO-3-METHYLPHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	4-CHLOROANILINE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	4-CHLOROPHENYL PHENYL ETHER	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	4-NITROANILINE	100208	723GW001N1	100208003	WG	62.5	U	62.5	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	723GW01DN1	100208004	WG	66.7	U	66.7	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	4-NITROANILINE	100208	563GW004N1	100208005	WG	55.6	U	55.6	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	563HW004N1	100208006	WG	51	U	51	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	563GW04DN1	100208007	WG	51	U	51	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	569GW005N1	100208008	WG	50	U	50	UJ	ug/L	IC
SVOA	SW8270C	4-NITROANILINE	100208	569GW05DN1	100208009	WG	50	U	50	UJ	ug/L	IC
SVOA	SW8270C	4-NITROPHENOL	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	ACENAPHTHENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	ACENAPHTHYLENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	ANTHRACENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	BENZO(a)ANTHRACENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	BENZO(a)PYRENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	BENZO(b)FLUORANTHENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	BENZO(g,h,i)PERYLENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	BENZO(g,h,i)PERYLENE	100208	569GW005N1	100208008	WG	10	U	10	UJ	ug/L	CC
SVOA	SW8270C	BENZO(k)FLUORANTHENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
SVOA	SW8270C	Benzoic acid	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
SVOA	SW8270C	Benzyl alcohol	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE

VOA	SW8270C	BENZYL BUTYL PHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	bis(2-CHLOROETHOXY) METHANE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	Bis(2-Chloroisopropyl)Ether	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	bis(2-ETHYLHEXYL) PHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	CARBAZOLE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	CHRYSENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	723GW001N1	100208003	WG	12.5	U	12.5	UJ	ug/L	CC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	723GW01DN1	100208004	WG	13.3	U	13.3	UJ	ug/L	CC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	563GW004N1	100208005	WG	11.1	U	11.1	UJ	ug/L	CC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	563HW004N1	100208006	WG	10.2	U	10.2	UJ	ug/L	CC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	569GW005N1	100208008	WG	10	U	10	UJ	ug/L	CC
VOA	SW8270C	DIBENZ(a,h)ANTHRACENE	100208	569GW05DN1	100208009	WG	10	U	10	UJ	ug/L	CC
VOA	SW8270C	DIBENZOFURAN	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	DIETHYL PHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	DIMETHYL PHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	Di-n-BUTYL PHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	DI-n-OCTYLPHTHALATE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	Diphenylamine	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	FLUORANTHENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	FLUORENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	HEXACHLOROBENZENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	HEXACHLOROBUTADIENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	HEXACHLOROCYCLOPENTADIENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	HEXACHLOROETHANE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	723GW001N1	100208003	WG	12.5	U	12.5	UJ	ug/L	CC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	723GW01DN1	100208004	WG	13.3	U	13.3	UJ	ug/L	CC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE

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Zone E, AOC 723 Groundwater - Data Validation

VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	563GW004N1	100208005	WG	11.1	U	11.1	UJ	ug/L	CC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	563HW004N1	100208006	WG	10.2	U	10.2	UJ	ug/L	CC
VOA	SW8270C	INDENO(1,2,3-c,d)PYRENE	100208	569GW05DN1	100208009	WG	10	U	10	UJ	ug/L	CC
VOA	SW8270C	ISOPHORONE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	m,p-Cresols	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	NAPHTHALENE	100208	723GW01DN1RE	100208004	WG	0.18	JB	0.18	R	ug/L	RE
VOA	SW8270C	NITROBENZENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	N-NITROSODI-n-PROPYLAMINE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	PENTACHLOROPHENOL	100208	723GW01DN1RE	100208004	WG	58.8	U	58.8	R	ug/L	RE
VOA	SW8270C	PHENANTHRENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	PHENOL	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
VOA	SW8270C	PYRENE	100208	723GW01DN1RE	100208004	WG	11.8	U	11.8	R	ug/L	RE
OA	SW8260B	1,1,1-TRICHLOROETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,1-TRICHLOROETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,1-TRICHLOROETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,1,2,2-TETRACHLOROETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,2,2-TETRACHLOROETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,2,2-TETRACHLOROETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,1,2-TRICHLOROETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,2-TRICHLOROETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1,2-TRICHLOROETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHANE	100208	569GW05DN1	100208009	WG	5	U	5	UJ	ug/L	IC
OA	SW8260B	1,1-DICHLOROETHENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,1-DICHLOROETHENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL

OA	SW8260B	1,2,3-Trichlorobenzene	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2,3-Trichlorobenzene	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2,3-Trichlorobenzene	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,2,4-TRICHLOROBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2,4-TRICHLOROBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2,4-TRICHLOROBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,2-Dichloroethene (total)	100208	563GW004N1DL	100208005	WG	31	D	31	R	ug/L	DL
OA	SW8260B	1,2-Dichloroethene (total)	100208	563HW004N1DL	100208006	WG	28.2	D	28.2	R	ug/L	DL
OA	SW8260B	1,2-Dichloroethene (total)	100208	563GW04DN1	100208007	WG	212	E	212	R	ug/L	LR
OA	SW8260B	1,2-Dichloroethene (total)	100208	563GW04DN1DL	100208007	WG	169	DJ	169	J	ug/L	DL
OA	SW8260B	1,2-DICHLOROPROPANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROPROPANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,2-DICHLOROPROPANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,3-DICHLOROBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,3-DICHLOROBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,3-DICHLOROBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	1,4-DICHLOROBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,4-DICHLOROBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	1,4-DICHLOROBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	2-BUTANONE (MEK)	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-BUTANONE (MEK)	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-BUTANONE (MEK)	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Groundwater - Data Validation

OA	SW8260B	2-Chloroethyl vinyl ether	100208	723GW001N1	100208003	WG	10	U	10	R	ug/L	MS
OA	SW8260B	2-Chloroethyl vinyl ether	100208	723GW01DN1	100208004	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563GW004N1	100208005	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563HW004N1	100208006	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563GW04DN1	100208007	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-Chloroethyl vinyl ether	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	2-Chloroethyl vinyl ether	100208	569GW005N1	100208008	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-Chloroethyl vinyl ether	100208	569GW05DN1	100208009	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	2-HEXANONE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-HEXANONE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	2-HEXANONE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	4-METHYL-2-PENTANONE (MIBK)	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	4-METHYL-2-PENTANONE (MIBK)	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	4-METHYL-2-PENTANONE (MIBK)	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	ACETONE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	ACETONE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	ACETONE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	BENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	BROMODICHLOROMETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BROMODICHLOROMETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BROMODICHLOROMETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	BROMOFORM	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BROMOFORM	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	BROMOFORM	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL

OA	SW8260B	BROMOMETHANE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	BROMOMETHANE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	BROMOMETHANE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	CARBON DISULFIDE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CARBON DISULFIDE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CARBON DISULFIDE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	CARBON TETRACHLORIDE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CARBON TETRACHLORIDE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CARBON TETRACHLORIDE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	CHLOROBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CHLOROBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CHLOROBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	CHLOROETHANE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	CHLOROETHANE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	CHLOROETHANE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	CHLOROFORM	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CHLOROFORM	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	CHLOROFORM	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	CHLOROMETHANE	100208	723GW001N1	100208003	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	723GW01DN1	100208004	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	563GW004N1	100208005	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
OA	SW8260B	CHLOROMETHANE	100208	563HW004N1	100208006	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
OA	SW8260B	CHLOROMETHANE	100208	563GW04DN1	100208007	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
OA	SW8260B	CHLOROMETHANE	100208	569GW005N1	100208008	WG	10	U	10	UJ	ug/L	IC
OA	SW8260B	CHLOROMETHANE	100208	569GW05DN1	100208009	WG	10	U	10	UJ	ug/L	IC

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 723 Groundwater - Data Validation

[illegible]	Analytical Method	[illegible]	SDG	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OA	SW8260B	cis-1,2-DICHLOROETHYLENE	100208	563GW004N1DL	100208005	WG	25.8	D	25.8	R	ug/L	DL
OA	SW8260B	cis-1,2-DICHLOROETHYLENE	100208	563HW004N1DL	100208006	WG	23.4	DJ	23.4	R	ug/L	DL
OA	SW8260B	cis-1,2-DICHLOROETHYLENE	100208	563GW04DN1	100208007	WG	200	E	200	R	ug/L	LR
OA	SW8260B	cis-1,2-DICHLOROETHYLENE	100208	563GW04DN1DL	100208007	WG	169	DJ	169	J	ug/L	DL
OA	SW8260B	cis-1,3-DICHLOROPROPENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	cis-1,3-DICHLOROPROPENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	cis-1,3-DICHLOROPROPENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	DIBROMOCHLOROMETHANE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	DIBROMOCHLOROMETHANE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	DIBROMOCHLOROMETHANE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	ETHYLBENZENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	ETHYLBENZENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	ETHYLBENZENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	m+p Xylene	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	m+p Xylene	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	m+p Xylene	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	METHYLENE CHLORIDE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	METHYLENE CHLORIDE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	METHYLENE CHLORIDE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	o-Xylene	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	o-Xylene	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	o-Xylene	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	STYRENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	STYRENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	STYRENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
OA	SW8260B	TETRACHLOROETHYLENE(PCE)	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
OA	SW8260B	TETRACHLOROETHYLENE(PCE)	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
OA	SW8260B	TETRACHLOROETHYLENE(PCE)	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL

/OA	SW8260B	TOLUENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	TOLUENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	TOLUENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
/OA	SW8260B	trans-1,2-DICHLOROETHENE	100208	563GW004N1DL	100208005	WG	5.2	DJ	5.2	R	ug/L	DL
/OA	SW8260B	trans-1,2-DICHLOROETHENE	100208	563HW004N1DL	100208006	WG	4.8	DJ	4.8	R	ug/L	DL
/OA	SW8260B	trans-1,2-DICHLOROETHENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
/OA	SW8260B	trans-1,3-DICHLOROPROPENE	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	trans-1,3-DICHLOROPROPENE	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	trans-1,3-DICHLOROPROPENE	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL
/OA	SW8260B	TRICHLOROETHYLENE (TCE)	100208	563GW004N1	100208005	WG	293	E	293	R	ug/L	LR
/OA	SW8260B	TRICHLOROETHYLENE (TCE)	100208	563HW004N1	100208006	WG	250	E	250	R	ug/L	LR
/OA	SW8260B	TRICHLOROETHYLENE (TCE)	100208	563GW04DN1	100208007	WG	2810	E	2810	R	ug/L	LR
/OA	SW8260B	Vinyl acetate	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
/OA	SW8260B	Vinyl acetate	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
/OA	SW8260B	Vinyl acetate	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
/OA	SW8260B	VINYL CHLORIDE	100208	563GW004N1DL	100208005	WG	50	U	50	R	ug/L	DL
/OA	SW8260B	VINYL CHLORIDE	100208	563HW004N1DL	100208006	WG	50	U	50	R	ug/L	DL
/OA	SW8260B	VINYL CHLORIDE	100208	563GW04DN1DL	100208007	WG	500	U	500	R	ug/L	DL
/OA	SW8260B	XYLENES, TOTAL	100208	563GW004N1DL	100208005	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	XYLENES, TOTAL	100208	563HW004N1DL	100208006	WG	25	U	25	R	ug/L	DL
/OA	SW8260B	XYLENES, TOTAL	100208	563GW04DN1DL	100208007	WG	250	U	250	R	ug/L	DL

Appendix D

Surface Soil - Hypothetical Future Residential Child Scenario
Charleston Navy Complex - Zone E, AOC 723

Ingestion:

$$CDI = \frac{Cs * IRing * FI * EF * ED * CF}{BW * AT}$$

		Noncarcinogenic	
Cs =	Concentration in soil (mg/kg)	RME	
IRing =	Ingestion Rate (mg/event)	200	a
FI =	Fraction Ingested (unitless)	100%	
EF =	Exposure Frequency (events/year)	350	a
ED =	Exposure Duration (year)	6	a
CF =	Conversion Factor (kg/mg)	1.00E-06	
BW =	Body Weight (kg)	15	a
AT =	Averaging Time (days)	2190	a

Dermal:

$$CDI = \frac{Cs * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	
SA =	Surface Area (cm^2/event)	2394	b
AF =	Soil-Skin Adherence Factor (mg/cm^2)	1	c
ABS =	Absorption Factor (unitless)	(Chemical Specific)	d
EF =	Exposure Frequency (events/year)	350	a
ED =	Exposure Duration (year)	6	a
CF =	Conversion Factor (kg/mg)	1.00E-06	
BW =	Body Weight (kg)	15	a
AT =	Averaging Time (days)	2190	a

Dust Inhalation:

$$CDI = \frac{Cs * ((1/VF)+(1/PEF)) * IRinh * EF * ED}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	
PEF =	Particulate Emission Factor (m^3/kg)	1.32E+09	e
VF =	Volatilization Factor (m^3/kg)	(Chemical Specific)	f
IRinh =	Inhalation Rate (m^3/event)	15	a
EF =	Exposure Frequency (events/year)	350	a
ED =	Exposure Duration (year)	6	a
BW =	Body Weight (kg)	15	a
AT =	Averaging Time (days)	2190	a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Def Factors," OSWER Directive 9285.6-03, March 25, 1991.

c = Surface area of hands, 1/2 arms, 1/2 legs and feet of a child (age 1-6 years), adaptec Soil Cleanup Target Levels for FDEP, September 2, 1997.

d = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

e = Chemical-specific absorption factors are found in Appendix C.

f = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: T Background Document, May 1996.

g = Chemical-specific volatilization factors are found in Appendix C.

Surface Soil - Hypothetical Future Residential Child Non-carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDI**	**RME**	**ABS**	**VFres**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
	Metals and Pesticides												
MG/KG	ARSENIC	A	3.00E-04		7.67E+01	0.001		9.81E-04	3.3	1.17E-05	0.04	5.57E-08	
	Semivolatiles												
MG/KG	BEQs	B2			3.68E+00	0.1	2.96E+07	4.71E-05		5.63E-05		2.67E-09	
	Hazard Index								3.3		0.0		
											Total HI=		**3.3**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Surface Soil - Hypothetical Future Residential Adult Scenario
Charleston Navy Complex - Zone E, AOC 723

Ingestion:

Intake for non-carcinogenic compounds:

$$CDI = \frac{Cs * IR * FI * EF * ED * CF}{BW * AT}$$

Age-specific intake (for carcinogenic compounds only):

$$CDI_{adj} = \frac{Cs * FI * EF * CF * IR_{adj}}{AT}$$

		Carcinogenic	Noncarcinogenic
Cs =	Concentration in soil (mg/kg)	RME	RME
IR_{adj} =	Age-Specific Factor (ingestion) (mg - year)/(kg - day)	114.29 g	na
IRing =	Ingestion Rate (mg/event)	na	100 a
FI =	Fraction Ingested (unitless)	100%	100%
EF =	Exposure Frequency (events/year)	350 a	350 a
ED =	Exposure Duration (year)	na	30 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	na	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Dermal:

$$CDI = \frac{Cs * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
SA =	Surface Area (cm^2/event)	5419 b	5419 b
AF =	Soil-Skin Adherence Factor (mg/cm^2)	1 c	1 c
ABS =	Absorption Factor (unitless)	(Chemical Specific) d	(Chemical Specific) d
EF =	Exposure Frequency (events/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Dust Inhalation:

$$CDI = \frac{* ((1/VF)+(1/PEF)) * IRinh * EF * ED}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
PEF =	Particulate Emission Factor (m^3/kg)	1.32E+09 e	1.32E+09 e
VF =	Volatilization Factor (m^3/kg)	(Chemical Specific) f	(Chemical Specific) f
IRinh =	Inhalation Rate (m^3/event)	20 a	20 a
EF =	Exposure Frequency (events/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors," OSWER Directive 9285.6-03, March 25, 1991.

b = Surface area of hands, 1/2 arms, 1/2 legs and feet of an adult, adapted from CEHT, Technical Report: Soil Cleanup Target Levels for FDEP, September 2, 1997.

c = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

d = Chemical-specific absorption factors are found in Appendix C.

e = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: Technical Background Document, May 1996.

f = Chemical-specific volatilization factors are found in Appendix C.

g = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IRadj = \frac{IRc \times EDc}{BWc} + \frac{IRa \times (EDa - EDc)}{BWa} = \frac{200 \times 6}{15} + \frac{100 \times (30-6)}{70}$$

=)ata'!F23 (mg-year)/(kg-day)

Surface Soil - Hypothetical Future Residential Adult Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFI**	**RME**	**ABS**	**VFres**	**CDI_{adj}**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
	Metals												
MG/KG	ARSENIC	A	1.50E+00	4.00E-03	7.67E+01	0.001		1.20E-04	2E-04	2.44E-06	4E-06	6.82E-09	3E-11
	Semivolatiles												
MG/KG	BEQs	B2	7.30E+00	3.10E+00	3.68E+00	0.1	2.96E+07	5.76E-06	4E-05	1.17E-05	9E-05	3.27E-10	1E-09
	Total Risk								2.2E-04		9E-05		1E-09
											Total Risk =		**3.1E-04**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration;
ELCR = Excess Lifetime Cancer Exposure 8.1E+01

Surface Soil - Hypothetical Future Residential Adult Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	Chemical	WOE	RfDo	RfDi	RME	ABS	VFres	CDI	HQ	CDI	HQ	CDI	HQ
	Metals												
MG/KG	ARSENIC	A	3.00E-04		7.67E+01	0.001		1.05E-04	0.4	5.69E-06	0.019	1.59E-08	
	Semivolatiles												
MG/KG	BEQs	B2			3.68E+00	0.1	2.96E+07	5.04E-06		2.73E-05		7.64E-10	
	Hazard Index								0.4		0.0		
											Total HI=	**0.4**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Surface Soil - Hypothetical Future Industrial Worker Scenario
Charleston Navy Complex - Zone E, AOC 723

Ingestion:

$$CDI = \frac{Cs * IRing * FI * EF * ED * CF}{BW * AT}$$

		Carcinogenic	Noncarcinogenic
Cs =	Concentration in soil (mg/kg)	RME	RME
IRing =	Ingestion Rate (mg/event)	50 a	50 a
FI =	Fraction Ingested (unitless)	100%	100%
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

Dermal:

$$CDI = \frac{Cs * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
SA =	Surface Area (cm^2/event)	2458 b	2458 b
AF =	Soil-Skin Adherence Factor (mg/cm^2)	1 c	1 c
ABS =	Absorption Factor (unitless)	(Chemical Specific) d	(Chemical Specific) d
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

Dust Inhalation:

$$CDI = \frac{Cs * ((1/VF)+(1/PEF)) * IRinh * EF * ED}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
PEF =	Particulate Emission Factor (m^3/kg)	1.32E+09 e	1.32E+09 e
VF =	Volatilization Factor (m^3/kg)	(Chemical Specific) f	(Chemical Specific) f
IRinh =	Inhalation Rate (m^3/event)	20 a	20 a
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors," OSWER Directive 9285.6-03, March 25, 1991.

b = Surface area of hands, 1/2 arms and 1/2 head (face) of an adult worker, adapted from CEHT, Technical Report: Soil Cleanup Target Levels for FDEP, September 2, 1997.

c = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

d = Chemical-specific absorption factors are found in Appendix C.

e = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: Technical Background Document, May 1996.

f = Chemical-specific volatilization factors are found in Appendix C.

Surface Soil - Hypothetical Future Industrial Worker Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFi**	**RME**	**ABS**	**VFres**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
	Metals												
MG/KG	ARSENIC	A	1.50E+00	4.00E-03	7.67E+01	0.001		1.34E-05	2E-05	6.59E-07	1E-06	4.06E-09	2E-11
	Semivolatiles												
MG/KG	BEQs	B2	7.30E+00	3.10E+00	3.68E+00	0.1	2.96E+07	6.43E-07	5E-06	3.16E-06	2E-05	1.95E-10	6E-10
	Total Risk								2E-05		2E-05		6E-10
											Total Risk =		**5E-05**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; ELCR = Excess Lifetime Cancer Exposure

Surface Soil - Hypothetical Future Industrial Worker Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDI**	**RME**	**ABS**	**VFres**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
	Metals												
MG/KG	ARSENIC	A	3.00E-04		7.67E+01	0.001		3.75E-05	0.13	1.84E-06	0.006	1.14E-08	
	Semivolatiles												
MG/KG	BEQs	B2			3.68E+00	0.1	2.96E+07	1.80E-06		8.85E-06		5.46E-10	
	Hazard Index								0.13		0.01		
											Total HI=	**0.1**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Subsurface Soil - Hypothetical Future Industrial Worker Scenario
Charleston Navy Complex - Zone E, AOC 723

Ingestion:

$$CDI = \frac{Cs * IRing * FI * EF * ED * CF}{BW * AT}$$

		Carcinogenic	Noncarcinogenic
Cs =	Concentration in soil (mg/kg)	RME	RME
IRing =	Ingestion Rate (mg/event)	50 a	50 a
FI =	Fraction Ingested (unitless)	100%	100%
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

Dermal:

$$CDI = \frac{Cs * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
SA =	Surface Area (cm^2/event)	2458 b	2458 b
AF =	Soil-Skin Adherence Factor (mg/cm^2)	1 c	1 c
ABS =	Absorption Factor (unitless)	(Chemical Specific) d	(Chemical Specific) d
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

Dust Inhalation:

$$CDI = \frac{Cs * ((1/VF)+(1/PEF)) * IRinh * EF * ED}{BW * AT}$$

Cs =	Concentration in soil (mg/kg)	RME	RME
PEF =	Particulate Emission Factor (m^3/kg)	1.32E+09 e	1.32E+09 e
VF =	Volatilization Factor (m^3/kg)	(Chemical Specific) f	(Chemical Specific) f
IRinh =	Inhalation Rate (m^3/event)	20 a	20 a
EF =	Exposure Frequency (events/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors," OSWER Directive 9285.6-03, March 25, 1991.

b = Surface area of hands, 1/2 arms and 1/2 head (face) of an adult worker, adapted from CEHT, Technical Report: Soil Cleanup Target Levels for FDEP, September 2, 1997.

c = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

d = Chemical-specific absorption factors are found in Appendix C.

e = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: Technical Background Document, May 1996.

f = Chemical-specific volatilization factors are found in Appendix C.

Subsurface Soil - Hypothetical Future Industrial Worker Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

								Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFI**	**RME**	**ABS**	**VFres**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
	Semivolatiles												
MG/KG	BEQs	B2	7.30E+00	3.10E+00	1.22E+00	0.1	2.96E+07	2.13E-07	2E-06	1.05E-06	8E-06	6.46E-11	2E-10
	Total Risk								2E-06		8E-06		2E-10
											Total Risk =		**9E-06**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; ELCR = Excess Lifetime Cancer Exposure

Subsurface Soil - Hypothetical Future Industrial Worker Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

Units	Chemical	WOE	RfDo	RfDI	RME	ABS	VFres	Ingestion CDI	Ingestion HQ	Dermal CDI	Dermal HQ	Inhalation CDI	Inhalation HQ
	Semivolatiles												
MG/KG	BEQs	B2			1.22E+00	0.1	2.96E+07	5.97E-07		2.93E-06		1.81E-10	
	Hazard Index												
											Total HI=		

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Shallow Groundwater - Hypothetical Future Residential Child Scenario
Charleston Navy Complex - Zone E, AOC 723

		Carcinogenic	Noncarcinogenic
Ingestion:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	1 a	1 a
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	6 a	6 a
BW =	Body Weight (kg)	15 a	15 a
AT =	Averaging Time (days)	25550 a	2190 a
Dermal:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	6557 b, c	6557 b, c
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	6 a	6 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	15 a	15 a
AT =	Averaging Time (days)	25550 a	2190 a
Inhalation:			
CDI =	**Ingestion CDI from above** [f]		

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.
b = US EPA Exposure Factors Handbook, August 1997.
Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance, May 1998.
c = Total Body Surface Area represents whole body (average of male & female children (1-6 years old)).
d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.
e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.
f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Shallow Groundwater - Hypothetical Future Residential Child Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 725

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	ANTIMONY	NA	4.00E-04	1.40E-05		6.65E-03	3.50E-02	1.00E-03	4.25E-04	1.1E+00	1.95E-08	1.4E-03	
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		8.50E-04	1.40E-01	1.20E-02	5.43E-05	6.0E-03	2.99E-08	2.4E-05	
MG/L	CIS-1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.17E-02	9.00E-02	7.70E-03	7.48E-04	7.5E-02	2.64E-07	2.9E-04	
MG/L	BENZENE		3.00E-03	4.50E-04	1.70E-03	4.10E-04	1.50E-01	1.50E-02	2.62E-05	8.7E-03	1.80E-08	4.0E-05	1.5E-02
MG/L	TRICHLORETHYLENE (TCE)	B2	3.00E-04	5.10E-05	1.00E-02	2.58E-01	1.70E-01	1.20E-02	1.65E-02	5.5E+01	9.08E-06	1.8E-01	1.6E+00
	Hazard Index									**5.6E+01**		**1.8E-01**	**1.7E+00**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Total Hazard Index = 5.8E+01

Shallow Groundwater - Hypothetical Future Residential Adult Scenario

Charleston Navy Complex - Zone E, AOC 723

Ingestion:

Intake for non-carcinogenic compounds:

$$CDI = \frac{C_{gw} * IR * EF * ED}{BW * AT}$$

Age-specific intake (for carcinogenic compounds only):

$$CDI_{adj} = \frac{C_{gw} * EF * CF * IR_{adj}}{AT}$$

		Carcinogenic	Noncarcinogenic
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	N/A	2 a
IR_{adj} =	Age-adjusted Ingestion Rate (L-year/kg-day)	1.1 b	N/A
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Dermal:

Intake for non-carcinogenic compounds:

$$CDI = \frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$$

Age-specific intake (for carcinogenic compounds only):

$$CDI_{adj} = \frac{C_{gw} * SA_{adj} * PC * ET * EF * CF}{AT}$$

		Carcinogenic	Noncarcinogenic
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	N/A	20000 b,c
SA_{adj} =	Age-adjusted Surface Area (cm^2-yr/kg)	9480 b,c	N/A
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Inhalation:

CDI = **Ingestion CDI from above** [f]

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IRadj = \frac{IRc \times EDc}{BWc} + \frac{IRa \times (EDa - EDc)}{BWa} = \frac{1 \times 6}{15} + \frac{2 \times (30-6)}{70}$$

1.09 (L-year)/(kg-day)

b = USEPA Exposure Factors Handbook, August 1997

c = Total Body Surface Area represents whole body (average of male & female adults).

f = Age-adjusted surface area for adults, adjusted for body weight and time for carcinogenic exposure.

$$SAadj = \frac{SAc \times EDc}{BWc} + \frac{SAa \times (EDa - EDc)}{BWa} = \frac{6557 \times 6}{15} + \frac{20000 \times (30-6)}{70}$$

9480 (cm^2-year)/(kg)

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Shallow Groundwater - Hypothetical Future Residential Adult Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**ELCR**
MG/L	ANTIMONY	NA				6.65E-03	3.50E-02	1.00E-03	9.89E-05		6.05E-09		
MG/L	1,1-DICHLOROETHENE	C	6.00E-01	4.29E+00	1.75E-01	8.50E-04	1.40E-01	1.20E-02	1.26E-05	7.6E-06	9.27E-09	4.0E-08	2.2E-06
MG/L	CIS-1,2-DICHLOROETHYLENE	NA				1.17E-02	9.00E-02	7.70E-03	1.74E-04		8.19E-08		
MG/L	BENZENE		5.50E-02	3.67E-01	2.90E-02	4.10E-04	1.50E-01	1.50E-02	6.10E-06	3.4E-07	5.59E-09	2.0E-09	1.8E-07
MG/L	TRICHLORETHYLENE (TCE)	B2	4.00E-01	2.35E+00	4.00E-01	2.58E-01	1.70E-01	1.20E-02	3.84E-03	1.5E-03	2.81E-06	6.6E-06	1.5E-03
	Total Risk									**1.5E-03**		**6.7E-06**	**1.5E-03**
Notes:										**Total Risk =**		**3.1E-03**	

a - One-hit equation for high carcinogenic risk levels (1E-02) used Risk = 1 - e $^{(-CDI*SF)}$ (USEPA, 1989). 9.9E+01

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;
ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Shallow Groundwater - Hypothetical Future Residential Adult Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

										Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	ANTIMONY	NA	4.00E-04	1.40E-05		6.65E-03	3.50E-02	1.00E-03	1.82E-04	4.6E-01	1.28E-08	9.1E-04	
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		8.50E-04	1.40E-01	1.20E-02	2.33E-05	2.6E-03	1.96E-08	1.6E-05	
MG/L	CIS-1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.17E-02	9.00E-02	7.70E-03	3.21E-04	3.2E-02	1.73E-07	1.9E-04	
MG/L	BENZENE		3.00E-03	4.50E-04	1.70E-03	4.10E-04	1.50E-01	1.50E-02	1.12E-05	3.7E-03	1.18E-08	2.6E-05	6.6E-03
MG/L	TRICHLORETHYLENE (TCE)	B2	3.00E-04	5.10E-05	1.00E-02	2.58E-01	1.70E-01	1.20E-02	7.07E-03	2.4E+01	5.94E-06	1.2E-01	7.1E-01
	Hazard Index									**2.4E+01**		**1.2E-01**	**7.1E-01**
Notes:	WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;									**Total Hazard Index =**		**2.5E+01**	
	HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake												

Shallow Groundwater - Hypothetical Future Industrial Worker Scenario
Charleston Navy Complex - Zone E, AOC 723

		Carcinogenic	Noncarcinogenic
Ingestion:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	1 a	1 a
EF =	Exposure Frequency (day/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a
Dermal:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	2679 b,c	2679 b,c
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a
Inhalation:			
CDI =	**Ingestion CDI from above** [g]		

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Default factors adapted from EPA Exposure Factors Handbook, August 1997.

c = Surface area represents 1/2 head, 1/2 arms, and the hands of an adult worker.

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

g = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Shallow Groundwater - Hypothetical Future Industrial Worker Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**ELCR**
MG/L	ANTIMONY	NA				6.65E-03	3.50E-02	1.00E-03	2.32E-05		4.36E-10		
MG/L	1,1-DICHLOROETHENE	C	6.00E-01	4.29E+00	1.75E-01	8.50E-04	1.40E-01	1.20E-02	2.97E-06	1.8E-06	6.68E-10	2.9E-09	5.2E-07
MG/L	CIS-1,2-DICHLOROETHYLENE	NA				1.17E-02	9.00E-02	7.70E-03	4.09E-05		5.90E-09		
MG/L	BENZENE		5.50E-02	3.67E-01	2.90E-02	4.10E-04	1.50E-01	1.50E-02	1.43E-06	7.9E-08	4.03E-10	1.5E-10	4.2E-08
MG/L	TRICHLORETHYLENE (TCE)	B2	4.00E-01	2.35E+00	4.00E-01	2.58E-01	1.70E-01	1.20E-02	9.02E-04	3.6E-04	2.03E-07	4.8E-07	3.6E-04
	Total Risk									**3.6E-04**		**4.8E-07**	**3.6E-04**
Notes:											**Total Risk =**	**7E-04**	

a - One-hit equation for high carcinogenic risk levels (1E-02) used Risk = 1 - e $^{(-CDI*SF)}$ (USEPA, 1989).
WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; 9.9E+01
ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Shallow Groundwater - Hypothetical Future Industrial Worker Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

										Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	ANTIMONY	NA	4.00E-04	1.40E-05		6.65E-03	3.50E-02	1.00E-03	6.51E-05	1.6E-01	1.22E-09	8.7E-05	
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		8.50E-04	1.40E-01	1.20E-02	8.32E-06	9.2E-04	1.87E-09	1.5E-06	
MG/L	CIS-1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.17E-02	9.00E-02	7.70E-03	1.14E-04	1.1E-02	1.65E-08	1.8E-05	
MG/L	BENZENE		3.00E-03	4.50E-04	1.70E-03	4.10E-04	1.50E-01	1.50E-02	4.01E-06	1.3E-03	1.13E-09	2.5E-06	2.4E-03
MG/L	TRICHLORETHYLENE (TCE)	B2	3.00E-04	5.10E-05	1.00E-02	2.58E-01	1.70E-01	1.20E-02	2.52E-03	8.4E+00	5.68E-07	1.1E-02	2.5E-01
	Hazard Index									**8.6E+00**		**1.1E-02**	**2.5E-01**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Total Hazard Index = 9E+00

Deep Groundwater - Hypothetical Future Residential Child Scenario
Charleston Navy Complex - Zone E, AOC 723

		Carcinogenic	Noncarcinogenic
Ingestion:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	1 a	1 a
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	6 a	6 a
BW =	Body Weight (kg)	15 a	15 a
AT =	Averaging Time (days)	25550 a	2190 a
Dermal:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	6557 b, c	6557 b, c
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	6 a	6 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	15 a	15 a
AT =	Averaging Time (days)	25550 a	2190 a
Inhalation:			
CDI =	**Ingestion CDI from above** [f]		

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.
b = US EPA Exposure Factors Handbook, August 1997.
Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance, May 1998.
c = Total Body Surface Area represents whole body (average of male & female children (1-6 years old)).
d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.
e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.
f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Deep Groundwater - Hypothetical Future Residential Child Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		1.90E-03	1.40E-01	1.20E-02	1.21E-04	1.3E-02	6.69E-08	5.3E-05	
MG/L	CIS 1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.02E-01	9.00E-02	7.70E-03	6.52E-03	6.5E-01	2.30E-06	2.6E-03	
MG/L	CHLOROFORM	B2	1.00E-02	9.00E-04	1.40E-02	5.30E-03	9.00E-02	6.80E-03	3.39E-04	3.4E-02	1.06E-07	1.2E-04	2.4E-02
MG/L	TRICHLOROETHENE (TCE)	B2	3.00E-04	4.50E-05	1.00E-02	1.18E+00	1.50E-01	1.60E-02	7.57E-02	2.52E+02	5.56E-05	1.2E+00	7.6E+00
MG/L	VINYL CHLORIDE	A	3.00E-03	1.50E-04	2.90E-02	1.77E-02	5.00E-02	5.60E-03	1.13E-03	3.8E-01	2.91E-07	1.9E-03	3.9E-02
	Hazard Index									**2.5E+02**		**1.2E+00**	**7.6E+00**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Total Hazard Index = 2.62E+02

Deep Groundwater - Hypothetical Future Residential Adult Scenario

Charleston Navy Complex - Zone E, AOC 723

Ingestion:

Intake for non-carcinogenic compounds:

$$CDI = \frac{C_{gw} * IR * EF * ED}{BW * AT}$$

Age-specific intake (for carcinogenic compounds only):

$$CDI_{adj} = \frac{C_{gw} * EF * CF * IR_{adj}}{AT}$$

		Carcinogenic	Noncarcinogenic
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	N/A	2 a
IR_{adj} =	Age-adjusted Ingestion Rate (L-year/kg-day)	1.1 b	N/A
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Dermal:

Intake for non-carcinogenic compounds:

$$CDI = \frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$$

Age-specific intake (for carcinogenic compounds only):

$$CDI_{adj} = \frac{C_{gw} * SA_{adj} * PC * ET * EF * CF}{AT}$$

		Carcinogenic	Noncarcinogenic
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	N/A	20000 b,c
SA_{adj} =	Age-adjusted Surface Area (cm^2-yr/kg)	9480 b,c	N/A
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Inhalation:

CDI = **Ingestion CDI from above** [f]

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IRadj = \frac{IRc \times EDc}{BWc} + \frac{IRa \times (EDa - EDc)}{BWa} = \frac{1 \times 6}{15} + \frac{2 \times (30-6)}{70}$$

1.09 (L-year)/(kg-day)

b = USEPA Exposure Factors Handbook, August 1997

c = Total Body Surface Area represents whole body (average of male & female adults).

f = Age-adjusted surface area for adults, adjusted for body weight and time for carcinogenic exposure.

$$SAadj = \frac{SAc \times EDc}{BWc} + \frac{SAa \times (EDa - EDc)}{BWa} = \frac{6557 \times 6}{15} + \frac{20000 \times (30-6)}{70}$$

9480 (cm^2-year)/(kg)

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Deep Groundwater - Hypothetical Future Residential Adult Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFi**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**ELCR**
MG/L	1,1-DICHLOROETHENE	C	6.00E-01	4.29E+00	1.75E-01	1.90E-03	1.40E-01	1.20E-02	2.83E-05	1.7E-05	2.07E-08	8.9E-08	4.9E-06
MG/L	CIS 1,2-DICHLOROETHYLENE	NA				1.02E-01	9.00E-02	7.70E-03	1.52E-03		7.14E-07		
MG/L	CHLOROFORM	B2				5.30E-03	9.00E-02	6.80E-03	7.88E-05		3.28E-08		
MG/L	TRICHLOROETHENE (TCE)	B2	4.00E-01	2.67E+00	4.00E-01	1.18E+00	1.50E-01	1.60E-02	1.76E-02	7.0E-03	1.72E-05	4.6E-05	7.0E-03
MG/L	VINYL CHLORIDE	A	2.10E-05	4.20E-04	1.50E-02	1.77E-02	5.00E-02	5.60E-03	2.63E-04	5.5E-09	9.01E-08	3.8E-11	3.9E-06
	Total Risk									**7.1E-03**		**4.6E-05**	**7.1E-03**
												Total Risk =	**1.4E-02**

Notes:

a - One-hit equation for high carcinogenic risk levels (1E-02) used Risk = 1 - e $^{(-CDI*SF)}$ (USEPA, 1989).
WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;
ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Deep Groundwater - Hypothetical Future Residential Adult Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	Chemical	WOE	RfDo	RfDd	RfDi	RME	DE	PC	CDI	HQ	CDI	HQ	HQ
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		1.90E-03	1.40E-01	1.20E-02	5.21E-05	5.8E-03	4.37E-08	3.5E-05	
MG/L	CIS 1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.02E-01	9.00E-02	7.70E-03	2.79E-03	2.8E-01	1.51E-06	1.7E-03	
MG/L	CHLOROFORM	B2	1.00E-02	9.00E-04	1.40E-02	5.30E-03	9.00E-02	6.80E-03	1.45E-04	1.5E-02	6.91E-08	7.7E-05	1.0E-02
MG/L	TRICHLOROETHENE (TCE)	B2	3.00E-04	4.50E-05	1.00E-02	1.18E+00	1.50E-01	1.60E-02	3.24E-02	1.1E+02	3.63E-05	8.1E-01	3.2E+00
MG/L	VINYL CHLORIDE	A	3.00E-03	1.50E-04	2.90E-02	1.77E-02	5.00E-02	5.60E-03	4.85E-04	1.6E-01	1.90E-07	1.3E-03	1.7E-02
	Hazard Index									**1.1E+02**		**8.1E-01**	**3.3E+00**

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Total Hazard Index = 1.13E+02

Deep Groundwater - Hypothetical Future Industrial Worker Scenario
Charleston Navy Complex - Zone E, AOC 723

		Carcinogenic	Noncarcinogenic
Ingestion:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	1 a	1 a
EF =	Exposure Frequency (day/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a
Dermal:			
Intake for non-carcinogenic and carcinogenic compounds:			
CDI =	$\frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$		
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
SA =	Surface Area (cm^2)	2679 b,c	2679 b,c
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e	0.007 b,e
EF =	Exposure Frequency (day/year)	250 a	250 a
ED =	Exposure Duration (year)	25 a	25 a
CF =	Conversion Factor (L/cm^3)	1.00E-03	1.00E-03
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	9125 a
Inhalation:			
CDI =	**Ingestion CDI from above** [g]		

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Default factors adapted from EPA Exposure Factors Handbook, August 1997.

c = Surface area represents 1/2 head, 1/2 arms, and the hands of an adult worker.

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

g = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Deep Groundwater - Hypothetical Future Industrial Worker Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFi**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**ELCR**
MG/L	1,1-DICHLOROETHENE	C	6.00E-01	4.29E+00	1.75E-01	1.90E-03	1.40E-01	1.20E-02	6.64E-06	4.0E-06	1.49E-09	6.4E-09	1.2E-06
MG/L	CIS 1,2-DICHLOROETHYLENE	NA				1.02E-01	9.00E-02	7.70E-03	3.56E-04		5.15E-08		
MG/L	CHLOROFORM	B2				5.30E-03	9.00E-02	6.80E-03	1.85E-05		2.36E-09		
MG/L	TRICHLOROETHENE (TCE)	B2	4.00E-01	2.67E+00	4.00E-01	1.18E+00	1.50E-01	1.60E-02	4.14E-03	1.7E-03	1.24E-06	3.3E-06	1.7E-03
MG/L	VINYL CHLORIDE	A	2.10E-05	4.20E-04	1.50E-02	1.77E-02	5.00E-02	5.60E-03	6.19E-05	1.3E-09	6.50E-09	2.7E-12	9.3E-07
	Total Risk									**1.7E-03**		**3.3E-06**	**1.7E-03**
Notes:											**Total Risk =**	**3E-03**	

a - One-hit equation for high carcinogenic risk levels (1E-02) used Risk = 1 - e $^{(-CDI*SF)}$ (USEPA, 1989).

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure; 9.98E+01

ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Deep Groundwater - Hypothetical Future Industrial Worker Non-Carcinogenic Scenario

Charleston Navy Complex - Zone E, AOC 723

									Ingestion		Dermal		Inhalation*
Units	Chemical	WOE	RfDo	RfDd	RfDi	RME	DE	PC	CDI	HQ	CDI	HQ	HQ
MG/L	1,1-DICHLOROETHENE	C	9.00E-03	1.26E-03		1.90E-03	1.40E-01	1.20E-02	1.86E-05	2.1E-03	4.18E-09	3.3E-06	
MG/L	CIS 1,2-DICHLOROETHYLENE	NA	1.00E-02	9.00E-04		1.02E-01	9.00E-02	7.70E-03	9.98E-04	1.0E-01	1.44E-07	1.6E-04	
MG/L	CHLOROFORM	B2	1.00E-02	9.00E-04	1.40E-02	5.30E-03	9.00E-02	6.80E-03	5.19E-05	5.2E-03	6.61E-09	7.3E-06	3.7E-03
MG/L	TRICHLOROETHENE (TCE)	B2	3.00E-04	4.50E-05	1.00E-02	1.18E+00	1.50E-01	1.60E-02	1.16E-02	3.9E+01	3.48E-06	7.7E-02	1.2E+00
MG/L	VINYL CHLORIDE	A	3.00E-03	1.50E-04	2.90E-02	1.77E-02	5.00E-02	5.60E-03	1.73E-04	5.8E-02	1.82E-08	1.2E-04	6.0E-03
	Hazard Index									**3.9E+01**		**7.8E-02**	**1.2E+00**
Notes:	WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;									**Total Hazard Index =**		**4.0E+01**	
	HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake												

Appendix E

Leachate Transport Analysis Model
Charleston Naval Complex
Zone E - AOC 723

						Parameter	Trichloriethylene
Chemical Specific Input Parameters							
Cw	=	Target groundwater concentration MCL (mg/L)					**5.00E-03**
H	=	Henry's Law Constant, dimensionless					**4.22E-01**
ks	=	Soil-water sorption coefficient (cm3 water / g soil = L/kg) = Koc x foc where					6.14E+00
		koc = organic carbon-water sorption coefficient, (cm3 (ml) water) / (g soluble organic carbon)					**1.66E+02**
		foc = Fraction of organic content, dimensionless				**0.037**	
Site Specific Input Parameters							
Sw	=	Width of Source Parallel to Groundwater Flow Direction	(impacted soil zone)	**36.6** m	[redacted] ft		
da	=	Aquifer Thickness		**7.7** m	[redacted] ft		
d	=	Groundwater Mixing Zone thickness	(paved)	**3.93** m	12.9 ft		
			(unpaved)	**4.75** m	15.6 ft		
i	=	Groundwater Gradient		[redacted]	(unitless)		
Ks	=	Saturated Hydraulic Conductivity		**778.7** m/yr	2555.0 ft/yr		
θw	=	Volumetric Water Content of Soil Pore Space		**0.3** cm^3_{vapor}/cm^3_{soil}	0.3 in^3_{vapor}/in^3_{soil}		
θv	=	Volumetric Vapor Content of Soil Pore Space		**0.15** cm^3_{vapor}/cm^3_{soil}	0.15 in^3_{vapor}/in^3_{soil}		
ρs	=	Soil Bulk Density		**1.5** g/cm^3	93.64 lb_m/ft^3		
qi	=	Water Infiltration Rate	(paved)	**0.0086** m/yr	0.0283 ft/yr		
			(unpaved)	**0.1372** m/yr	0.4500 ft/yr		
		Partition Term, Cw/Csoil, (L/kg)					6.38E+00
		Dilution Term, dimensionless	(paved)				6.81E+01
			(unpaved)				6.10E+00
		Csoil/Cw =Partition term * Dilution term (mg/kg / mg/L) = L/kg	(paved)				4.35E+02
			(unpaved)				3.90E+01
		Calculated Site Specific Target Level for Soil					
		C_{soil} calculated source soil concentration (SSL, mg/kg) Cw*(partion term)*(dilution term)				(paved)	**2.173**
						(unpaved)	**0.195**

$$\frac{C_{soil}}{C_w} = \left(\frac{\theta_w + K_s\rho_s + H\theta_v}{\rho_s}\right)\left(\frac{K_s i d + q_i S_w}{q_i S_w}\right)$$

Cwt is the MCL from EPA National Drinking Water Standards (March 2001)or US EPA Region III RBCs (October, 2000). No MCL established for Carbazole, therefore EPA Reg III Tapwater RBC was used.
H from Table 36 of the Soil Screening Guidance; Technical Background Document (EPA, 1996).
ks = koc x foc.
koc from Table 39 of the Soil Screening Guidance; Technical Background Document (EPA, 1996).
foc calculated as the mean foc from TOC measurements from Zone E.
Sw Estimated as the distance along gw flow path (length, NW-SE) of AOC 723 (120 ft).
d is calculated as $M = (0.0112\ L^2)^{0.5} + da\{1 - e^{[-L\ qi/Ks\ da]}\}$ or da, whichever is less.
da is based on top of Ashley (-20 ft, GIS) and nearest isocontour line for groundwater level (5.4 ft msl, GIS).
i Calculated from isocontour groundwater map for AOC 723 ([5.4-4.5]/130 ~ 0.007, CH2MHill, 2003).
Ks Based on CH2MHill's hydraulic conductivity theme in the GIS (7 ft/d).
θw is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
θv is calculated as total porosity (0.45, assumed) - θw (0.3) = 0.15.
ρs is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
qi is a derived value (unpaved, 5.4 in/yr or paved, 0.34 in/yr) based on annual precipitation, evapo-transportation, and runoff coefficient values for the Charleston area.