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CORRECTIVE MEASURES STUDY REPORT SOLID WASTE MANAGEMENT UNIT 102 (SWMU 102) AND AREA OF CONCERN 590 (AOC 590) ZONE E CNC CHARLESTON SC

6/17/2003

CH2M HILL

CORRECTIVE MEASURES STUDY REPORT

SWMU 102 and AOC 590, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

CH2M-Jones

June 2003

Contract N62467-99-C-0960

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June 17, 2003

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

Re: CMS Report (Revision 0) – SWMU 102 and AOC 590, Zone E

Dear Mr. Scaturo:

Enclosed please find two copies of the CMS Report (Revision 0) for SWMU 102 and AOC 590 in Zone E of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Sam Naik. Please contact him at 770/604-9182, ext. 255, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

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

CORRECTIVE MEASURES STUDY REPORT

SWMU 102 and AOC 590, 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 2003

Revision 0
Contract N62467-99-C-0960
158814.ZE.PR.13

Certification Page for Corrective Measures Study Report (Revision 0) — SWMU 102 and AOC 590, 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.

6/13/2003

Date

Contents

Section			Page
Acronyms and Abbreviations			**vi**
1.0	**Introduction**		**1-1**
	1.1	Purpose and Scope of Corrective Measures Study Report	1-1
	1.2	Background Information	1-2
		1.2.1 Facility Description	1-2
		1.2.2 Soil COC Summary	1-3
	1.3	Report Organization	1-4
Figure 1-1		Location of SWMU 102 and AOC 590 in Zone E	1-6
Figure 1-2		Aerial Photograph of SWMU 1-2 and AOC 590	1-7
Figure 1-3		RFI Soil Sampling Locations	1-8
Figure 1-4		August 2002 Soil Sampling Locations	1-9
2.0	**Remedial Goal Options and Proposed Media Cleanup Standards**		**2-1**
	2.1	Remedial Action Objectives	2-1
	2.2	Media Cleanup Standards	2-1
3.0	**Overall Approach for Evaluating Focused Alternatives for SWMU 102 and AOC 590**		**3-1**
	3.1	Preferred Remedies	3-1
	3.2	Evaluation Criteria	3-1
4.0	**Description of Candidate Corrective Measure Alternatives**		**4-1**
	4.1	General Description of Alternatives	4-1
	4.2	Alternative 1: Soil Excavation and Offsite Disposal with LUCs	4-1
		4.2.1 Description of Alternative	4-1
		4.2.2 Other Considerations	4-2
	4.3	Alternative 2: LUCs with Periodic Indoor Air Monitoring	4-3
		4.3.1 Description of Alternative	4-3
		4.3.2 Other Considerations	4-3
Figure 4-1		Excavation Areas Under CMS Alternative 1	4-4
5.0	**Evaluation and Comparison of Corrective Measure Alternatives**		**5-1**
	5.1	Alternative 1: Soil Excavation and Offsite Disposal with LUCs	5-1
		5.1.1 Protection of Human Health and the Environment	5-1
		5.1.2 Attain MCS	5-1

Contents, Continued

5.1.3 Control the Source of Releases 5-2
5.1.4 Compliance with Applicable Standards for the Management of Generated Wastes 5-2
5.1.5 Other Factors (a) Long-term Reliability and Effectiveness 5-2
5.1.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes 5-2
5.1.7 Other Factors (c) Short-term Effectiveness 5-2
5.1.8 Other Factors (d) Implementability 5-3
5.1.9 Other Factors (e) Cost 5-3
5.2 Alternative 2: LUCs with Periodic Indoor Air Monitoring 5-3
5.2.1 Protection of Human Health and the Environment 5-4
5.2.2 Attain MCS 5-4
5.2.3 Control the Source of Releases 5-4
5.2.4 Compliance with Applicable Standards for the Management of Generated Wastes 5-4
5.2.5 Other Factors (a) Long-term Reliability and Effectiveness 5-4
5.2.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes 5-4
5.2.7 Other Factors (c) Short-term Effectiveness 5-4
5.2.8 Other Factors (d) Implementability 5-5
5.2.9 Other Factors (e) Cost 5-5
5.3 Comparative Ranking of Corrective Measure Alternatives 5-5
Table 5-1 Qualitative Comparison of Corrective Measure Alternatives 5-6
6.0 Recommended Corrective Measure Alternative 6-1
7.0 References 7-1

Appendices

A Cost Estimates For Proposed Corrective Measure Alternatives

Acronyms and Abbreviations

AOC	Area of concern
BCT	BRAC Cleanup Team
BEQ	Benzo[a]pyrene equivalent
BRAC	Base Realignment and Closure Act
BTEX	Benzene, toluene, ethylbenzene, and xylene
CA	Corrective action
CFR	*Code of Federal Regulations*
CMS	Corrective Measures Study
CMSWP	Corrective Measures Study Work Plan
CNC	Charleston Naval Complex
COC	Chemical of concern
CSI	Corrective Study Investigation
DAF	Dilution attenuation factor
EBS	Environmental Baseline Survey
EnSafe	EnSafe Inc.
EPA	U.S. Environmental Protection Agency
ft bls	Feet below land surface
ft^2	Square feet
HI	Hazard Index
ILCR	Incremental lifetime cancer risk
LUC	Land use control
LUCIP	Land Use Control Implementation Plan
LUCMP	Land Use Control Management Plan
µg/kg	Micrograms per kilogram
mg/kg	Milligram per kilogram
MCL	Maximum contaminant level

Acronyms and Abbreviations, Continued

MCS	Media cleanup standard
NAVBASE	Naval Base
PAH	Polycyclic aromatic hydrocarbon
PPE	Personal protective equipment
RAO	Remedial action objective
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RFIRA	RFI Report Addendum
RGO	Remedial goal option
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	Soil screening level
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
VOC	Volatile organic compound
yd^3	Cubic yards

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.

A RCRA Facility Investigation (RFI) Report Addendum and Corrective Measures Study (CMS) Work Plan (RFIRA/CMSWP) were prepared for the combined site Solid Waste Management Unit (SWMU) 102 and Area of Concern (AOC) 590 in Zone E of the CNC (CH2M-Jones, 2003b). The RFIRA/CMSWP (Revision 1) presented the remedial action objectives (RAOs) and media cleanup standards (MCSs) proposed for SWMU 102 and AOC 590. This CMS report has been prepared by CH2M-Jones to complete the next stage of the CA process for SWMU 102 and AOC 590.

1.1 Purpose and Scope of Corrective Measures Study Report

This CMS report evaluates corrective measure (remedial) alternatives for preventing unacceptable exposure to mercury and benzo[a]pyrene equivalent (BEQ) contamination found in the soil at SWMU 102 and AOC 590. Mercury and BEQs in surface soil, and mercury in subsurface soil are the chemicals of concern (COCs) identified at SWMU 102 and AOC 590 under the unrestricted (i.e., residential) use scenario. BEQs were also identified as COCs for the non-residential future land use scenario. Figure 1-1 illustrates the original location of SWMU 102 and AOC 590 within Zone E. Figure 1-2 is an aerial photograph showing the layout of SWMU 102 and AOC 590.

This CMS report consists of: 1) the identification of a set of corrective measure alternatives that are considered to be technically appropriate for addressing COC-contaminated soil; 2) an evaluation of the alternatives using standard criteria from U.S. Environmental Protection

Agency (EPA) RCRA guidance; and 3) the selection of a recommended (preferred) corrective measure alternative for the site.

This CMS evaluates the options for meeting the RAOs, which are described in Section 2.0 of this CMS report. The two remedies considered for achieving the RAOs are: 1) soil excavation and offsite disposal, and land use controls (LUCs); and 2) LUCs with periodic indoor air monitoring for mercury. The remedial activities associated with soil removal include excavation, backfilling, replacing pavement, and offsite disposal. The remedial activities that are associated with LUCs include maintaining the existing site use (commercial/industrial) and site controls (pavement/building), a LUC Management Plan (LUCMP) agreement between the Navy and the State of South Carolina, and long-term monitoring and review.

1.2 Background Information

This section of the CMS report presents background information on the facility, site history, and a summary of the nature and extent of the COCs at the site. This information is important to the understanding of the remedial goal options (RGOs), MCSs, and ultimately the evaluation of corrective measure alternatives for SWMU 102 and AOC 590. Additional information on the site and hydrogeology in the Zone E area of the CNC is provided in the *Zone E RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1997).

1.2.1 Facility Description

AOC 590 – Alley, Buildings 79 and 1760

AOC 590 comprises the alley between Buildings 79 and 1760. According to the *Final RCRA Facility Assessment (RFA) Report* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995), this alley was reported to have been the site of past releases of acetone and cutting oil. No information was found during the RFA regarding the specific locations, volumes, or duration of the waste discharge in this area. Currently, this alley is paved with asphalt.

As identified in the RFA documentation, the materials of concern for AOC 590 include heavy metals, benzene, toluene, ethylbenzene, and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and petroleum hydrocarbons. The AOC 590 area is zoned M-2 (marine industrial). The CNC RCRA Permit identified AOC 590 as requiring a confirmatory sampling investigation (CSI).

SWMU 102 – Mercury Spill, Building 79

Building 79 is a single-story concrete block structure with a concrete slab foundation that

was constructed in 1943. The building previously housed the Ordnance Shop and then served as a dental clinic from 1966 until 1976. Currently, Building 79 is being used by the Neal Brothers Co. as a storage facility. This area is zoned for marine industrial use (M-2).

According to the RFA, several incidents involving hazardous material spills, as well as cleanup activities, have been documented since 1976. The most noteworthy was the 1969 discovery of a pool of mercury under the floor inside the central portion of Building 79. Mercury reportedly spilled and seeped under the floor, forming a pool approximately 10 feet in diameter.

According to the Environmental Baseline Survey (EBS) conducted in 1994 at Building 79 (EnSafe, 1996), the 1970 Incident Report #CNS-12-70 reported that five pounds of mercury were recovered by a vacuum cleaner and disposed of properly. The exposed area was scrubbed with HgX to remove any traces of remaining mercury, and the floor was replaced. The mercury was reportedly used in gyroscopes before World War II.

As identified in the RFA documentation, the materials of concern for SWMU 102 include mercury, silver and other metals, VOCs, and petroleum hydrocarbons. The CNC RCRA Permit identified SWMU 102 as requiring a CSI.

Regulatory review was conducted on the *Zone E RFI Report, Revision 0* (EnSafe, 1997), and a draft response to the comments from SCDHEC were prepared by the Navy/EnSafe team. During 2003, an RFIRA/CMSWP was prepared by CH2M-Jones and submitted to EPA for review. Detailed information on the analytical results and the screening of those results for the determination of COCs can be found in the *Zone E RFI Report, Revision 0*, and the *RFI Report Addendum and CMS Work Plan for SWMU 102 and AOC 590, Zone E, Revision 1* (CH2M-Jones, 2003b).

1.2.2 Soil COC Summary

Two soil sampling events were conducted at SWMU 102 and AOC 590 during the RFI. Soil samples collected during the first sampling event were analyzed for VOCs, semivolatile organic compounds (SVOCs), and metals. Soil samples collected during the second sampling event were analyzed for SVOCs and metals.

During August 2002, additional soil sampling was conducted to verify current concentrations of antimony, lead, mercury, and BEQs in soil at SWMU 102 and AOC 590. Additional soil samples were collected at ten RFI soil boring locations, which showed elevated antimony, lead, mercury, and BEQ concentrations during the initial RFI. In addition, 14 new soil samples were collected to further delineate BEQs, antimony, lead, and

mercury. At all of these sampling locations, surface and subsurface samples were collected from the 0 to 1 foot below land surface (ft bls) and the 3 to 5 ft bls depth interval. Figure 1-3 shows the RFI sampling locations and Figure 1-4 shows the August 2002 soil sampling locations.

Mercury and BEQs in surface soil, and mercury in subsurface soil were identified as COCs in the RFIRA/CMSWP for SWMU 102 and AOC 590, under an unrestricted (i.e., residential) land use scenario. Additionally, BEQs were identified as COCs in surface soil for the industrial land use scenario. This CMS focuses on these soil COCs. No COCs were identified in the RFIRA for groundwater at SWMU 102 and AOC 590.

Detailed information on the analytical results and the screening of those results for the determination of COCs can be found in the *Zone E RFI Report, Revision 0* and the *RFI Report Addendum and CMS Work Plan for SWMU 102 and AOC 590, Zone E, Revision 1.*

1.3 Report Organization

This CMS report consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of and background information relating to this CMS report.

2.0 Remedial Goal Options and Proposed Media Cleanup Standards— Defines the RGOs and proposed MCSs for SWMU 102 and AOC 590, in addition to the criteria used in evaluating the corrective measure alternatives for the site.

3.0 Overall Approach for Evaluating Focused Alternatives for SWMU 102 and AOC 590 — Describes the alternative development process and presents the detailed evaluation criteria.

4.0 Description of Candidate Corrective Measure Alternatives — Describes each of the candidate corrective measure alternatives for addressing mercury and BEQs in soil.

5.0 Evaluation and Comparison of Corrective Measure Alternatives — Evaluates each alternative relative to standard criteria, then compares the alternatives and the degree to which they meet or achieve the evaluation criteria.

6.0 Recommended Corrective Measure Alternative — Describes the preferred corrective measure alternative to achieve the MCSs and RGOs for mercury and BEQs in soil, based on a comparison of the alternatives.

7.0 References— Lists the references used in this document.

Appendix A contains cost estimates developed for the proposed corrective measure alternatives.

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

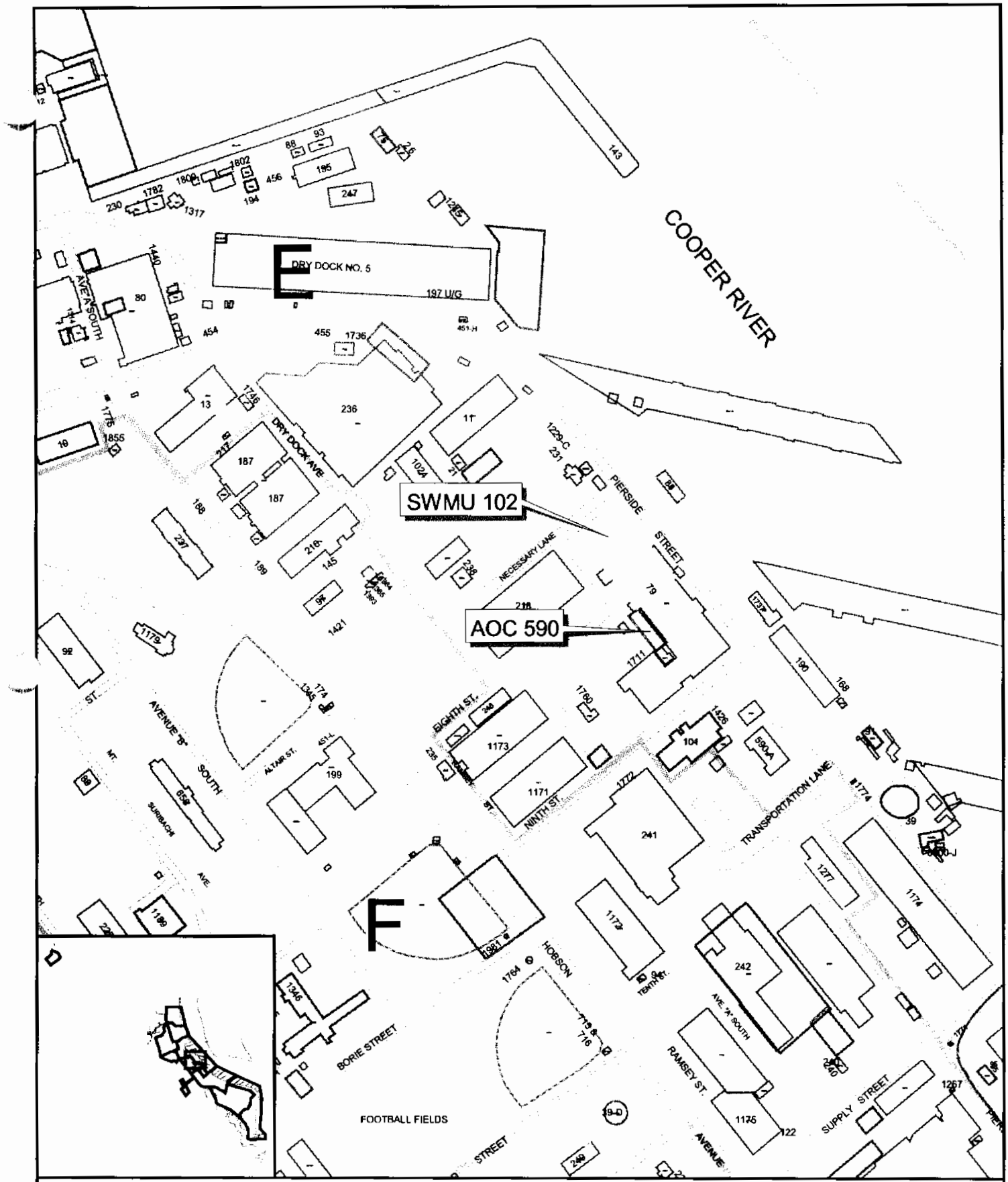

Figure 1-1
Location of AOC 590 and SWMU 102 in Zone E
Charleston Naval Complex

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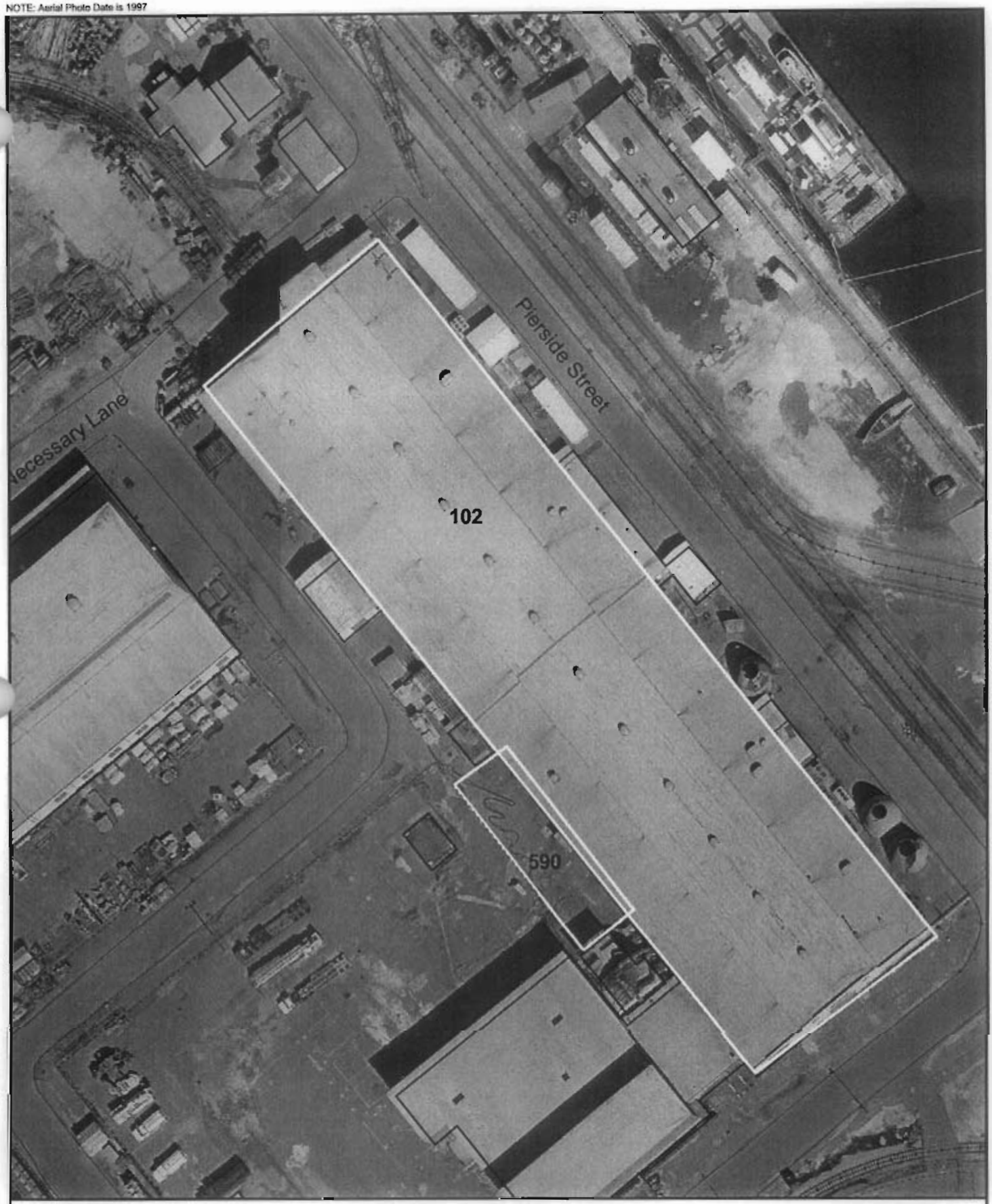

Figure 1-2
Site Map
SWMU 102 and AOC 590, Zone E
Charleston Naval Complex

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File Path: C:\18gis\Projects\Zone_E\SWMU102\swmu102.apr, Date: 10 Jan 2002 6:38, User: NMOUDRY, Figure 1-2 Site Map

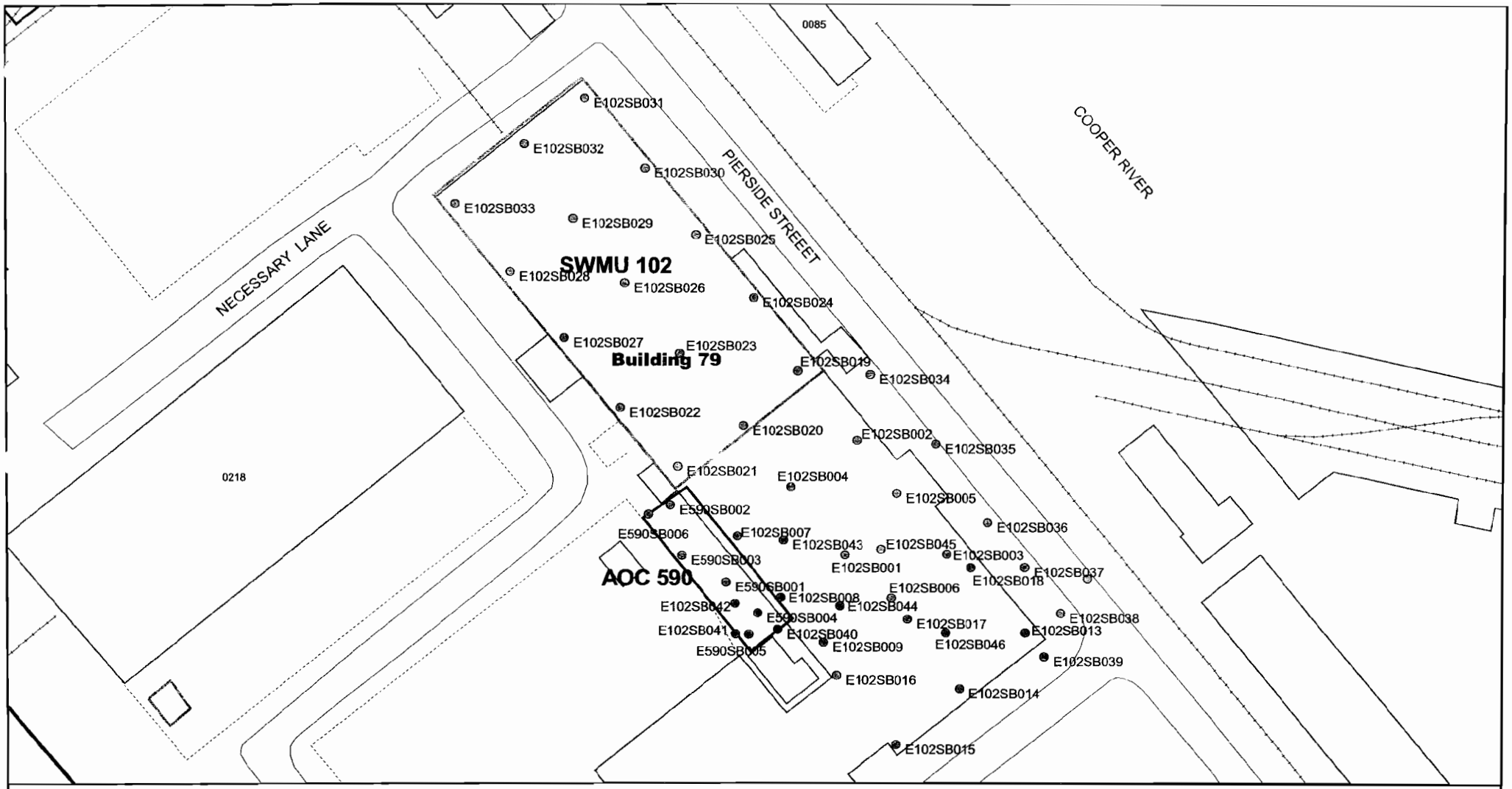

Figure 1-3
RFI Soil Sampling Locations
AOC 590 and SWMU 102, Zone E
Charleston Naval Complex

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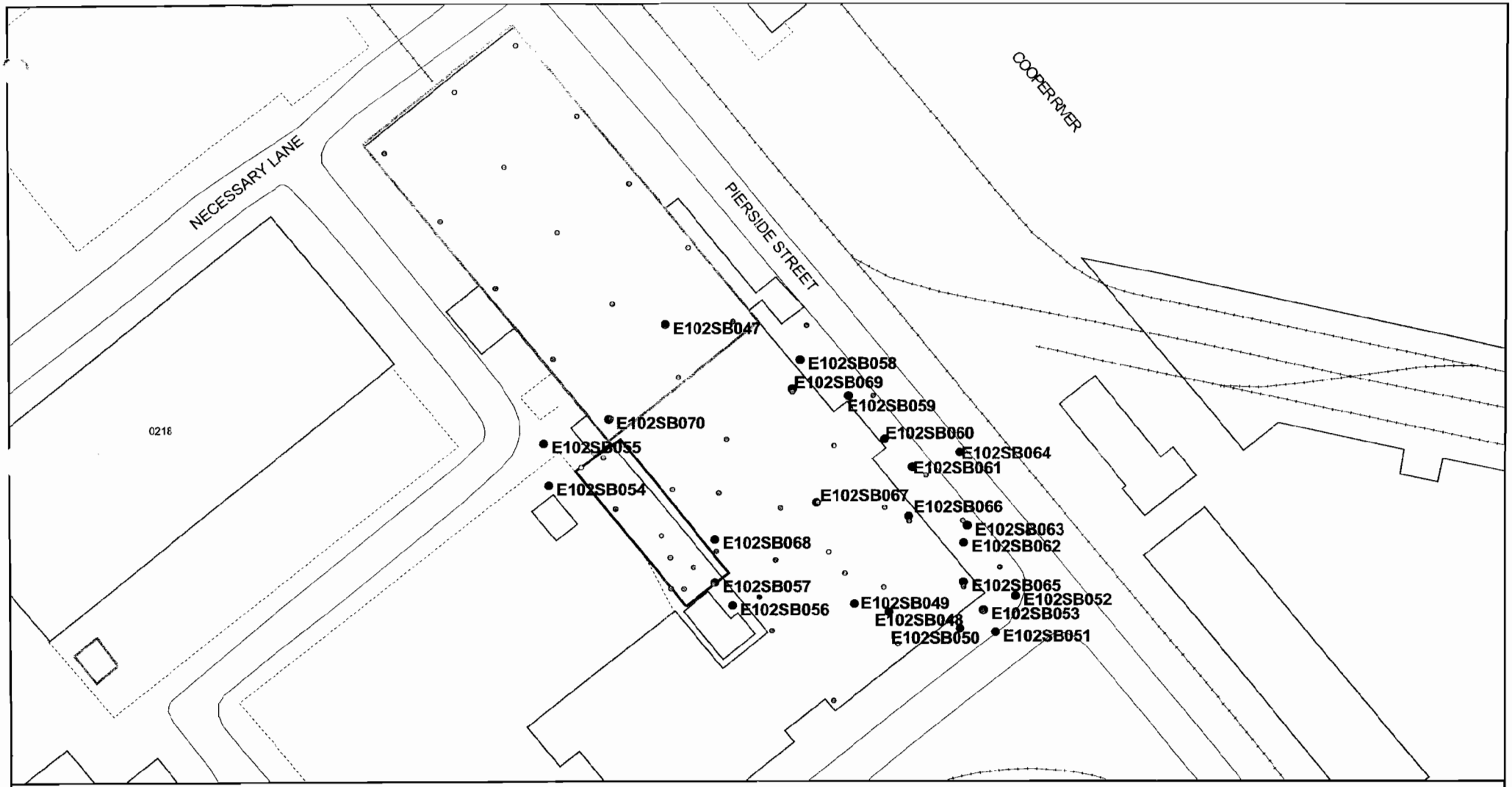

Figure 1-4
August 2002 Soil Sampling Locations
AOC 590 and SWMU 102, Zone E
Charleston Naval Complex

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Section 2.0

2.0 Remedial Goal Options and Proposed Media Cleanup Standards

RGOs and MCSs are typically developed at the end of the risk assessment in the RFI. RGOs can be based on a variety of criteria, such as drinking water maximum contaminant levels (MCLs), specific incremental lifetime cancer risk (ILCR) target levels (e.g., 1E-04, 1E-05, or 1E-06), target Hazard Index (HI) levels (e.g., 0.1, 1.0, 3.0), or site background concentrations. When area background concentrations are higher than the health protection-based concentrations, the background levels are the target MCSs. Achieving these goals should protect human health and the environment, while achieving compliance with applicable state and federal standards.

2.1 Remedial Action Objectives

RAOs are medium-specific goals that protect human health and the environment by preventing or reducing exposures under current and future land use conditions. In the *RFI Report Addendum and CMS Work Plan for SWMU 102 and AOC 590, Zone E, Revision 1* (CH2M-Jones, 2003b), the RAOs identified for surface soil are to prevent ingestion and direct/dermal contact with soil containing COCs at unacceptable levels.

2.2 Media Cleanup Standards

MCSs for SWMU 102 and AOC 590 were presented in the *RFI Report Addendum and CMS Work Plan for SWMU 102 and AOC 590, Zone E, Revision 1.*

The MCS for BEQs is the CNC BEQ sitewide reference concentration, which is 1,304 micrograms per kilogram (µg/kg) for surface soil. In surface soil, BEQs were detected above the CNC sitewide reference concentration for surface soils of 1.304 milligrams per kilogram (mg/kg) at 12 locations, with concentrations at these locations ranging from 1.41 mg/kg to 17.501 mg/kg.

The MCSs for mercury are the EPA Region III residential risk-based concentration (RBC) (with a HI=0.1) of 2.3 mg/kg for surface soil, and the soil screening level (SSL) (with a dilution attenuation factor [DAF]=10) of 1 mg/kg for subsurface soil. For the soil-to-air exposure pathway for mercury, the EPA target goal of 10 mg/kg in soil is an acceptable MCS. In surface soil at SWMU 102 and AOC 590, mercury was detected above the

residential RBC (with a HI=0.1) of 2.3 mg/kg in 20 samples with concentrations ranging from 2.55 mg/kg to 57.8 mg/kg. In subsurface soil at SWMU 102 and AOC 590, mercury was detected above the generic SSL (with a DAF=10) of 1 mg/kg in 24 samples with concentrations ranging from 1.01 mg/kg to 47.7 mg/kg. Some of these surface and subsurface samples were collected during 2002 at locations which had previously been sampled during the initial RFI and had showed elevated detections of mercury.

The MCSs will be met if the site statistical estimates of concentrations are similar to background statistical estimates. For point comparisons between site and background, ranges of site concentrations may be compared with the ranges of background concentrations. Other potential RGOs, such as the 1E-06 ILCR level, were considered but regarded as not applicable because the site background concentrations of BEQs are greater than this level.

The focus of this CMS is to evaluate alternatives that will achieve the RAOs described above. The corrective measure alternatives evaluated include:

1) Soil removal and offsite disposal with LUCs; and
2) LUCs with periodic indoor air monitoring for mercury.

These alternatives are discussed in Section 4.0 of this CMS report.

Section 3.0

3.0 Overall Approach for Evaluating Focused Alternatives for SWMU 102 and AOC 590

3.1 Preferred Remedies

A variety of corrective measure approaches are conceptually feasible for mercury and BEQs in soil at SWMU 102 and AOC 590. However, remedy selection at the CNC has focused on a few demonstrated technologies. For contaminants in soil that are limited in area, the preferred technologies that are expected to be effective at the CNC include: 1) soil excavation and offsite disposal with LUCs, and 2) LUCs. Generally, at sites similar to SWMU 102 and AOC 590 with limited soil contamination, a preference exists for implementing one of these remedies to expedite the remedy selection and implementation processes, improve predictability of the remedy, and lower costs. These candidate alternatives are screened and evaluated using the conventional criteria presented below.

In this focused CMS, these two alternatives will be described in Section 4.0, evaluated in detail in Section 5.0, and one alternative will be recommended in Section 6.0.

3.2 Evaluation Criteria

According to the EPA RCRA CA guidance, corrective measure alternatives should be evaluated using the following five criteria:

1. Protection of human health and the environment.
2. Attainment of MCSs.
3. The control of the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Compliance with applicable standards for the management of wastes generated by remedial activities.
5. Other factors, including (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 these criteria is defined in more detail below:

1. **Protection of 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 criterion may or may not be independent of its ability to achieve the other criteria. For example, an alternative may be protective of human health, but may not be able to attain the MCSs, if the MCSs were not developed based on human health protection factors.

2. **Attainment of MCSs.** The alternatives will be evaluated on the basis of their ability to achieve the MCS defined in this CMS. Another aspect of this criterion is the time frame required to achieve the MCS. Estimates of the time frame for the alternatives to achieve RGOs will be provided.

3. **The control of the source of releases.** This criterion deals with the control of releases of contamination from the source (the area in which the contamination originated) and the prevention of future migration to uncontaminated areas.

4. **Compliance with applicable standards for management of wastes.** This criterion deals with the management of wastes derived from implementing the alternatives (i.e., treatment or disposal of contaminated soil removed from excavations). Corrective measure alternatives will be designed to comply with all standards for the management of wastes. Consequently, this criterion will not be explicitly included in the detailed evaluation presented in the CMS, but such compliance would be incorporated into the cost estimates for which this criterion is relevant.

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

    a. Long-term reliability and effectiveness

    Corrective measure alternatives will be evaluated on the basis of their reliability and the potential impact should the alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failing 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 +100 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.

Section 4.0

4.0 Description of Candidate Corrective Measure Alternatives

4.1 General Description of Alternatives

Two candidate corrective measure alternatives were selected for this site:

- Alternative 1: Soil Excavation and Offsite Disposal with LUCs
- Alternative 2: LUCs with periodic indoor air monitoring for mercury

Alternative 1 would involve the removal of soil at 23 locations where mercury and BEQ concentrations exceed the MCSs in surface soil and/or subsurface soil. These locations are shown in Figure 4-1.

A 20-percent scope contingency is also assumed and included in the cost for this alternative.

For Alternative 2, it is assumed that the LUCs will include the following administrative controls:

- Restrictions limiting the property land use to non-residential uses.
- Restrictions to maintain the extent of paved area, unless a demonstration is made that changing a currently paved area to unpaved status will not cause a failure to meet one of the RAOs.

In addition, periodic sampling of ambient air in the breathing zone inside Building 79 will be conducted near the exceedance locations. If air monitoring shows that mercury concentrations do not pose a threat in the breathing zone, an evaluation will be made to discontinue this monitoring while keeping the LUCs in place.

The sections below describe each alternative in detail.

4.2 Alternative 1: Soil Excavation and Offsite Disposal with Land Use Controls

4.2.1 Description of Alternative

This alternative will remove contaminated soil in areas shown on Figure 4-1 that exceed the MCS established in Section 2.0. The majority of the removal locations are under concrete

pavement inside Building 79. The concrete pavement will need to be removed in order to access underlying soils exceeding the MCS which need to be removed and replaced with clean fill. During the soil sampling conducted inside Building 79 during August 2002, it was noticed that several large pieces of equipment were stored in the areas where excavations are being proposed. These pieces of equipment will need to be relocated in order to make room for excavation equipment and to allow excavation to be conducted safely. It is quite likely that buried underground utility lines will be encountered during these excavations. Should buried utility lines be encountered, they may need to be temporarily shut down and relocated during excavation and backfill activities.

Excavated soil would be transported to a permitted landfill facility for long-term disposal, and the excavation would be filled with clean fill from an offsite borrow source. The impacted concrete flooring will need to be replaced also. Once the contaminated soil is removed and the excavations backfilled with clean soil and repaved with concrete, the site would be acceptable for unrestricted land use, with no long-term monitoring required. However, because the site is located in Zone E, there will continue to be LUCs applied at this site, similar to other sites within the entire zone. These LUCs are expected to include restrictions of the property to non-residential activities.

4.2.2 Other Considerations

Coordination with the CNC Redevelopment Authority (RDA) would be required for site restrictions during excavation and traffic control for the haul trucks. Additionally, since most of the excavations are inside Building 79, access to excavation locations would have to be through existing entrances to the building which could constrict traffic in and out of the building.

The potential for expansion of scope during excavation is moderate. It is likely that the excavations could expand beyond the 10 ft x 10 ft footprint at a few locations. Therefore, a 30-percent scope contingency for increased excavation is assumed. Due to the likelihood of increased excavation, the potential exists for scope expansion for confirmation testing. Therefore, a 20-percent scope contingency is assumed for the confirmation testing.

4.3 Alternative 2: Land Use Controls with Periodic Indoor Air Monitoring

4.3.1 Description of Alternative

This alternative involves leaving the contaminated soil and co-located overlying pavement and railroad lines in place and instituting administrative/legal controls to restrict future use of the land. The controls would limit land use to activities that present less frequent exposure by sensitive populations to surface soil and preclude uncontrolled disturbance to the contaminated soil, thus minimizing the potential for human exposure to the contamination. The addition of restrictions on soil disturbance and site occupancy would minimize the potential for human exposure that could occur in a residential or industrial setting. The controls may be in the form of deed restrictions and/or easements (property interests retained by the Navy during property transfer to assure protectiveness of the remedy). Periodic monitoring would be required to assure controls are maintained; periodic site inspections would be required to assure the institutional controls are complied with. Controls may be layered (multiple controls at the same time) to enhance protectiveness. The Navy is negotiating a comprehensive Land Use Control Implementation Plan (LUCIP) for the CNC.

4.3.2 Other Considerations

Currently, the Navy is the property owner and land use in Zone E of the CNC is restricted to non-residential. Existing engineering controls include pavement and structures that prevent or limit access to contaminated soil. The location and proximity of the site to other industrial properties make residential use highly unlikely. Periodic monitoring of the deed controls and the site would be required. For the purpose of developing a representative cost estimate for this process, an annual evaluation that would include a site inspection, is assumed.

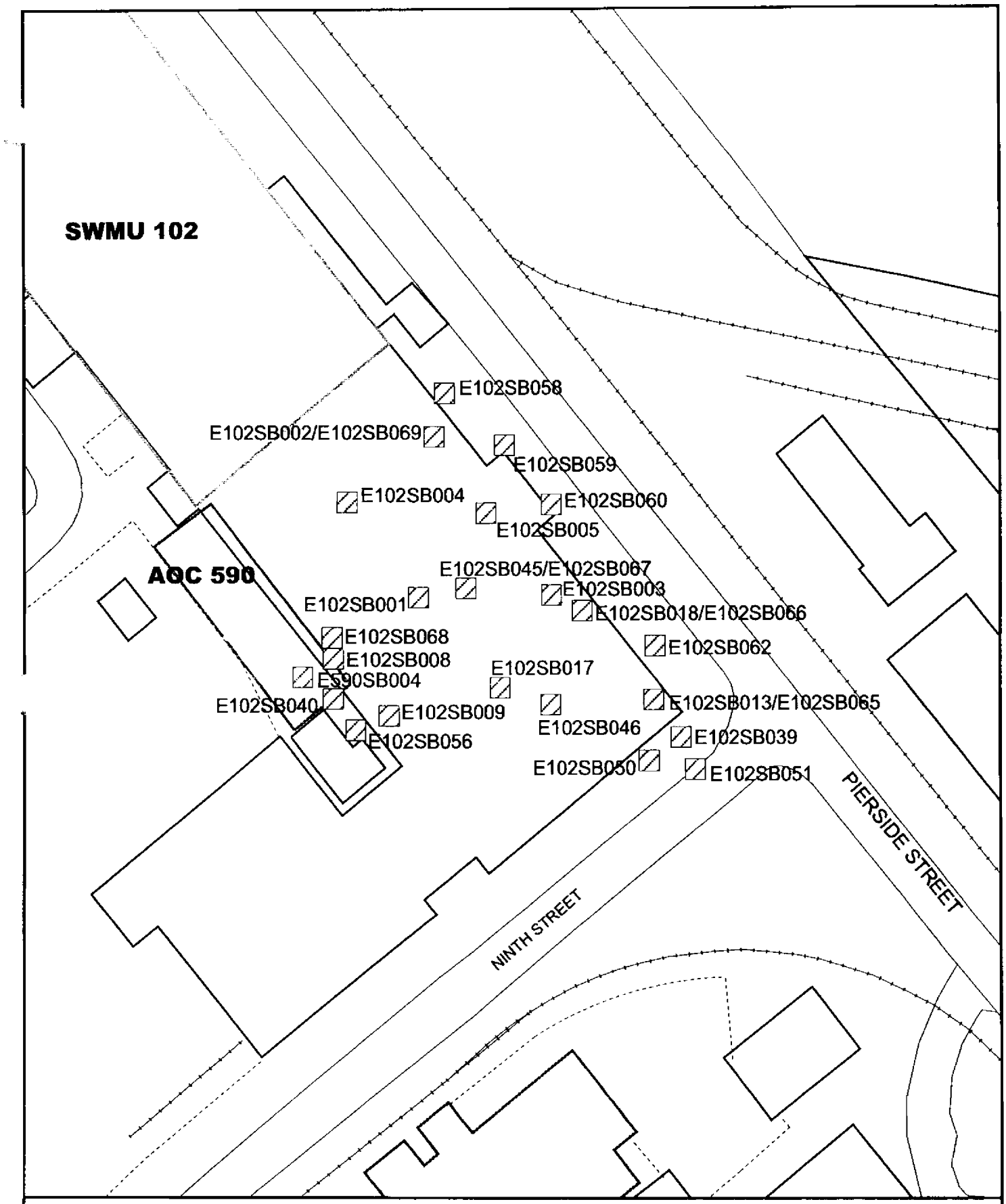

Figure 4-1
Pavement and Soil Excavation Locations
CMS Alternative 1, SWMU 102 and AOC 590
Zone E, Charleston Naval Complex

CH2MHILL

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Section 5.0

5.0 Evaluation and Comparison of Corrective Measure Alternatives

The corrective measure alternatives were evaluated relative to the criteria previously described in Section 2.0 and then subjected to a comparative evaluation. A cost estimate for each alternative was also developed; the assumptions and unit costs used for these estimates are included in Appendix A.

5.1 Alternative 1: Soil Excavation and Offsite Disposal with Land Use Controls

The following assumptions were made for Alternative 1:

- 23 areas would be targeted for soil excavation, as shown in Figure 4-1.
- A total of 213 cubic yards (yd^3) of soil (in-place measurement) would be excavated for offsite disposal at a Subtitle D facility and replaced with clean backfill.
- Approximately 2,500 square feet (ft^2) of concrete flooring would be removed/replaced and approximately 121 yd^3 of concrete (in-place measurement) would be removed/replaced.
- Excavations would include known exceedances plus extrapolated areas to account for uncertainty.
- Confirmation testing will validate that the extent of contaminated soil is limited to that shown on Figure 4-1, plus a contingency of 30 percent.

5.1.1 Protection of Human Health and the Environment

This alternative is effective at protecting human health and the environment because it removes soil with mercury and BEQ concentrations that exceed the MCSs, from the site. The replacement soil will have concentrations of mercury and BEQs below the MCSs.

5.1.2 Attain MCSs

This alternative will permanently remove soil with mercury and BEQ concentrations that exceed the MCSs. The MCSs will be achieved at the completion of soil removal actions.

5.1.3 Control the Source of Releases

There are no ongoing sources of releases at SWMU 102 and AOC 590. For this reason, this issue is not applicable.

5.1.4 Compliance with Applicable Standards for the Management of Generated Wastes

Excavated soil will be sampled and analyzed for waste characterization prior to disposal. Soil, decontamination waste, and personal protective equipment (PPE) will be disposed of in accordance with applicable regulations and permits. Offsite transportation and disposal will be performed by properly permitted and licensed subcontractors.

5.1.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative would have long-term reliability and be effective for the site, as long as all exceedances are removed. The removal of contamination from the site would be permanent. Uncertainty in the distribution of mercury and BEQs in soil is addressed by expanding the excavations beyond the RFI delineation, thus reducing the risk of failure of this alternative. Confirmation sampling would verify that the excavations have removed soil exceedances. It is much less likely that any significant amount of soil with mercury and BEQ concentrations above the MCSs will be left in place; site-wide average concentrations will be below the MCS for the unrestricted land use scenario.

5.1.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

Alternative 1 reduces the mobility of the contaminated soil by transporting it to a regulated containment facility (landfill). Treatment will not be required unless the soil exhibits toxicity characteristics per 40 *Code of Federal Regulations* (CFR) 261.24. If required, soil will be treated at the disposal facility to further reduce mobility of the mercury and BEQs.

5.1.7 Other Factors (c) Short-term Effectiveness

The excavation and hauling of contaminated soil in this alternative has the potential to create dust containing contaminated soil particles. However, standard engineering controls such as dust suppression during excavation, tarp covers on trucks, and worker PPE to prevent dust inhalation will be implemented. Thus, with controls, the alternative provides short-term effectiveness in preventing ingestion of or contact with the contaminated soil and minimizes the potential for migration of soil particles. The technologies for dust control and worker protection are well-established and robust. No unmanageable hazards would be created during implementation.

5.1.8 Other Factors (d) Implementability

This alternative will be moderately difficult to implement. Most of the required activities have been routinely implemented at nearby sites using standard equipment and procedures. Utility clearance, subcontracting, waste characterization, and base approval are customary activities. The field implementation of this remedy is estimated to require 4 to 6 weeks, and the benefits will be immediate. There is ample offsite capacity for disposal (and treatment, if required) of the contaminated soil.

5.1.9 Other Factors (e) Cost

Appendix A presents the overall cost estimate for implementing this remedy. These costs reflect soil removal based on available RFI sample results, plus removal and replacement of concrete flooring. A scope contingency (20 percent) is added to cover minor additional excavation that may be required based on the results of the confirmation testing. In summary, the costs include the following:

- Remove concrete flooring or pavement and underlying soil in each area with an MCS exceedance.
- Perform confirmation tests in each excavation area to verify compliance with MCS.
- Apply 20-percent contingency for additional compliance tests that may be required due to the potential for some additional contamination around the proposed 10 ft x 10 ft excavation footprint.
- Apply 30-percent contingency for additional scope that may be required based on expansion of the excavations due to unanticipated mercury or BEQ concentrations detected above the MCSs in the excavation sidewall samples.

Using the assumptions listed above, the total present value of Alternative 1 is $244,000.

5.2 Alternative 2: Land Use Controls with Periodic Indoor Air Monitoring

The assumptions for Alternative 2 include the following:

- A base-wide LUCIP will be developed for the CNC. The plan will allow for restrictions on the use of land at SWMU 102 and AOC 590 and other areas, and it will be developed outside the scope of this CMS.
- Periodic monitoring will be performed for 30 years. Periodic indoor air monitoring will be performed, initially on an annual basis. Should this indicate no threat to site workers,

it will be discontinued. The monitoring will consist of an annual site visit to confirm that site use(s) are consistent with the LUCIP. Although the present worth costs have been calculated for a 30-year period of monitoring, it is assumed that LUCs could be in place for as long as required. The present worth costs for a longer period of monitoring are not significantly different from those for a 30-year period of monitoring.

5.2.1 Protection of Human Health and the Environment

This alternative is effective at protecting human health because it prevents exposure to the site contaminants at concentrations that would cause unacceptable risks, and it also restricts future use of the site that would be inappropriate for the MCS exceedances at the site.

5.2.2 Attain MCS

This alternative would not achieve the MCSs for mercury and BEQs.

5.2.3 Control the Source of Releases

There are no ongoing sources of releases at SWMU 102 and AOC 590. For this reason, this issue is not applicable.

5.2.4 Compliance with Applicable Standards for the Management of Generated Wastes

Alternative 2 does not generate any wastes that would require special management.

5.2.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative provides some level of protection that has long-term reliability and effectiveness. The risk of failure is low, provided the LUCIP is enforced by the responsible entity. If the LUCs were not enforced, unpermitted use of the site may result in human exposure to mercury and BEQs above the MCS.

5.2.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

This alternative involves no treatment and does not reduce the toxicity, mobility, or volume of contaminated soil at SWMU 102 and AOC 590.

5.2.7 Other Factors (c) Short-term Effectiveness

The Navy retains ownership and control of the site use until LUCs are implemented. This alternative does not involve any site activities, so no short-term risks are created.

5.2.8 Other Factors (d) Implementability

Alternative 2 is relatively easy to implement since it requires only the development of LUCs and an appropriate monitoring program.

5.2.9 Other Factors (e) Cost

Alternative 2 is not costly to implement since it requires no construction of treatment facilities or disposal of wastes. The cost for this alternative is for administrative/legal services and periodic monitoring/review for 30 years. Longer monitoring would likely be required, but its cost impact to present value of this alternative is minimal. Although the present worth costs have been calculated for a 30-year period of monitoring, it is assumed that LUCs could be in place for as long as required. The present worth costs for a longer period of monitoring are not significantly different from those for a 30-year period of monitoring.

Using the assumptions described earlier, the total present value of Alternative 2 is $32,000.

5.3 Comparative Ranking of Corrective Measure Alternatives

The overall ability of each corrective measure alternative to meet the evaluation criteria is described above. In Table 5-1, a comparative evaluation of the degree to which each alternative meets a particular criteria is presented. Alternative 2: LUCs with periodic indoor air monitoring is the preferred alternative. It provides a protective and reliable remedy at a lower cost.

TABLE 5-1
Qualitative Comparison of Corrective Measure Alternatives
Corrective Measures Study Report, SWMU 102 and AOC 590, Zone E, Charleston Naval Complex

Criterion	Alternative 1 Soil Excavation and Offsite Disposal with LUCs	Alternative 2 LUCs with Periodic Indoor Air Monitoring
Overall Protection of Human Health and the Environment	Protects human health and the environment	Protects human health and the environment
Attainment of MCS	Would achieve MCS	Would not achieve MCS
Control of the source of releases	N/A	N/A
Compliance with applicable standards for the management of wastes	Complies with applicable standards	Complies with applicable standards
Long-term Reliability and Effectiveness	Reliable and effective long term	Reliable and effective long term, provided that periodic inspections are performed
Reduction of Toxicity, Mobility, or Volume through Treatment	Reduces mobility via placement of soil in landfill	Does not reduce toxicity, mobility, or volume
Short-term Effectiveness	Effective in short term	Effective in short term
Implementability	Moderately difficult to implement due to need to remove/replace railroad line, concrete, and asphalt pavement and work inside a building in a busy industrial area.	Easy to implement
Cost Ranking	Significantly Expensive	Inexpensive
Estimated Cost	$244,000	$32,000

N/A = not applicable

Section 6.0

6.0 Recommended Corrective Measure Alternative

Two corrective measure alternatives were evaluated using the criteria described in Section 2.0 of this CMS report: (1) Alternative 1: Soil Excavation and Offsite Disposal with LUCs, and (2) Alternative 2: LUCs with Periodic Indoor Air Monitoring.

The preferred corrective measure alternative is Alternative 2: LUCs with Periodic Indoor Air Monitoring. The remedy would be protective at a moderate cost.

Alternative 2 would protect human health and the environment by maintaining the current and planned future use of the site as industrial/commercial. Limitations would prevent residential and other unrestricted land use that could expose sensitive populations.

Engineering controls to minimize future releases are already in place. Most of the area is paved or covered by a structure. Planning is already underway to develop and implement administrative controls that would limit future site activities to those that would not involve unrestricted exposures. The expected reliability of this alternative is good.

There are no community safety issues associated with implementation of this remedy, and the controls would be relatively easy to implement. This alternative provides long-term effectiveness for the planned industrial/commercial use, and relies on administrative controls to prevent future residential use.

Section 7.0

7.0 References

CH2M-Jones. *RFI Report Addendum and CMS Work Plan for SWMU 102 and AOC 590, Zone E, Revision 0.* February 7, 2003a.

CH2M-Jones. *RFI Report Addendum and CMS Work Plan, for SWMU 102 and AOC 590, Zone E, Revision 1.* May 23, 2003b.

EnSafe Inc./Allen & Hoshall. *Final Zone E RCRA Facility Investigation (RFI) Work Plan, Revision 1.* 1995.

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

Appendix A

COMPARISON OF TOTAL COST OF REMEDIAL SOLUTIONS

Site:	Charleston Naval Complex	**Base Year:**	2003
Location:	SWMU 102 & AOC 590	**Date:**	06/03/03
Phase:	Corrective Measures Study		

	Alternative Number 1	Alternative Number 2
Total Project Duration (Years)	<1	30
Capital Cost	$213,000	$17,000
Annual O&M Cost	$0	$1,100
Total Present Value of Solution	$244,000	$31,000

Disclaimer: The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude cost estimate that is expected to be within -50 to +100 percent of the actual project costs.

Alternative: Number 1 — **COST ESTIMATE SUMMARY**

Elements: Soil Excavation and Offsite Disposal

Site: Charleston Naval Complex

Location: SWMU 102 & AOC 590

Phase: Corrective Measures Study

Base Year: 2003

Date: 06/03/03

Description: Excavation of contaminated soil, disposal offsite at permitted landfill, backfill with clean soil; replace concrete. Extent includes RFI sample points plus 20% scope contingency.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation Sampling	1	EA	$17,300	$17,300	See Confirmation Worksheet
Soil and Concrete Removal, Disposal and Replacement	1	EA	$116,000	$116,000	See Excavation 1 Worksheet
				$0	
SUBTOTAL				$133,300	
Contingency	20%		$133,300	$26,660	
SUBTOTAL				**$159,960**	
Project Management	8%		$159,960	$12,797	USEPA 2000, p. 5-13, $100K-$500K
Remedial Design	15%		$159,960	$23,994	USEPA 2000, p. 5-13, $100K-$500K
Construction Management	10%		$159,960	$15,996	USEPA 2000, p. 5-13, $100K-$500K
SUBTOTAL				**$52,787**	
TOTAL CAPITAL COST				**$213,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Allowance for Misc. Items	20%		$0	$0	
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

PRESENT VALUE ANALYSIS

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$213,000	$213,000	1.000	$213,000	
	ANNUAL O&M COST	$0	$0	0.000	$0	
		$213,000			$213,000	
	PRESENT VALUE OF LUC				$31,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$244,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Alternative: Number 2
Elements: Land Use Controls

COST ESTIMATE SUMMARY

Site: Charleston Naval Complex
Location: SWMU 102 & AOC 590
Phase: Corrective Measures Study
Base Year: 2003
Date: 06/03/03

Description: Implementation of base-wide land use management plan to put institutional controls in place to restrict site use to commercial/industrial.

Assumes this site is part of a multi-site implementation, and costs are shared among all the sites.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Deed Restrictions - Attorney	4	hour	$200	$800	
Record Deed	4	each	$500	$2,000	
LUC Implementation	24	hours	$75	$1,800	
Preiodic Indoor Air Monitoring	4	each	$2,000	$8,000	
SUBTOTAL				$12,600	
Contingency	20%		$12,600	$2,520	
SUBTOTAL				**$15,120**	
Project Management	10%		$15,120	$1,512	USEPA 2000, p. 5-13, <$100K
Remedial Design	0%		$15,120	$0	Not applicable.
Construction Management	0%		$15,120	$0	Not applicable.
SUBTOTAL				**$1,512**	
TOTAL CAPITAL COST				**$17,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Annual Evaluation	12	hour	$75	$900	
SUBTOTAL				$900	
Allowance for Misc. Items	20%		$900	$180	
SUBTOTAL				$1,080	
TOTAL ANNUAL O&M COST				**$1,100**	

PRESENT VALUE ANALYSIS - 20 years

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$17,000	$17,000	1.000	$17,000	
30	ANNUAL O&M COST	$33,000	$1,100	12.409	$13,650	
		$50,000			$30,650	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$31,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).