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NAS WHITING FIELD
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FEASIBILITY STUDY FOR SITE 1 NORTHWEST DISPOSAL AREA NAS WHITING FIELD

8/1/1998

HARDING LAWSON ASSOCIATES

FEASIBILITY STUDY
SITE 1, NORTHWEST DISPOSAL AREA

NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA

UNIT IDENTIFICATION CODE: N60508
CONTRACT NO.: N62467-89-D-0317/116

AUGUST 1998

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29418

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Unit Identification Code: N60508

Contract No.: N62467-89-D-0317/116

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August 1998

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, Harding Lawson Associates, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/116 are complete and accurate and comply with all requirements of this contract.

DATE: August 25, 1998

NAME AND TITLE OF CERTIFYING OFFICIAL: Terry Hansen, P.G.
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(DFAR 252.227-7036)

The engineering evaluations and professional opinions rendered in this planning document describing the feasibility study for Site 1, Naval Air Station Whiting Field, Milton, Florida, were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice. This document is not intended to be used for construction of the selected alternative.

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FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, and/or disposal of hazardous materials. Through accidental spills or leaks or as a result of and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by current standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), the Resource Conservation and Recovery Act, and the Hazardous and Solid Waste Amendments of 1984. These acts establish the means to assess and clean up hazardous waste sites for both private-sector and Federal facilities. The CERCLA and SARA acts form the basis for what is commonly known as the Superfund program.

Originally, the Navy's part of this program was called the Naval Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program.

The IR program is conducted in several stages as follows:

- preliminary assessment (PA),
- site inspection (SI) (formerly the PA and SI steps were called the initial assessment study under the NACIP program),
- remedial investigation and feasibility study, and
- remedial design and remedial action.

The Southern Division, Naval Facilities Engineering Command manages and the U.S. Environmental Protection Agency and the Florida Department of Environmental Protection (formerly Florida Department of Environmental Regulation) oversee the Navy environmental program at Naval Air Station (NAS) Whiting Field. All aspects of the program are conducted in compliance with State and Federal regulations, as ensured by the participation of these regulatory agencies.

Questions regarding the CERCLA program at NAS Whiting Field should be addressed to Ms. Linda Martin, Code 1859, at (803) 743-5574.

EXECUTIVE SUMMARY

Harding Lawson Associates has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command to complete a feasibility study (FS) for Site 1, Northwest Disposal Area, at Naval Air Station (NAS) Whiting Field, Milton, Florida. The FS report is being completed under contract number N62467-89-D-0317-116. The FS report for Site 1 is one in a series of site-specific reports being completed in conjunction with the NAS Whiting Field General Information Report (ABB-ES, 1998) and Remedial Investigation (RI) report (ABB-ES, 1997) to present the results of the overall RI/FS for the site. This FS report includes the development, screening, and evaluation of potential remedial alternatives addressing contaminated media at Site 1.

Site 1 is a 5-acre parcel of land located along the northwestern facility boundary of NAS Whiting Field. The site, a former disposal site, received general refuse and wastes associated with operation and maintenance of aircrafts at the station. These disposal activities occurred at the site from 1943 until 1965. Anecdotal evidence suggests waste disposal may have included unknown quantities of waste paints, paint thinners, solvents, waste oils, and hydraulic fluids.

Based on the results of the RI, including a risk assessment, the primary chemical of concern (COC) at Site 1 is arsenic in surface soil. The risk assessment indicated an excess lifetime cancer risk of 1×10^{-5} for adult and child residents exposed to arsenic in surface soil at the site. However, the concentration of arsenic at the site is less than the site-specific soil cleanup goal established for arsenic at NAS Whiting Field disposal sites (refer to Appendices A and B). The use of the site-specific cleanup goal for arsenic at these disposal sites requires land-use controls (LUCs) be implemented. Although groundwater at NAS Whiting Field has been identified as a separate site (Site 40) and will be investigated and remediated separately from Site 1, no COCs or unacceptable risks were identified for this medium.

The purpose of the FS is to identify remedial action objectives (RAOs), identify and evaluate remedial action alternatives to achieve those objectives, and recommend, based on the evaluation, the alternative best meeting the evaluation criteria. The FS contains the identification and discussion of applicable or relevant and appropriate requirements (ARARs), and a brief overview of the findings of the RI and the risk assessment in order to identify RAOs. For Site 1, two RAOs were established:

RAO 1: Establish and maintain a LUC plan for Site 1.

RAO 2: Complete closure of the disposal area in accordance with State and Federal ARARs for landfill closure.

Remedial technologies addressing site-specific considerations established in the RAOs were identified and screened; those technologies passing the screening phase were then developed into remedial alternatives. For this FS, a limited number of technologies were identified based on guidance established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations 300). This guidance indicates that because landfill (or

disposal) sites typically have similar characteristics, similar waste management approaches will be required for remediation. Furthermore, containment technologies will generally be appropriate for landfills posing a relatively low long-term threat or where treatment is impractical. Based on this guidance, a limited number of remedial technologies and alternatives were identified in this FS.

After screening of remedial technologies, alternatives were developed and analyzed in detail for comparison in the comparative analysis. Three remedial alternatives were identified to address the RAOs. These alternatives included

- the no action alternative (Alternative 1), including 5-year site reviews as required by CERCLA ($23,000);
- a site closure alternative (Alternative 2), including 5-year site reviews, LUCs ($146,000); and
- a site capping alternative (Alternative 3), including all of Alternative 2 actions, placement of a soil cover over the existing disposal site, and groundwater monitoring ($423,000).

In the comparative analysis, each alternative was compared against each other based on three criteria: threshold, primary balancing, and modifying. This analysis indicates the following:

- Alternative 1 should be eliminated from further consideration because it would not achieve the established RAOs.
- The implementation of Alternative 2 would provide protection of human health and the environment because the alternative includes LUCs. In this manner, Alternative 2 would achieve the RAOs established for the site, and would therefore achieve ARARs.
- Alternative 3 would also achieve the RAOs, but would adversely affect the existing environment at the site. Construction of a cap at the site would result in habitat destruction including destruction of a planted pine tree area and other features of the site. Implementation of Alternative 3 may also have potential short-term effects of exposure to site workers.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/s	centimeters per second
CT	central tendency
ELCR	excess lifetime cancer risk
FDEP	Florida Department of Environmental Protection
FGGC	Florida Groundwater Guidance Concentration
FS	feasibility study
FSCG	Florida Soil Cleanup Goal
GIR	General Information Report
HI	hazard index
IR	Installation Restoration
LUC	land-use control
LUCAP	Land-Use Control Assurance Plan
LUCIP	Land-Use Control Installation Plan
MCL	maximum contaminant level
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Contingency Plan
RA	risk assessment
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
TBC	to be considered
TCL	target compound list
USEPA	U.S. Environmental Protection Agency
yd^3	cubic yard

RA, and for collecting physical measurements and chemical analytical data necessary for remedial alternative evaluation in the FS. The RI provides the basis for determining whether or not remedial action is necessary. The RI Report for Site 1 at NAS Whiting Field provides the following information:

- a site description and a summary of previous investigations for Site 1;
- a summary of the field investigation methods used during the RI at the site;
- a site-specific data quality assessment;
- an assessment of the extent, magnitude, and impact of contamination at the site; and
- a qualitative and quantitative assessment of risks to human health and the environment.

The FS, described in more detail later in this chapter, uses the results of the RI and the information presented in the GIR to identify remedial action objectives (RAOs) and to develop, screen, and evaluate potential remedial alternatives. The FS is prepared in accordance with the following regulations and guidance documents: CERCLA, as amended by SARA (references made to CERCLA in this report should be interpreted as "CERCLA, as amended by SARA"); the National Oil and Hazardous Substances Pollution Contingency Plan: 40 CFR, Part 300; and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (RI/FS Guidance) (USEPA, 1988).

The remaining sections in this chapter describe the FS process for CERCLA sites (Section 1.1), presents how this process is applied to NAS Whiting Field sites (Section 1.2), and provides the conceptual understanding of Site 1 environmental conditions as of the completion of the RI report (Section 1.3).

1.1 THE CERCLA FS PROCESS. The development of remedial alternatives for CERCLA sites consists of developing RAOs and then identifying applicable technologies and developing those technologies into remedial alternatives to meet the RAOs. The NCP requires a range of alternatives be presented in the FS to the maximum practicable extent.

The first step in the FS process is to develop RAOs specifying the contaminants, media of interest, exposure pathways, and preliminary remedial goals permitting a range of alternatives to be developed. The preliminary remedial goals are developed based on chemical-specific applicable or relevant and appropriate requirements (ARARs), when available, site-specific risk-based factors, or other available information.

Once RAOs are identified, general response actions for each medium of interest are developed. General response actions typically fall into the following categories: no action, containment, excavation, extraction, treatment, disposal, or other actions, singular or in combination, taken to satisfy the RAOs for the site.

The next step in the FS process is to identify and screen applicable technologies for each general response action. This step eliminates technologies not being implemented technically. Those technologies passing the screening phase are then assembled into remedial alternatives. Remedial alternatives are then described and analyzed in detail using seven criteria described in the NCP, including

- overall protection of human health and the environment;
- reduction of toxicity, mobility, or volume of contaminants through treatment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- short-term effectiveness;
- implementability; and
- economics (i.e., cost).

Alternatives are evaluated against two additional factors after State participation and the public comment period for the FS:

- State acceptance, and
- community acceptance.

The results of the detailed analyses (for the first seven criteria) are summarized and compared in a comparative analysis. The alternatives are compared with each other against several criteria, including the following:

Threshold criteria:

- protection of human health and the environment; and

- attainment of Federal and State human health and environmental requirements identified for the site.

Primary Balancing criteria:

- cost effectiveness;

- use of permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable; and

- preference for treatment reducing toxicity, mobility, or volume of contaminants as a principal element.

These criteria are used because SARA requires them to be considered during remedy selection. **Modifying criteria**, including State and community acceptance, are also evaluated. State acceptance is evaluated when the State reviews and comments on the draft FS report and a proposed plan is then prepared in consideration of the State's comments. Community acceptance is evaluated based on comments received on the FS and proposed plan during a public comment period. This evaluation is described in a responsiveness summary in the Record of Decision (ROD).

The entire FS process provides the technical information and analyses forming the basis for a proposed remedial action plan (proposed plan), and the subsequent ROD documents the identification and selection of the remedy.

1.2 PURPOSE OF THE FS REPORT FOR SITE 1. The purpose of the FS report for Site 1 at NAS Whiting Field is to document the results of the study, including developing RAOs to address contaminated media at the site and developing, screening, and evaluating potential remedial alternatives to meet these objectives. The FS was based on the results and conclusions of the RI completed for the site, and the information presented in the GIR. Information presented in these reports will not be repeated in this FS Report.

The FS report for Site 1 was developed in accordance with the NCP and with USEPA's *Streamlining the RI/FS for CERCLA Municipal Landfill Sites* (USEPA, 1991a); both of these documents provide guidance for identifying technologies for municipal landfills. Because municipal landfill sites typically have similar characteristics, the USEPA recognizes similar waste management approaches will be required for remediation. The NCP states the following: the USEPA expects containment technologies will generally be appropriate for waste (e.g., landfills) posing a relatively low long-term threat or where treatment is impractical (Section 300.430[a][1][iii][B]). Additionally, the USEPA expects physical and/or thermal treatment to be considered for identifiable areas of highly toxic and/or mobile material constituting the principal threat(s) posed by the site (Section 300.430[a][1][iii][A]).

Therefore, the purpose of the FS report for Site 1 is not to present all the possible variations and combinations of remedial actions to be taken at the site, but to present distinctly different alternatives representing a range of opportunities for meeting the RAOs. It is expected these different alternatives can be adjusted during the proposed plan and decision process, and to a lesser extent during detailed design, to accomplish RAOs in a manner similar to the initially proposed alternative. The FS report also does not present information on alternatives failing to meet the RAOs, except for a no action alternative, which provides a baseline for comparison of all alternatives.

The following components are considered in identifying appropriate remedial action for Site 1:

- Remedial Action Objectives (RAOs) - Chapter 2.0. RAOs are developed to specify the contaminants, media of interest, exposure pathways, and remedial action goals for the site.

- Applicable Technologies - Chapter 3.0. Technologies applicable for addressing contaminated media at the site are identified and screened. Technologies that cannot be implemented are eliminated.

- Remedial Alternatives - Chapter 3.0. Technologies passing the screening phase are assembled into remedial alternatives.

- Detailed Analysis - Chapter 4.0. Selected remedial alternatives are described and evaluated using seven of the nine criteria outlined in the NCP.

- Comparative Analysis - Chapter 5.0. Remedial alternatives identified for Site 1 are compared against each other using threshold and primary balancing criteria.

Upon completion of the FS Report, a Proposed Plan will be developed. The Proposed Plan will identify the preferred remedial alternative for Site 1. This document will be written in community-friendly language, and will be made available for public comment. Upon receipt of public comments, responses to these comments will be developed in a responsiveness summary, and the ROD will be prepared. The ROD will document the chosen alternative for the site, and will include the responsiveness summary as an appendix. Once the ROD is signed, the chosen remedial alternative will be implemented.

1.3 SITE 1 ENVIRONMENTAL CONDITIONS. Site 1, Northwest Disposal Area, is a 5-acre parcel located along the northwestern facility boundary near the North Air Field at NAS Whiting Field (Figure 1-1). The site is a surface depression gently sloping toward a drainage outlet located along the southwestern site boundary (Figure 1-2). The site is currently forested with pine trees approximately 20 feet in height. Large concrete pipes and culverts and some concrete rubble are present on the ground surface of the site. Buried wastes are not exposed at the land surface in erosional areas, nor are there indications (e.g., stained soil or stressed vegetation) of other past waste disposal practices.

According to the U.S. Department of Agriculture (USDA, 1980), the soil at Site 1 is classified as Troup Loamy Sand. There is no evidence of a clay soil cap over the site area. Because the soil at the site is predominantly silty sand, much of the on-site rainfall infiltrates directly into the soil. Surface water runoff flows along the southwestern site boundary and is intercepted by concrete drainage ditch "E." This ditch is present near the southern boundary of the site and conveys surface water from the North Air Field to Clear Creek.

The results of previous investigations suggest that Site 1 received wastes from a variety of sources including military household wastes and aircraft maintenance activities at NAS Whiting Field. These investigations also indicated that the site was first utilized as a borrow area and then subsequently utilized as a landfill. Based on the results of the RI, the wastes present in the landfill do not pose a principal threat to human health or the environment. Further, the manner in which the site was developed into a landfill and subsequently operated is the primary reason resulting in arsenic levels being a principal threat. Consequently, the Navy believes Site 1 exhibits the characteristics of a CERCLA municipal landfill site and will be addressed as such in this FS.

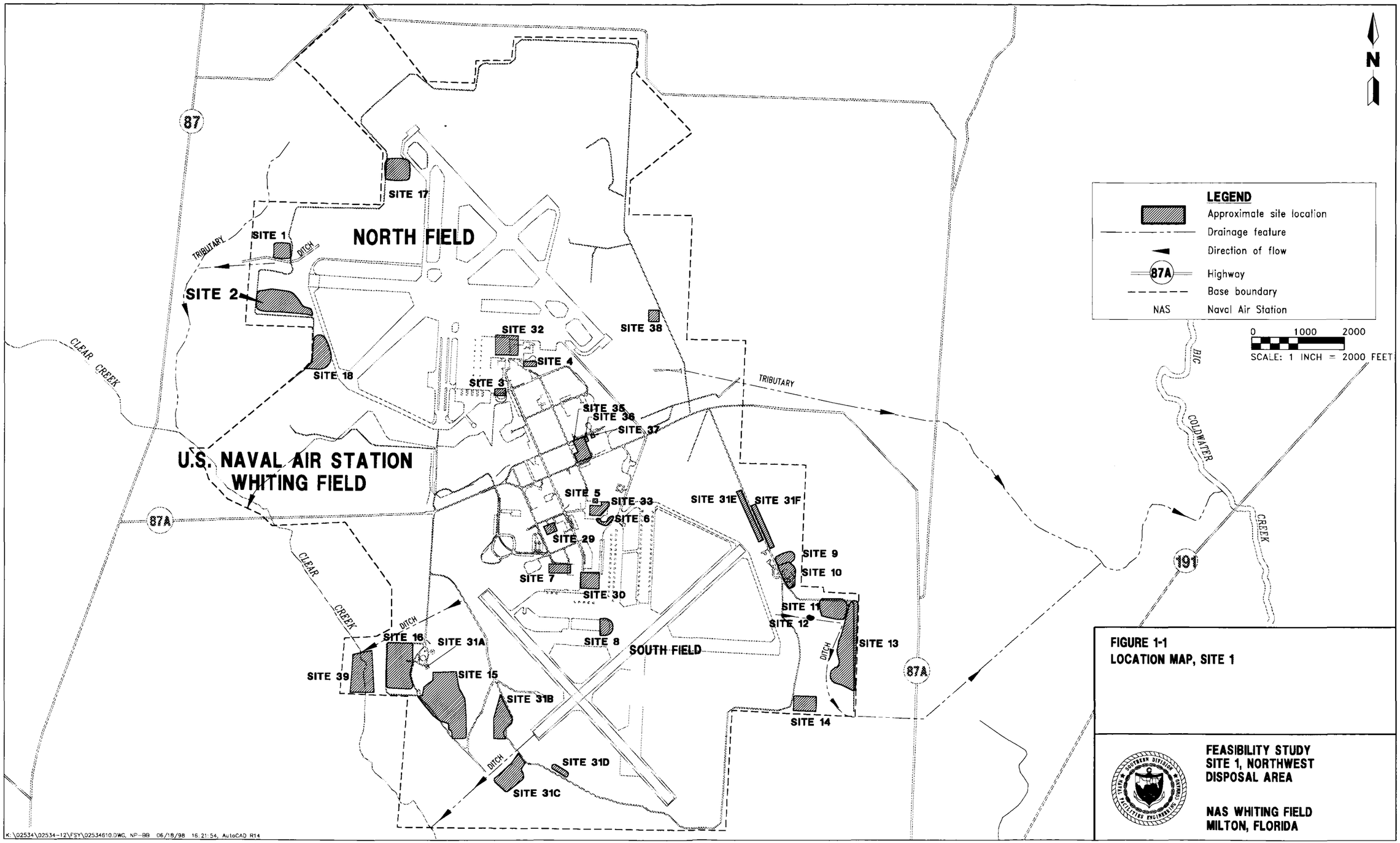

FIGURE 1-1
LOCATION MAP, SITE 1

FEASIBILITY STUDY
SITE 1, NORTHWEST
DISPOSAL AREA

NAS WHITING FIELD
MILTON, FLORIDA

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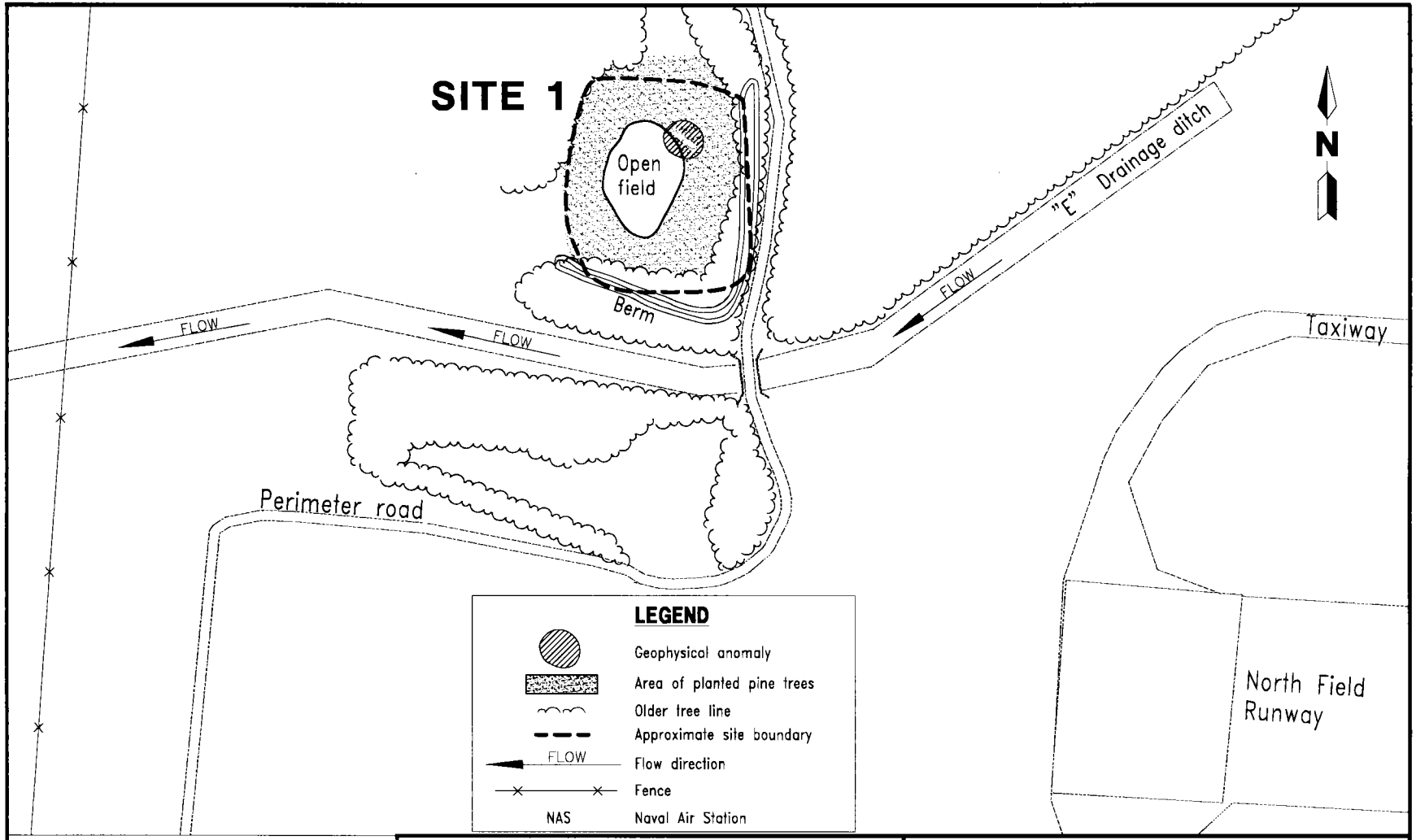

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FIGURE 1-2
SITE 1, GENERAL FEATURES

FEASIBILITY STUDY
SITE 1, NORTHWEST DISPOSAL AREA

NAS WHITING FIELD
MILTON, FLORIDA

if there are no specific ARARs for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

Under the description of ARARs set forth in the NCP and SARA, State and Federal ARARs are categorized as

- chemical-specific (i.e., governing the extent of site remediation with regard to specific contaminants and pollutants);
- location-specific (i.e., governing site features such as wetland, floodplains, and sensitive ecosystems and pertaining to existing natural and manmade site features such as historical or archaeological sites); and
- action-specific (i.e., pertaining to the proposed site remedies and governing the implementation of the selected site remedy).

During the detailed analysis of remedial alternatives, each alternative will be analyzed to determine its compliance with ARARs. Chemical-, location-, and action-specific ARARs are discussed in the following subsections, and presented in Table 2-1.

2.1.1 Chemical-Specific ARARs Chemical-specific requirements are standards limiting the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels. Currently, there are no promulgated Federal or State chemical-specific ARARs providing limits for the concentration of chemicals in soil. However, the State of Florida has provided soil cleanup goals for sites in Florida (Florida Department of Protection [FDEP], 1998).

2.1.2 Location-Specific ARARs Location-specific ARARs govern site features (e.g., wetland, floodplains, wilderness areas, and endangered species) and manmade features (e.g., places of historical or archaeological significance). These ARARs place restrictions on concentrations of hazardous substances or the conduct of activities based solely on the site's particular characteristics or location.

Observations made during the ecological survey of NAS Whiting Field indicate no State or federally listed rare, threatened, or endangered species of concern are known to exist at Site 1 (Nature Conservancy, 1997). Site 1 does not contain wetland areas and no part of the site is located within a 100-year floodplain. In addition, because site 1 was originally a borrow pit and then used as a landfill, soils at the site have been reworked. Therefore, no areas of historical or archeological significance exist at Site 1.

2.1.3 Action-Specific ARARs Action-specific ARARs are technology- or activity-based limitations controlling activities for remedial actions. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. To develop technically feasible alternatives, applicable performance or design standards must be considered during the detailed analysis of remedial alternatives. During the detailed analysis of alternatives, each alternative will be analyzed to determine compliance with action-specific ARARs.

Table 2-1
Synopsis of Federal and State ARARs and Guidance for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Hazardous Substance and Contingency Plan Regulations (40 Code of Federal Regulations [CFR], Section 300.430)	Discusses the types of institutional controls to be established at CERCLA sites.	**Applicable.** These regulations may be used as guidance in establishing appropriate institutional controls at Site 1.	Action-specific
Occupational Safety and Health Act (29 CFR Part 1910)	Requires establishment of programs to ensure worker health and safety at hazardous waste sites.	**Applicable.** These requirements apply to response activities conducted in accordance with the National Contingency Plan. During the implementation of any remedial alternative for Site 1, these regulations must be attained.	Action-specific
Resource Conservation and Recovery Act (RCRA) Regulations, Landfills (40 CFR, Part 264, Subpart N)	Provides monitoring, inspection, closure and post-closure care requirements for landfills containing hazardous waste.	**Relevant and Appropriate.** These regulations are not applicable to Site 1 because they apply only to landfills that received waste after 1980; however, the requirements may be used as guidance for developing a landfill inspection program.	Action-specific
RCRA Regulations, Releases from Solid Waste Management Units (40 CFR, Part 264, Subpart F)	Contains general groundwater monitoring requirements. Establishes detection and compliance monitoring programs applying to owners and operators of solid waste units.	**Relevant and Appropriate.** These regulations provide guidance for establishing and conducting a groundwater monitoring program at sites contaminated with RCRA wastes, if necessary.	Action-specific
Safe Drinking Water Act (SDWA) (40 CFR, Parts 141 and 143)	Establishes maximum concentration levels for contaminants in groundwater. Levels are determined based on protection of human health, technologies available for treatment, and cost data.	**Applicable.** These values should be considered when evaluating data from the groundwater monitoring program, if necessary.	Chemical-specific
USEPA, Design and Construction of RCRA/CERCLA Final Covers (May 1991)	Provides guidance on components of landfill closure, including long-term maintenance, groundwater monitoring, and institutional controls. Recommends groundwater sampling frequency and strategy.	**TBC.** This guidance may be used for establishing remedial action alternatives for closure of the Site 1 disposal area.	Guidance

See notes at end of table.

Table 2-1 (Continued)
Synopsis of Federal and State ARARs and Guidance for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
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Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Florida Groundwater Classes, Standards and Exemptions (Florida Administrative Code [FAC], Chapter 62-520)	Designates groundwaters of the State into 5 classes and establishes minimum "free from" criteria. The regulation also specifies that classes I & II must meet the primary and secondary drinking water standards listed in FAC, Chapter 62-550.	**Applicable.** These regulations may be used to evaluate data from a groundwater monitoring program, if necessary.	Chemical-specific
Florida Drinking Water Standards (FAC, Chapter 62-550)	Provides maximum concentration levels for contaminants in groundwater in the State of Florida. Implements the Federal SDWA by adopting the primary and secondary drinking water standards and by creating additional rules to fulfill State requirements.	**Applicable.** The values in this guidance should be considered when evaluating data from the groundwater monitoring program, if necessary.	Chemical-specific
Florida Groundwater Guidance Concentrations, (June 1994)	Provides maximum concentration levels for contaminants in groundwater in the State of Florida. Groundwater with concentrations less than the listed values are considered "free from" contamination.	**TBC.** The values in this guidance should be considered when evaluating data from the groundwater monitoring program, if necessary.	Guidance
Florida Soil Cleanup Target Levels (FAC, Chapter 62-785)	Default soil cleanup target levels.	**TBC.** These guidelines aid in determining health and leachability-based cleanup goals for soil promulgated after completion of RI.	Guidance
Florida Hazardous Waste Rules (FAC, Chapter 62-730)	Adopts by reference, specific sections of the Federal hazardous waste regulations, including the section regulating hazardous waste landfills (40 CFR, Part 264, Subpart N) and makes additions to these regulations.	**Relevant and Appropriate.** These regulations are not applicable to Site 1 because they apply only to landfills receiving waste after 1983; however, the requirements may be used as guidance for developing a landfill inspection program.	Chemical-specific; Action-specific
Florida Solid Waste Regulations (FAC, Chapter 62-701)	Provides guidance for design and closure of solid waste landfills in the State of Florida.	**Relevant and Appropriate.** These regulations may be relevant and appropriate when considering a cover for the disposal site as a remedial alternative.	Action-specific
Florida Rules on Hazardous Waste Warning Signs (FAC, Chapter 62-736)	Requires warning signs at National Priorities List (NPL) sites to inform the public of the presence of potentially harmful conditions.	**Applicable.** This requirement is applicable for sites on the NPL.	Action-specific

Notes: ARAR = applicable or relevant and appropriate requirement.
USEPA = U.S. Environmental Protection Agency.
TBC = to be considered guidance materials.

Certain action-specific ARARs include permit requirements. Under CERCLA Section 121(e), permits are not required for remedial actions conducted entirely on site at Superfund sites. This permit exemption applies to all administrative requirements, including approval of or consultation with administrative bodies, documentation, record keeping, and enforcement. However, the substantive requirements of these ARARs must be attained.

2.1.4 To Be Considered Criteria As previously stated, TBCs are Federal and State nonpromulgated advisories or guidance not legally binding and do not have the status of being a potential ARAR (i.e., have not been promulgated by statute or regulation). However, if there are no specific regulatory requirements for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

2.2 IDENTIFICATION OF RAOs. RAOs are defined in the CERCLA RI/FS guidance manual as media-specific goals established to protect human health and the environment, and are typically based on chemicals of concern, exposure routes, and receptors present or available at the site. RAOs are developed to ensure compliance with ARARs. RAOs for Site 1 will be identified by consideration of ARARs, the RI, and the RA.

Groundwater. Although groundwater at NAS Whiting Field has been identified as a separate site (Site 40) being investigated and remediated separately from Site 1, chemical-specific ARARs and TBCs for groundwater were considered when identifying RAOs for Site 1 based on ARARs. The concentration of two chemicals detected in unfiltered groundwater samples from the shallow portion of the surficial aquifer were greater than the Federal Maximum Contaminant Level (MCL), Florida Drinking Water Standard, and/or Florida Groundwater Guidance Concentration (FGGC). These two chemicals, aluminum and iron, are inorganics and are regulated under the Federal and State secondary drinking water standards. Table 2-2 lists these chemicals and their respective concentrations, Federal MCL, Florida Drinking Water Standard, and FGGC. Although concentrations of these chemicals exceed their respective secondary regulatory standards, an RAO will not be established for surficial groundwater for Site 1 because the risk posed by the consumption of groundwater by humans at the site is less than the USEPA target risk range (i.e., an excess lifetime cancer risk [ELCR] between 1×10^{-4} and 1×10^{-6}, and a hazard index [HI] of 1) and the FDEP risk threshold (i.e., an ELCR of 1×10^{-6} and an HI of 1).

The iron and aluminum contamination in the groundwater at Site 1, as described in Section 5.0 of the *Remedial Investigation Report* (ABB-ES, 1997), will be addressed during the investigation of Site 40 (facilitywide groundwater), groundwater at NAS Whiting Field. The investigation at Site 40 may include additional sampling of the soil at Site 1 or any other investigations necessary for assessment of the soil and groundwater at the site.

No chemicals detected in the intermediate portion of the surficial aquifer exceeded their respective chemical-specific ARARs or TBCs. Therefore, no RAOs will be established for the intermediate portion of the surficial aquifer.

The ecological assessment completed for Site 1 did not include exposure to groundwater by ecological receptors. This is because groundwater at the site is approximately 70 to 80 feet below land surface and is not expected to discharge

Table 2-2
Summary of Chemicals Exceeding Chemical-Specific ARARs and TBCs in Groundwater at Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection[1]	Range of Detected Analyte Concentrations	Mean Analyte Concentration[2]	Background Screening Value[3]	Federal MCL[4]	Florida Groundwater Guidance	
						Concentration[5]	Basis[6]
Inorganic Analytes (μg/ℓ)							
Aluminum	2/5	202 to 842	522	654	200	200	S
Iron	3/5	246 to 2,630	1,044	964	[7]300	300	S

[1] Frequency of detection is the fraction of total samples analyzed in which the analyte was detected.
[2] The mean of detected concentrations is the arithmetic mean of all environmental samples in which the analyte was detected. The arithmetic mean does not include those environmental samples in which the analyte was not detected.
[3] Background screening values are two times the arithmetic mean detected background concentrations.
[4] Federal MCLs are maximum permissible concentrations of contaminants in water that are delivered to a user by a public water system.
[5] Source: Florida Department of Environmental Protection, Florida Groundwater Guidance Concentration (June 1994).
[6] The Florida Groundwater Guidance Concentrations are based on a number of enforceable and nonenforceable State of Florida regulations:
S = secondary drinking water standards based on FAC Rule 17-550.310, .320
[7] Secondary MCL.

Notes: * Facilitywide groundwater has been identified as a separate site (Site 40) at NAS Whiting Field. This site will be addressed under a separate Remedial Investigation and Feasibility Study.

ARARs = applicable or relevant and appropriate requirements.
TBC = to be considered guidance material.
MCL = maximum contaminant level.
TAL = target analyte list.
FAC = Florida Administrative Code.
μg/ℓ = micrograms per liter.

surface water within several thousand feet at the site. Therefore, there are no current or future predicted exposure pathways for ecological receptors to groundwater. Consequently, no RAOs will be established for groundwater based on ecological receptor exposure.

Surface Soil. Chemical-specific ARARs and TBCs for surface soil were considered when identifying RAOs based on ARARs. As previously noted (Subsection 2.1.1), there are no promulgated Federal or State chemical-specific ARARs providing limits for the concentration of chemicals in soil. However, the State of Florida has provided soil cleanup target levels for sites in Florida (FAC, Chapter 62-785); these target levels are referred to as the Soil Cleanup Target Levels (SCTLs). The concentration of one chemical, arsenic, detected in surface soil exceeded its respective residential and industrial SCTL. Table 2-3 provides a summary of the detected concentrations of arsenic and its respective SCTLs and USEPA Region III Soil Screening Level.

The human health risk assessment completed for Site 1 evaluated risks to current and future users of the site. The risks posed to adult and adolescent trespassers, site maintenance workers, occupational workers, and excavation workers based on exposure to surface soil at Site 1 via direct contact, ingestion, or inhalation of particulates are less than the USEPA target risk range and the FDEP risk threshold. The ELCR posed to adult and child residents based on the same exposure pathways and reasonable maximum exposure (RME) assumptions is 1×10^{-5}, which is within the acceptable USEPA risk range and greater than the FDEP risk threshold. Noncancer risks for the adult and child resident were within the acceptable USEPA and FDEP risk thresholds.

The human health assessment for Site 1 also considered adult and child residents exposed to surface soil at the site using central tendency (CT), or average, exposure assumptions. This assessment indicated an ELCR of 1×10^{-6}, within the acceptable USEPA risk range, is acceptable to the FDEP. The range of ELCR presented by the RME and CT exposure scenarios (i.e., 1×10^{-6} to 1×10^{-5}) provide the risk managers and decision makers with a perspective of the potential risk range presented by the site.

Since completion of the RI report for Site 1, FDEP has promulgated new SCTLs (FAC, Chapter 62-785). However, because the RI report for Site 1 was completed prior to promulgation of the SCTLs, the RI utilized existing FSCGs to establish surface soil screening criteria. The affect of the SCTLs has been evaluated, however, and is presented in Appendix D of this report.

The ecological risk assessment completed for Site 1 considered exposure of terrestrial plants, terrestrial invertebrates, and wildlife to chemicals in surface soil at the site. The following is a summary of this assessment:

- Two inorganic analytes detected in surface soil, chromium and vanadium, could have potential adverse effects for plants at Site 1. However, background screening concentrations of chromium and vanadium, which are similar to site-related concentrations, also exceed the phytotoxicity benchmarks. In addition, maximum exposure point concentrations of ecological CPCs are well below available invertebrate biomass or abundance would be reduced such that small mammals and bird populations would be affected. Therefore, no RAOs will be established for terrestrial plant exposure to surface soil at Site 1. Therefore, no RAOs will be established for terrestrial plant exposure to surface soil at Site 1.

Table 2-3
Summary of Chemicals Exceeding Chemical-Specific ARARs and TBCs in Surface Soil at Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection[1]	Range of Detected Analyte Concentrations	Mean Analyte Concentration[2]	Background Screening Value[3]	Florida Soil Cleanup Goal Residential/Industrial[4]	Florida Soil Cleanup Target Level Residential/Industrial[5]	Site-Specific Soil Cleanup Goal[6]	Soil Screening Level[7]
Inorganic Analytes (mg/kg)								
Arsenic	8/8	1.3 to 4.2	2.9	3.2	0.8/[8]3.7	0.8/3.7	4.62	15

[1] Frequency of detection is the fraction of total samples analyzed in which the analyte was detected.
[2] The mean of detected concentrations is the arithmetic mean of all environmental samples in which the analyte was detected. The arithmetic mean does not include those environmental samples in which the analyte was not detected.
[3] Background screening values are two times the arithmetic mean detected background concentration.
[4] Source: Memorandum dated September 9, 1995, from John M. Ruddell, Director, Florida Department of Environmental Protection (FDEP), Division of Waste Management, to District Directors, Waste Program. Subject: Soil Cleanup Goals for Florida.
[5] Florida Administrative Code, Chapter 62-785.
[6] The site-specific cleanup goal for arsenic for disposal sites at NAS Whiting Field was approved by FDEP on April 27, 1998 (see Appendix B for a copy of this acceptance).
[7] The soil screening level is from U.S. Environmental Protection Agency Region III Risk-Based Concentration Table, dated March 1997 (USEPA, 1997).
[8] Source: Updated Memorandum dated January 19, 1996, from John M. Ruddell, Director, FDEP, Division of Waste Management to District Directors, Waste Program. Subject: Applicability of Soil Cleanup Goals for Florida.

Notes: ARAR = applicable or relevant and appropriate requirement.
FDEP = Florida Department of Environmental Protection.
NAS = Naval Air Station.
TAL = target analyte list.
TBC = to be considered guidance material.

- Terrestrial invertebrates are not at risk from exposure to chemicals detected in surface soil at Site 1.

- Lethal effects to wildlife receptors are unlikely at Site 1.

- Sublethal effects to wildlife receptors are unlikely to result in adverse effects to reproduction and survival except for the herbivore mammal. The representative species for the herbivore mammal, the cotton mouse, had a calculated HI of 2, suggesting a potential for adverse effects. The primary contributor of this sublethal risk is arsenic.

As indicated in the ecological assessment of the RI, groundwater at Site 1 is approximately 70 to 80 feet below ground surface and is not expected to discharge to surface water within several thousand feet of the site. Because of lack of standing water on the site and the limited amount of standing water within 1,000 feet of the site, wildlife access to surface water in this area is limited. Therefore, overland flow of surface water was eliminated as an exposure pathway.

Because Site 1, and several other sites at NAS Whiting Field, are disposal sites where the cover fill was most likely brought to the site from an off-site borrow source, the Navy requested that the FDEP consider a site-specific soil cleanup goal for arsenic. The Navy recommended a soil cleanup goal for arsenic at NAS Whiting Field disposal sites (Sites 1, 2, 9, 10, 11, 12, 13, 14, 15, and 16) of 4.62 milligrams per kilogram (ABB-ES, 1998). This request is included as Appendix A of this report.

The FDEP responded to this request in a letter dated April 27, 1998 (FDEP, 1998). The FDEP concurred with the recommendation for the site-specific soil cleanup goal for arsenic at NAS Whiting Field disposal sites (Sites 1, 2, 9, 10, 11, 12, 13, 14, 15, and 16), given the following conditions:

1. The sites may be utilized for activities that involve less than full-time contact with the site. This may include, but is not limited to, a) parks, b) recreation areas that receive heavy use (such as soccer or baseball fields), or c) agricultural sites where farming practices result in moderate site contact (approximately 100 days/year, or less).

2. The Navy must assure adherence to the land use by incorporating the site and conditions in a legally binding Land-Use Control (LUC) agreement.

3. The above soil cleanup goal shall not be utilized at any other site without specific Department approval.

Based on the establishment of this site-specific cleanup goal for arsenic at Site 1 at NAS Whiting Field, and as shown in Table 2-3, the establishment of a chemical-specific RAO for arsenic is not necessary.

However, in order to apply this site-specific cleanup goal, the Navy must adhere to the conditions of the FDEP concurrence letter. Namely, the Navy must establish a legally binding LUC Agreement. Therefore, the following RAOs have been established for Site 1:

RAO 1:

- Establish and maintain a LUC plan for Site 1.

Subsurface Soil. Chemical-specific ARARs and TBCs for subsurface soil were considered when identifying RAOs based on ARARs. As previously noted (Subsection 2.1.1), there are no promulgated Federal or State chemical-specific ARARs providing limits for the concentration of chemicals in soil. In addition, although the State of Florida has provided soil cleanup goals for sites in the State (FDEP, 1995), these goals, the FSCGs, apply only to surface soil (i.e., soil within the top two feet of land surface). However, for comparison purposes, the chemicals detected in subsurface soil at Site 1 were compared to the FSCGs for industrial sites, and no exceedences were noted. Based on this analysis, no RAOs will be developed for subsurface soil at Site 1.

Waste Disposal. Action-specific ARARs related to landfill closure were considered for identifying RAOs. In order to complete this review, it was noted that the disposal site at Site 1 did not receive wastes after 1965. Based on this review, Federal and State landfill closure regulations were deemed not applicable to Site 1 for the following reasons:

- Federal regulations for closure of Resource Conservation and Recovery Act (RCRA) hazardous waste landfills (40 CFR, Part 264) are not applicable because the disposal site did not receive waste after the effective date of RCRA, November 19, 1980;

- Federal regulations for the closure of solid waste landfills (40 CFR, Part 258) are not applicable because the disposal site did not receive waste after the effective date of the regulation, October 9, 1993; and

- Florida Solid Waste Disposal Facilities Regulations (Florida Administrative Code, Chapter 62-701) are not applicable because the disposal site did not receive waste after the effective date of the regulation, July 1, 1983.

The closure requirements described in these regulations do not apply to disposal areas receiving their final covers before 1983; however, closure certification of the site has not been provided by the FDEP. Therefore, the following RAO has been developed for Site 1:

RAO 2:

- Complete closure of disposal area in accordance with State and Federal ARARs for landfill closure.

Other Considerations. Although the above-referenced regulations are not directly applicable to remedial action at Site 1, portions of the regulations may be relevant for developing remedial alternatives for the site. For example, the *Draft Technical Manual for Solid Waste Disposal Criteria* (USEPA, 1992) (guidance document for implementation of Federal Solid Waste Disposal criteria) provides information regarding statistical evaluation of groundwater monitoring data (where a groundwater monitoring program is necessary). Portions of the listed regulations and applicable guidance were used as a template for the various components of the selected remedial actions for Site 1, when appropriate.

In addition, guidance published for CERCLA sites provides information regarding closure of CERCLA landfills. Specifically, closure of CERCLA landfills not subject to specific closure regulations (as stated above) can be achieved by "hybrid-landfill closure." Hybrid-landfill closure is further described in the USEPA guidance document, *Design and Construction of RCRA/CERCLA Final Covers* (USEPA, 1991b). This guidance suggests the following items be considered for hybrid-landfill closures:

- covers, which may be permeable, to prevent a direct contact threat;
- limited long-term cover maintenance;
- groundwater monitoring; and
- institutional controls, as necessary.

Based on consideration of these items and the recommendations of the RI (including the RA), some or several of these components will be considered in developing remedial alternatives for Site 1.

Summary of RAOs. Two RAOs have been established for Site 1. Table 2-4 lists these RAOs.

Table 2-4
Summary of Remedial Action Objectives for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
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Milton, Florida

Remedial Action Objectives	Description
1	Establish and maintain a land-use control plan for Site 1.
2	Complete closure of disposal area in accordance with State and Federal ARARs for landfill closure.

2.3 IDENTIFICATION OF GENERAL RESPONSE ACTIONS. General response actions describe potential medium-specific measures employed to address RAOs. Potential response actions for CERCLA sites include the following general response categories:

- no action
- limited action
- containment
- treatment (either *in situ* or *ex situ*)
- disposal

However, Site 1 is a former disposal site, and the NCP and USEPA provide further guidance for developing general response actions for such sites. The USEPA has produced a document entitled *Streamlining the RI/FS for CERCLA Municipal Landfill Sites* (USEPA, 1991a). Because landfill (or disposal) sites typically have similar characteristics, the USEPA recognizes that similar waste management approaches will be required for remediation. These approaches are presumptive remedies. The NCP states the following: the USEPA expects containment technologies will generally be appropriate for landfills posing a relatively low long-term threat or where treatment is impractical (Section 300.430[a][1][iii][B]). Therefore, the number of general response actions identified for Site 1 were limited based

on these guidance documents. The presumptive remedy for Site 1 would be a landfill cap.

Furthermore, the USEPA states in the document entitled *Streamlining the RI/FS for CERCLA Municipal Landfill Sites* (USEPA, 1991a) that physical and/or thermal treatment technologies should be considered for identifiable areas of highly toxic and/or mobile material constituting the principal threat(s) posed by the site (i.e., "hot spots"); (Section 300.430[a][1][iii][A]). The RI for this site did not identify any hot spots; therefore, the general response actions identified for Site 1 did not include treatment technologies for such areas.

In summary, the general response actions identified for Site 1 include

- no action,
- limited action, and
- containment (i.e., landfill closure and post-closure activities).

These general response actions were selected based on the aforementioned guidance and the agreement with the FDEP established for arsenic (Appendix B). The agreement with FDEP requires the use of LUCs to insure protection of human health and the environment. Because of this requirement, and CERCLA's preference for a range of alternatives, an evaluation of potential other general response actions was performed in the FS.

3.0 REMEDIAL ACTION ALTERNATIVES

The approach and rationale leading to the development of remedial alternatives for Site 1 are presented in this chapter. The development of remedial alternatives for CERCLA sites consists of identifying applicable technologies, screening those technologies, and using the selected technologies to develop remedial alternatives accomplishing the RAOs identified in Chapter 2.0.

The NCP requires a range of remedial alternatives be considered. SARA emphasizes the use of treatment technologies. Treatment alternatives range from those eliminating the need for long-term management to those reducing toxicity, mobility, or volume of contaminants. The range of alternatives considered in this FS include alternatives from the following categories:

- no action,
- limited action, and
- containment.

As discussed in Section 2.3, the NCP and USEPA provide further guidance for developing remedial alternatives (USEPA, 1991a). Because municipal landfill sites typically have similar characteristics, the USEPA recognizes that similar waste management approaches will be required for remediation. The NCP states the following: the USEPA expects containment technologies will generally be appropriate for waste (e.g., landfills) posing a relatively low long-term threat or where treatment is impractical (Section 300.430[a][1][iii][B]). In this FS, the number of technologies and alternatives evaluated for Site 1 were limited in scope based on these guidance documents.

Additionally, the USEPA states in this guidance document that treatment technologies should be considered for identifiable areas of highly toxic and/or mobile material constituting the principal threat(s) posed by the site (i.e., "hot spots") (Section 300.430[a][1][iii][A]). The RI for this site did not identify any hot spots; therefore, the treatment technologies and alternatives were not identified for Site 1.

The remaining sections of this chapter identify the types of technologies contributing the RAOs, evaluate and select representative technologies for each technology type, and develop remedial alternatives using the selected technologies. A detailed evaluation of remedial alternatives is presented in Chapter 4.0.

3.1 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES FOR SITE 1. The purpose of this section is to identify and screen appropriate technologies for remedial alternatives addressing RAOs identified for Site 1. Each technology is then screened based on site- and waste-limiting characteristics.

Site characteristics considered during this process included the following:

- site geology, hydrogeology, and terrain;
- availability of space and resources necessary to implement the technology; and

- presence of special site features (e.g., wetlands, floodplains, or endangered species).

The following waste characteristics were also considered:

- contaminated media,
- types and concentrations of waste constituents, and
- physical and chemical properties of the waste (e.g., volatility, solubility, and mobility).

Table 3-1 presents the remedial technologies applicable for addressing the RAOs for Site 1. This table also presents the screening of those technologies. The technology screening process reduces the number of potentially applicable technologies by evaluating the applicability of each technology to site- and waste-limiting factors. Technologies deemed ineffective or not implementable were eliminated from further consideration. The remaining technologies are assembled into remedial alternatives in Section 3.2.

3.2 REMEDIAL ALTERNATIVES FOR SITE 1. Remedial technologies passing the technology screening are assembled into alternatives meeting the RAOs. Table 3-2 presents the alternative development for Site 1. The alternatives for Site 1 were developed to address closure of the landfill in accordance with ARARs.

Based on the applicable technologies identified in the preceding Section, three remedial alternatives were developed for Site 1. These alternatives are options under the no action, limited action, and containment general response categories. The no action alternative was developed to provide a baseline for comparison with other alternatives (USEPA, 1988). The alternatives developed for Site 1 are discussed in the following Subsections.

3.2.1 Alternative 1: No Action The NCP requires the development of the no action alternative to provide a baseline for comparison against other remedial alternatives. This alternative (i.e., Alternative 1) does not involve the implementation of any remedial technologies to treat wastes at Site 1. Under CERCLA Section 121(c), any remedial action resulting in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years. The 5-year site review typically involves an administrative review of site records. For this FS, Alternative 1 would include 5-year reviews for a period of 30 years. A period of 30 years for 5-year site reviews was chosen for costing purposes only. Under CERCLA, 5-year reviews must continue as long as hazardous substances, pollutants, and contaminants remain at the site.

3.2.2 Alternative 2: Site Closure Alternative 2 consists of activities necessary for complete closure of the disposal site at Site 1:

- LUCs (i.e., LUC documents), and

- 5-year site reviews.

LUCs that restrict the use of the land in the vicinity of a landfill and place regulatory controls on excavation of soil would be drafted, implemented, and enforced in compliance with local regulations as a part of this alternative per FDEP's requirements to adopt the Site-Specific Cleanup Goal (Appendix B).

Table 3-1
Identification and Screening of Remedial Technologies for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
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Milton, Florida

General Response Action and Technology	Description of Technology	Applicability to:		Screening Status
		Site Characteristics	Waste Characteristics	
No Action				
No action	No remedial actions are taken at Site 1. Five-year site reviews would be required.	Applicable.	Applicable.	Retained. This alternative is retained for a baseline for comparison with other alternatives as required by CERCLA.
Five-year site reviews	Under CERCLA, if wastes are left on a site after closure, the site should be reviewed every 5 years.	Applicable.	Applicable.	Retained. This alternative is retained based on the CERCLA requirement that if wastes remain on site after closure, a review of the site must be completed every 5 years.
Site Closure				
Land-use controls (LUC)	Use of LUC documents to maintain the site for non-residential purposes.	Applicable.	Applicable.	Retained. This alternative is retained because it would achieve RAO 1.
Containment				
Closure Plan development	Development of a Closure Plan for site monitoring (includes visual observation as well as sample collection and analysis) and maintenance. Plan includes a description of the disposal history and the effectiveness of the existing landfill design.	Applicable.	Applicable.	Retained. May be necessary to obtain landfill closure certification.

See notes at end of table.

Table 3-1 (Continued)
Identification and Screening of Remedial Technologies for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

General Response Action and Technology	Description of Technology	Applicability to:		Screening Status
		Site Characteristics	Waste Characteristics	
Containment (Continued)				
Soil Cover:				
Site Clearing and Grubbing	Removal of vegetation, shrubs, and small and large brush to allow for proper grading of landfill cap.	Applicable.	Not applicable.	Retained. May be necessary if the disposal area is capped.
Placement of Compacted Soil Cover	Placement, grading, and compacting of low-permeability capping system.	Applicable. Low-permeability cap does not exist; suitable low-permeability soil will be obtained from an off-site borrow source.	Applicable. Presence of clean cover would minimize human and ecological direct contact exposure to existing surface contaminants at Site 1.	Retained. May be necessary if the disposal area is capped.
Vegetative Support Layer	A 6-inch-thick soil cover is placed over a compacted soil cover to reduce water infiltration and erosion and enhance evapotranspiration through vegetative growth.	Applicable. Reduces infiltration of precipitation, thus providing source control at Site 1.	Applicable. Would reduce infiltration of precipitation into the waste.	Retained. May be necessary if the disposal area is capped.
Vegetative Cover	Establishment of vegetation by fertilizing, mulching, seeding, and planting.	Applicable. Vegetation would reduce infiltration and reduce erosion of soil cover.	Applicable. Would reduce direct contact with exposed waste.	Retained. May be necessary if the disposal area is capped.
Surface Water Management	The final cover design will consist of a top gradient (slope) between 3 and 4 percent and side slopes between 3 and 33 percent to comply with Florida landfill regulations.	Applicable. Would minimize erosion and maintenance.	Applicable. Would reduce erosion of contaminated soil.	Retained. This design will comply with Florida regulations and will ensure adequate surface water drainage into "E" ditch.
Groundwater Monitoring	Sampling and analysis of groundwater upgradient and downgradient of the landfill.	Applicable.	Applicable. Monitors migration of contaminants from landfills.	Retained. May be necessary if the disposal area is capped.

Notes: CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
RAO = remedial action objective.

Table 3-2
Development of Remedial Alternatives for Site 1

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Alternative	Description of Key Components
Alternative 1: No action	Five-year site review.
Alternative 2: Site Closure	Land-Use Controls (LUCs) including LUC Assurance and Implementation Plans.
	Five-year site review.
Alternative 3: Site Closure with Capping	Closure plan (including post-closure care) development to monitor and maintain site.
	LUCs including LUC Assurance and Implementation Plans.
	Posting of warning signs.
	Removal of surface debris.
	Disposal of surface debris.
	Clearing and grubbing of landfill site.
	Cap construction.
	Vegetative establishment to minimize erosion of final cover and enhance evapotranspiration.
	Surface water runoff management to minimize erosion of final cover and minimize maintenance requirements.
	Groundwater monitoring.
	Five-year site review.

Additionally, LUCs mandate that an ongoing inspection program be implemented to ensure compliance while the LUC restrictions are in effect. These restrictions will remain in effect until such time that the contamination at the site has been adequately addressed.

LUCs controlling the use of the land in the vicinity of a landfill and placing regulatory controls on excavation of soil would be drafted, implemented, and enforced in compliance with local regulations as a part of this alternative. The LUC will be placed on the parcel of land encompassing the disposal site, including a typical buffer zone, as is currently used at other landfill sites in the State.

Under CERCLA Section 121(c), any remedial action resulting in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years.

3.2.3 Alternative 3: Site Closure and Capping One containment alternative developed for Site 1 consists of all components of Alternative 2 with the addition of a capping component. Containment alternatives require no treatment of contaminated materials.

Under this alternative, a cover system would be constructed over the former landfill to reduce the infiltration of precipitation, control surface water run-on and runoff, and minimize potential direct contact risks. Reduction of infiltrating precipitation and surface water reduces contaminant leaching from soil and landfill wastes to groundwater. Surface water runoff controls would also be included to minimize erosion. The cover design would be in accordance with USEPA guidance provided in *Design and Construction of RCRA/CERCLA Final Covers* for hybrid-landfill closure (USEPA, 1991b).

Prior to cap construction, the site would be cleared, grubbed, and graded. To minimize run-on, erosion from runoff, and infiltration, landfill slopes would be graded to a 3:1 slope or flatter (3 horizontal:1 vertical). The initial soil layer would consist of clean fill compacted to a minimum thickness of 18 inches. Six inches of soil would then be placed on top of the clean fill. Once in place, the soil layer would be seeded.

During the construction phase of this alternative, temporary erosion control measures would be in place. These measures would remain in place until a vegetative cover was established.

Post-closure monitoring and maintenance of the installed cover system would be required until the cover system stabilized. This monitoring and maintenance program would include visual inspections and maintenance of the vegetative cover. For cost estimating purposes, monitoring and maintenance is estimated for a minimum of 5 years after closure.

In addition, LUCs and 5-year reviews would be implemented as previously discussed. The 5-year site review will assess the need for continued cover system monitoring and maintenance.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

This chapter presents detailed analyses of alternatives for Site 1 at NAS Whiting Field. A detailed analysis is performed to provide decision makers with sufficient information to select the appropriate remedial alternative for a site. The detailed analysis has been conducted in accordance with CERCLA Section 121, the NCP, and USEPA RI/FS Guidance (USEPA, 1988). The detailed evaluation of each remedial alternative includes the following:

- a detailed description of the alternative, emphasizing the applications of the technology or actions proposed for each alternative; and

- a detailed analysis of the alternative against seven of the nine criteria.

The remedial alternatives are examined with respect to the requirements stipulated by CERCLA and factors described in the USEPA's *Guidance for Conducting RI/FS Under CERCLA* (USEPA, 1988). The nine criteria from the RI/FS Guidance document are

- overall protection of human health and the environment,
- compliance with ARARs,
- long-term effectiveness and permanence,
- reduction of toxicity, mobility, and volume of contaminants through treatment,
- short-term effectiveness,
- implementability,
- cost,
- State acceptance, and
- community acceptance.

This FS presents evaluation of the first seven criteria in the alternative evaluation process. Table 4-1 outlines the specific elements considered for these seven criteria.

Typically, State acceptance (i.e., the eighth factor) is addressed when comments on the draft FS Report have been received from the State. Therefore, State comments will be addressed in the Final FS, and a summary of State acceptance of this FS will be included in the Final FS Report.

Community acceptance (i.e., the ninth factor) is addressed upon receipt of public comments on the Proposed Plan (USEPA, 1988). The responsiveness summary, included as an appendix to the ROD for the site, is intended to provide the overview of achievement of this ninth criterion.

4.1 DETAILED ANALYSIS FOR ALTERNATIVE 1: NO ACTION. Alternative 1 is a no action alternative. Under this alternative, no actions would be taken to address contamination at the site. A description of this alternative is presented in Subsection 4.1.1, and a technical assessment of this alternative is presented in Subsection 4.1.2.

Table 4-1
Factors for Detailed Analysis of Remedial Alternatives

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Factors	Criteria to Consider
Overall protection of human health and the environment	How risks are eliminated, reduced, or controlled. Short-term or cross-media effects.
Compliance with ARARs	Compliance with chemical-specific ARARs. Compliance with location-specific ARARs. Compliance with action-specific ARARs.
Long-term effectiveness and permanence	Magnitude of residual risk. Adequacy of controls. Reliability of controls.
Reduction of mobility, toxicity, and volume of contaminants through treatment	Treatment process and remedy. Amount of hazardous materials destroyed or treated. Reduction of mobility, toxicity, or volume through treatment. Irreversibility of treatment. Type and quantity of treatment residual.
Short-term effectiveness	Protection of community during remedial action. Protection of workers during remedial action. Environmental effects. Time until RAOs are achieved.
Implementability	Ability to construct technology. Reliability of technology. Ease of undertaking additional remedial action, if necessary. Coordination with other agencies.
Cost	Capital cost. Operation and maintenance cost. Total present worth of alternative.

Notes: ARAR = applicable or relevant and appropriate requirement.
RAO = Remedial Action Objective.

4.1.1 Detailed Description of Alternative 1 In accordance with the NCP, the no-action alternative is used as a baseline for comparison against other alternatives. Because hazardous substances, pollutants, or contaminants would be left in place at Site 1 as part of this alternative, this alternative would include 5-year site reviews. There would be no restrictions on land-use types; therefore, the site could be used for residential use or other high-exposure uses.

Five-Year Site Reviews. Under CERCLA Section 121(c), any remedial action resulting in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years. It is assumed, for this FS, that these reviews would occur over a 30-year period. These reviews would consist of evaluating changes to site conditions at the site (e.g., construction, demolition, change in potential receptors, migration pathways, qualitative risks, etc.) to assess whether or not human health and the environment continue to be protected by the alternative. The appropriateness of this alternative would then be compared to other remedial alternatives to confirm that it is still the most appropriate selection.

4.1.2 Technical Criteria Assessment of Alternative 1 This subsection provides the technical criteria assessment of Alternative 1 against the seven criteria.

Overall Protection of Human Health and the Environment. This alternative would provide no additional protection to human receptors who may be exposed to soils at Site 1. If this alternative were selected, 5-year site reviews would be instituted.

No adverse short-term or cross-media effects are anticipated with this no-action alternative.

Compliance with ARARs. This alternative would not comply with chemical-specific ARARs or TBCs (e.g., MCLs, FGGCs, or FSCGs) in the short term. It is unlikely that this alternative will comply with ARARs.

Long-term Effectiveness and Permanence. Human risks due to exposure to site soils would not be addressed via this alternative. Therefore, these risks would remain over a period of time until LUCs are implemented.

Administrative actions proposed in this alternative (e.g., 5-year site reviews) would provide a means of evaluating the effectiveness of the alternative, but would not provide a permanent remedy for the site. Administrative actions are considered to be reliable controls.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Because no treatment is included in this alternative, this alternative will not reduce contaminant toxicity. Additionally, this alternative will not provide a reduction in contaminant mobility or volume because no active mitigation of contaminant mobility or reduction in volume is proposed. No treatment residuals would be produced if this alternative were implemented.

Short-term Effectiveness. This alternative would not reduce human health risks in the short term because no land-use restrictions would be implemented.

This alternative would not comply with RAOs in the short term because the only means of contaminant reduction posed by this alternative is natural degradation processes.

This alternative does not pose a threat to workers through exposure to contaminated soils because remedial construction activities are not proposed under this alternative.

Implementability. This alternative does not require remedial construction for implementation. Other activities, such as 5-year site reviews are easily implemented.

Cost. The present worth cost of Alternative 1 is presented on Table 4-2. The 5-year site reviews proposed out over a 30-year monitoring period. A 30-year period was chosen only because the RI/FS guidance suggests using this timeframe. The total present worth cost of Alternative 1 is $23,000. Cost estimates are presented in Appendix C.

Table 4-2
Cost Summary Table, Alternative 1: No Action

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Operation and Maintenance Cost (O&M) (per event)	
5-year site review	$6,000
Total O&M cost (per event)	$6,000
Total O&M cost (present worth of semi-annual O&M for 30 years)	$21,000
Contingency (10 percent)	$2,000
Total cost Alternative 1: no action	$23,000

Note: Costs are rounded to the nearest $1,000. Detailed costing is included in Appendix C.

4.2 DETAILED ANALYSIS FOR ALTERNATIVE 2: SITE CLOSURE. Alternative 2 consists of administrative actions to limit the exposure to soils at Site 1. A description of this alternative is presented in Subsection 4.2.1, and a technical assessment of this alternative is presented in Subsection 4.2.2.

4.2.1 Detailed Description of Alternative 2 Under this alternative, LUCs would be implemented providing protection of human receptors. These LUCs would involve the use of institutional controls that would control the use of the land in the vicinity of Site 1. Additionally, LUCs would place regulatory controls on the excavation of soils or similar activities having the potential to disturb the site soils or increase the likelihood of exposure to the site soils. The LUCs would be placed on a parcel of land slightly larger than the boundaries of the current landfill. This would ensure that an appropriate buffer zone is created and maintained between the landfill and other areas of NAS Whiting Field.

The following components would be included as part of this alternative:

- LUCs
- 5-year site reviews

LUCs. Under new USEPA Region IV guidance, the use of LUCs as a remedy for contaminated sites requires the development of an LUC Assurance Plan (LUCAP) or

MOA and an LUC Implementation Plan (LUCIP). These two documents detail the actions required when LUCs are selected as a remedy for a site.

The LUCAP (MOA) is developed for the entire facility where LUCs are necessary. In this case, an LUCAP would be developed for NAS Whiting Field. This document would identify an individual at the facility who is responsible for ensuring no activities occur at a site where LUCs are necessary, violating what has been specified in the LUCs.

The LUCIP is then developed for each site where LUCs are necessary on the facility. The LUCIP would include details regarding additional required activities, such as restricting residential or recreational use and quarterly and annual inspection and reporting for the specific area. These measures ensure the selected LUCs will remain adhered to through time.

5-Year Site Reviews. Refer to Subsection 4.1.1 for a detailed description of these reviews.

4.2.2 Technical Criteria Assessment of Alternative 2 This subsection presents the technical criteria assessment of Alternative 2.

Overall Protection of Human Health and the Environment. Human receptors, namely residents, would be protected if this alternative were implemented. Regulatory controls (i.e., LUCs) would prohibit potential future residents from exposure to the site because residential use of the site would be restricted under the proposed LUCs. However, this alternative would not provide protection for ecological receptors at the site.

By implementing this alternative, no adverse short-term or cross-media effects are anticipated.

Compliance with ARARs. This alternative would not comply with chemical-specific ARARs or TBCs (e.g., MCLs, FGGCs, or FSCGs) in the short term. It is unlikely that this alternative will comply with ARARs.

Long-term Effectiveness and Permanence. The risks presented to the future resident based on exposure to surface soil at the site would be addressed via the LUCs. The long-term effectiveness and permanence of these controls will be controlled by the facility under the LUCAP developed for NAS Whiting Field.

Administrative actions proposed in this alternative (e.g., LUCs and 5-year site reviews) would provide a means of evaluating the effectiveness of the alternative. These administrative actions are considered to be reliable controls, as long as the facility maintains its LUCAP/LUCIP.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Because no treatment is included in this alternative, this alternative will not reduce contaminant toxicity. Additionally, this alternative would not provide a reduction in contaminant mobility or volume because no active mitigation of contaminant mobility or reduction in volume is proposed. No treatment residuals would be produced if this alternative were implemented.

Short-Term Effectiveness. This alternative would reduce human health risks in the short term by reducing the potential exposure to Site 1 soils by human receptors. However, ecological receptors would not be affected by this implementation of this alternative.

This alternative does not pose a threat to workers through exposure to contaminated soils because only limited remedial construction activities (e.g., posting signs) are proposed under this alternative.

Implementability. This alternative does not require remedial construction for implementation. Other activities, such as LUCs and 5-year site reviews, are easily implemented.

Cost. The present worth cost of Alternative 2 is presented on Table 4-3. Both the LUCs and 5-year site reviews were costed out over a 30-year monitoring period. A 30-year period was chosen only because it is what the RI/FS guidance recommends. The total present worth cost of Alternative 2 is $146,000. Cost estimates are presented in Appendix C.

Table 4-3
Cost Summary Table, Alternative 2: Site Closure

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Direct Cost	
Land-use controls	$12,000
Total direct cost	$12,000
Operation and Maintenance Cost (O&M) (per event)	
5-year site review	$ 6,000
Inspection/Reporting	$7,000
Total O&M cost (per event)	$ 13,000
Total O&M cost (present worth of semi-annual O&M for 30 years)	$121,000
Total Direct and O&M	$133,000
Contingency (10 percent)	$13,000
Total cost Alternative 2: Site Closure	$146,000

Note: Costs are rounded to the nearest $1,000. Detailed costing is including in Appendix C.

4.3 DETAILED ANALYSIS FOR ALTERNATIVE 3: SITE CLOSURE AND CAPPING. Alternative 3 consists of constructing an engineered cap at Site 1. A description of this alternative is presented in Subsection 4.3.1, and a technical criteria assessment of this alternative is presented in Subsection 4.2.2.

The design criteria presented in this section are intended for cost comparison purposes only and are not intended to be final design specifications. If Alternative 3 is the selected remedy for Site 1, it is recommended that land surveying, additional field sampling, and geotechnical testing be completed prior to preparing design plans and specifications. Final design plans and specifications should be prepared and sealed by a Florida-registered Professional Engineer.

4.3.1 Detailed Description of Alternative 3 Alternative 3 is designed to address closure of the landfill and exposure to surface soils at Site 1. Based on an evaluation of ARARs, landfill closure regulations are not directly applicable for Site 1, although several guidance documents were reviewed as to their applicability to the site (refer to Section 2.2).

The selected landfill cover design for Alternative 3 is primarily based on the Florida landfill closure regulations (FAC, Chapter 62-701). This document was used to develop appropriate criteria for a soil cover design and to formulate a cost estimate for the detailed evaluation of this alternative. The following components of this site closure and capping alternative are described below:

- site preparation, clearing, and grubbing;
- landfill capping;
- surface water drainage; and
- post-closure care.

Because a landfill gas survey was performed during the RI, one is not proposed as a part of this alternative. The results indicated landfill gas generation was not occurring. Consequently, no provision for landfill gas generation was included in the detailed analysis.

Site Preparation, Clearing, and Grubbing. A stockpile area, with a 12-inch-thick gravel base, would be installed at the site and would be large enough to provide sufficient volume for several days of filling and grading operations associated with this alternative. An area adjacent to the stockpile area would be prepared with a 12-inch-thick gravel base to be used as a parking area for construction-support trailers and heavy equipment. Equipment mobilized to the site would include earth-moving equipment such as backhoes, front-end loaders, bulldozers, and dump trucks.

Surface debris, including large concrete pipes and culverts, was observed at Site 1. All surface debris will be removed with a trackhoe or other type of excavation equipment prior to grading Site 1. The debris will be removed prior to construction of the landfill cap to avoid stability impacts of settlement. The debris will be staged on site at a designated location. The debris will then be characterized for disposal at either a construction and demolition debris disposal facility or an RCRA-permitted hazardous waste disposal facility. Based on information collected during the RI, it is anticipated that the debris can be disposed as non-hazardous material. Partially or fully buried debris will be left in place and covered during the site grading and placement of the compacted soil cover.

The topography of Site 1 is assumed to be generally level. Pine trees, shrubs, and other vegetation will be cleared with a trackhoe or other type of excavation equipment to provide a cleared surface for placement of the landfill cap. Small brush and vegetation will be chopped and spread over the landfill surface. Large trees will be disposed as yard-waste at an appropriate mulching or tree recycling facility, or chipped and spread over the landfill surface prior to construction of the cap.

Landfill Capping. The State of Florida requires the landfill cap to be less permeable than the existing cover; the proposed cap was intended to meet this requirement. Based on slug tests conducted at shallow monitoring wells, the permeability of the underlying soils at the landfill is estimated to be 19.47 feet/day (6.9×10^{-3} centimeters per second [cm/s]) (ABB-ES, 1997). Therefore, an 18-inch compacted soil layer with a permeability less than 6.9×10^{-3} cm/s would comply. Because groundwater has not been determined to be a health risk at this time, there is no need to prevent infiltration. Based on this analysis, a fine-grained soil layer (7,065 cubic yards [yd^3]) with a compacted permeability less

than 6.9×10^{-3} cm/s will be obtained from an off-site borrow source. The borrow soil will be tested to verify it is "clean" fill and exhibits a pH between 6 and 7.5.

This soil will be compacted with a sheepsfoot or smooth roller to achieve a structurally stable surface less permeable than the soil underlying the landfill waste. In accordance with State of Florida landfill closure regulations, the compacted soil cover will be designed to achieve a slope not exceeding 4 percent grade (100 feet horizontal run to 4 feet or less vertical rise). State of Florida landfill closure regulations suggest design grades be no less than 3 percent (100 feet horizontal run to 3 feet or more vertical rise) to ensure adequate surface water drainage. Thus, the final cover design will consist of a top slope between a 3 and 4 percent grade and side slopes between 3 and 33 percent grade.

This design will comply with Florida landfill regulations (FAC, Chapter 62-701) and will provide adequate surface water drainage into the "E" ditch located south of the landfill.

A final 6-inch layer of soil (1,200 yd^3) will be placed over the compacted soil to support vegetative growth. The soil will be obtained from an off-site borrow source to provide the adequate soil composition required to stimulate and support natural vegetation. The soil will be tested to verify that it is "clean" fill and exhibits a pH between 6 and 7.5.

Selected seed and fertilizer will be placed on the vegetative support layer to establish vegetation. Hay will be used to protect the seed and fertilizer during initial development. Post-closure care will include provisions to stimulate growth. The vegetative cover will minimize erosion by developing root systems within the vegetative support layer which overlies the compacted soil cover material. The vegetation will also provide evapotranspiration of moisture contained in the soil cover, increasing the cover's structural stability and reducing infiltration of rainwater through the 1.5 acre cover and underlying wastes.

Surface Water Drainage. Natural surface water drainage that exists at the site will be maintained to the extent possible. The final topographic surface of the landfill cover will be designed to direct surface water into the "E" ditch south of the landfill. The perimeter of the landfill will be cleared as necessary to maintain adequate drainage. If required, excavation or additional soil will be used to enhance the drainage system. The drainage system will have the capacity to control a 24-hour, 25-year storm event.

Post-Closure Care and Groundwater Monitoring. Post-closure care and groundwater monitoring will consist of the activities listed below, performed on an annual basis for a period of 5 years after cover construction.

- Visually inspecting, seeding, watering, and otherwise maintaining the vegetation on the surface of the closed landfill.

- Visually inspecting the landfill cover for signs of wear or discontinuities, such as seeps, pits, cracks, or other imperfections compromising the cover's structural integrity.

4.3.2 Technical Criteria Assessment of Alternative 3 This subsection presents the technical criteria assessment of Alternative 3.

Overall Protection of Human Health and the Environment. A maximum standard of protection to human receptors would be provided by the implementation of this alternative, in a landfill cover and regulatory controls (i.e., LUCs) would prohibit potential human receptors from coming into contact with the soils at Site 1. This alternative would also provide protection for ecological receptors at the site; however, in doing so, this alternative may alter the native ecological habitat present at the site.

Compliance with ARARs. Landfill closure requirements under RCRA Subtitles C and D, as well as Florida Solid Waste Disposal Facilities Regulations, are not applicable to this alternative because the landfill did not receive waste after the effective dates of the regulations (post 1965). However, appropriate portions of those regulations, such as recommended top and side slopes, were used in designing the landfill cover.

Worker safety standards will be maintained during construction activities to comply with ARARs. Dust control will be used to minimize the spread of wind-blown soil during site grading. A site-specific health and safety plan will be developed and implemented during all site activities. However, contact with landfill wastes is not anticipated during construction of the cover.

Groundwater sampling and analysis will be performed in accordance with appropriate contract laboratory protocol.

Five-year site reviews of monitoring data will be prepared to assess the effectiveness of the alternative.

Long-Term Effectiveness and Permanence. The construction of a soil cover will prevent human health risks posed by dermal contact, ingestion, and inhalation of surface soil and wind-blown particulates and ecological risks. The compacted soil cover will be less permeable than the existing fill and surface soil. This cover will (1) minimize the infiltration of surface water, (2) prevent the potential contamination of surface water by the landfill contents, (3) prevent ponding of water on the landfill surface, and (4) direct surface water into the "E" ditch. Thus, human health and ecological risks as a result of exposure to surface water will be minimized.

This alternative includes an operation and maintenance program to ensure the continued structural stability of the cover design. Alternative 3 can be viewed as a permanent method of reducing or eliminating human health risks posed by dermal contact, ingestion, and inhalation of surface soil and wind-blown particulates if the cover stability shows permanence after completion of the 5-year review.

Similar to human health risk reduction, the soil cover will also be designed to prevent risks posed to ecological receptors. A vegetative cover will be placed over the compacted soil to allow growth of native vegetation. The vegetation will increase evapotranspiration and reduce cover erosion. The risk posed to local species by ingesting biota that contain contaminants in their tissue, or by directly ingesting surface soil that contains contaminants, will be eliminated by placement of the compacted soil.

Alternative 3 will include clearing and grubbing vegetation currently existing on the landfills. Existing vegetation will be removed, and ecological diversity will be reduced at Site 1. This ecological loss is not permanent; new vegetation will be planted on the final cover to induce continued ecological growth. However, this new vegetation will consist of mostly grasses and small brush, which is not as diverse as the natural vegetation currently existing. The clearing and grubbing of the existing vegetation can be viewed as a permanent long-term ecological impact.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Alternative 3 does not include treatment of contaminants, and does not physically or chemically alter contaminants contained in the landfills. Thus, this alternative does not reduce the toxicity, mobility, and/or volume of contaminants through treatment. However, the cover design will effectively reduce the mobility of contaminants contained in surface soil by preventing the spread of wind-blown particulates and by limiting infiltration. The cover will also prevent the uptake of contaminants contained in surface soil, which will prevent biomagnification of contaminants through the local ecological food chain.

Short-Term Effectiveness. During the clearing, grubbing, and grading of the site, fugitive dust will be generated. This dust may contain hazardous particulates posing an inhalation risk to human receptors. Dust suppression by the use of water trucks and hoses is included in this alternative to minimize these potential short-term risks.

Site workers will be exposed to increased risks by dermal contact, ingestion, and inhalation during construction activities. Appropriate personal protective equipment can be used to minimize this increased risk.

Alternative 3 will include clearing and grubbing vegetation currently existing. Ecological species depending upon the surface of the landfills for food and other natural resources will be impacted by the removal of existing vegetation. This unavoidable construction item is an adverse short-term impact and will be reversed upon the growth of new vegetation. Construction operations are expected to last for 2 to 3 months, and new vegetation will likely require years to mature. Thus, the short-term ecological impacts as a result of clearing and grubbing the site may be significant.

Implementability. Equipment and materials are readily available to construct the cover designed for Alternative 3. Site work will be completed within a 3-month period, and will require standard construction expertise. Because of the difficulty in obtaining borrow soil in the vicinity of the site, compacted soil will be obtained from a non-local borrow source. The lack of local borrow sources would result in additional transportation cost, but does not render the alternative infeasible.

Cost. The cost estimate for Alternative 3 is presented in Table 4-4, and detailed cost calculations are provided in Appendix C. This estimate is based on the preliminary design criteria presented in this section. If this alternative is selected, land surveying, additional field sampling, and geotechnical testing should be performed during design to prepare a complete set of design plans and specifications. The total present worth cost of Alternative 3 is approximately $423,000.

Table 4-4
Cost Summary Table, Alternative 3: Site Closure and Capping

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

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Direct Cost	
Mobilization	$21,000
Site preparation	$12,000
Site clearing and grubbing	$15,000
Compacted soil	$97,000
Vegetative support layer	$15,000
Dust control	$1,000
Site restoration	$14,000
Land-use controls	$12,000
Total direct cost	$187,000
Indirect Cost	
Health and safety (3 percent)	$6,000
Administration and permitting (3 percent)	$6,000
Engineering and design (10 percent)	$19,000
Construction support services (10 percent)	$19,000
Total indirect cost	$50,000
Total capital cost (direct + indirect)	$237,000
Operation and Maintenance (O&M) Cost (per event)	
Land-use controls	$7,000
Site maintenance	$2,000
5-year site review	$6,000
Total O&M cost (per event)	$15,000
Total O&M Cost (present worth of annual O&M for 30 years)	$148,000
Total Direct and O&M costs	$385,000
Contingency (10 percent)	$38,000
Total cost Alternative 3: site closure and capping	$423,000

Note: Costs are rounded to the nearest $1,000.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Remedial alternatives for Site 1 were developed in Chapter 3.0 and were individually evaluated in Chapter 4.0 using seven technical criteria. For comparative purposes, these criteria are grouped into the following categories:

- threshold criteria,
- primary balancing criteria, and
- modifying criteria.

The remainder of this chapter presents a comparison of remedial alternatives with respect to these criteria. This comparison is intended to provide technical information required to support the selection of a preferred alternative for Site 1.

5.1 OVERALL APPROACH TO COMPARATIVE ANALYSIS. As presented in Chapter 4.0, remedial alternatives were developed to accomplish the RAOs identified for the site. The three sets of criteria identified above are used to streamline the comparison between alternatives, while ensuring compliance with the RAOs. Components of these criteria are described below.

5.1.1 Threshold Criteria Because the selected remedy must be protective of human health and the environment, as well as comply with ARARs, the following two threshold criteria are essential:

- overall protection of human health and the environment, and
- compliance with ARARs.

An individual assessment of each alternative with respect to these criteria was presented in Chapter 4.0. An overall comparative analysis of alternatives using threshold criteria is presented in Section 5.2.

5.1.2 Primary Balancing Criteria Primary balancing criteria consist of the following five components:

- long-term effectiveness and permanence;
- reduction of toxicity, mobility, and volume of contaminants through treatment;
- short-term effectiveness;
- implementability; and
- cost.

These criteria are used to provide an assessment of the permanence of each remedial alternative, while ensuring their implementability and cost-effectiveness. An individual assessment of each alternative with respect to these criteria is presented in Chapter 4.0. An overall comparative analysis of alternatives using primary balancing criteria is presented in section 5.2.

5.1.3 Modifying Criteria The final two criteria are as follows:

- State acceptance, and
- community acceptance.

Typically, State acceptance (i.e., the eighth factor) is addressed when comments on the draft FS Report have been received from the State. Therefore, State comments will be addressed in the Final FS, and a summary of State acceptance of this FS will be included in the Final FS Report.

Community acceptance (i.e., the ninth factor) is addressed upon receipt of public comments on the Proposed Plan (USEPA, 1988). The responsiveness summary, included as an appendix to the ROD for the site, is intended to provide the overview of achievement of this ninth criterion.

Based on this information, an evaluation of modifying criteria is not included in this FS.

5.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 1. This section provides the comparative analysis for remedial alternatives for Site 1 with respect to the criteria described in Section 5.1.

5.2.1 Comparison of Threshold Criteria The alternatives for source control were first compared to the two threshold criteria, overall protection of human health and the environment, and compliance with ARARs.

Alternative 1 should be eliminated from further consideration for the following reasons:

- Alternative 1 does not provide a means of restricting future land use of the area. Therefore, this alternative does not protect potential future residents from environmental conditions at the site.

- Site closure of the landfills would not be achieved via implementation of this alternative.

- Alternative 1 would not achieve either RAO, given the two previous statements.

- RAO 2 was established based on compliance with ARARs for the site. Alternative 1 would not achieve RAO 2; therefore, it would not achieve ARARs.

The implementation of Alternative 2 would provide a measure of continued protection of human health and the environment because the alternative includes LUCs and a site closure plan. In this manner, Alternative 2 would achieve the RAOs established for the site, and would therefore achieve ARARs.

Alternative 3 would also achieve the RAOs, but would adversely affect the existing environment at the site. Construction of a cap at the site would result in habitat destruction including destruction of planted pine tree area and other features of the site. Implementation of Alternative 3 may also have potential short-term effects of exposure to site workers.

Because the implementation of Alternative 2 would achieve the RAOs, and because the implementation of Alternative 3 would adversely affect the environment at site, Alternative 2 is preferred to Alternative 3.

5.2.2 Comparison of Primary Balancing Criteria The primary balancing criteria emphasize long-term effectiveness and permanence and reduction in mobility, toxicity, and volume of contaminants through treatment. The alternatives evaluated for Site 1 would not reduce the toxicity, mobility, or volume of contaminants at the site, as none of the alternatives involve treatment of contaminants in media at the site. Alternative 3 would provide a reduction in the leaching of contaminants from waste in the landfills; however, it does not appear contaminants are currently leaching from wastes to the groundwater. In addition, groundwater at NAS Whiting Field has been identified as a separate site (Site 40), to be investigated and remediated separately from Site 1.

Alternative 3 would provide the greatest direct adverse short-term impacts on potential ecological receptors via clearing and grubbing activities. These impacts could be mitigated if Alternative 2 were implemented; no short-term impacts to the environment are expected during implementation of Alternative 2.

The implementability of Alternative 2 would be comparatively easy. However, an MOA and LUCIP would need to be developed. The documents should be easy to complete, but implementation of the LUCs may be extended until an MOA is signed between USEPA, FDEP, and NAS Whiting Field.

Design plans would need to be prepared for Alternative 3 and the appropriate substantive requirements of the permit requirements for landfill capping would need to be met prior to implementation of that alternative. Alternative 3 would also be the most costly of the alternatives.

5.2.3 Modifying Criteria As stated in Subsection 5.1.3, an evaluation of modifying criteria will not be included in this FS.

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APPENDIX A

APPENDIX A

NAVY'S REQUEST FOR SITE-SPECIFIC SOIL CLEANUP GOAL FOR ARSENIC AT DISPOSAL SITES AT NAS WHITING FIELD

Evaluation of Background Arsenic Concentrations for Covered Landfill Sites

At Naval Air Station (NAS) Whiting Field nine soil types, as identified by the U. S. Department of Agriculture, Soil Conservation Service (USSCS), are present. The Remedial Investigation (RI) sites at NAS Whiting Field are associated with seven of the nine soil types. The background surface soil data set for each RI site was initially determined to be comprised of background surface soil samples from the same USSCS soil types as occur on the individual sites. However, available information and review of historical aerial photographs indicated that in the construction of landfills at the facility, a borrow pit was dug to an approximate depth of 10 to 15 feet below land surface (bls) and the excavated soil was piled to the side. Following landfill operations, the borrow materials comprised of undifferentiated surface and subsurface soils were used for the landfill cover. Any additional soils required to complete the landfill cover are believed to have been obtained from other borrow pits located at the facility.

If a mix of surface and subsurface soils were used in the cover for landfills, it would be appropriate to use the combined data set of surface and subsurface soil samples as the background screening value. However, in order to be protective of human health and the environment, it is proposed that the background surface and subsurface data set be combined to a single value as the "Industrial Use Soil Cleanup Goal." This modified "Industrial Use Soil Cleanup Goal" is specifically limited to the covered landfill sites including Sites 1, 2, 9, 10, 11, 13, 14, 15, and 16, and to the inorganic analyte arsenic.

Tables 3-8 through 3-18 in the General Information Report present the detected concentrations and summarize the analytical data for the individual background soil samples collected at NAS Whiting Field. A summary of the arsenic background data set and the modified "Industrial Use Soil Cleanup Goal" for arsenic is presented in Table A-1. As indicated on the table, the modified "Industrial Use Soil Cleanup Goal" for arsenic to be used at covered landfill sites is 4.62 milligrams per kilogram.

Table A-1
Summary of Arsenic Detected in Surface and Subsurface Background Soil Samples

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection Surface Soil Samples[1]	Mean of Detected Concentrations Surface Soil Samples[2]	Frequency of Detection Subsurface Soil Samples[1]	Mean of Detected Concentrations Subsurface Soil Samples[2]	Frequency of Detection Surface and Subsurface Soil Samples[1]	Mean of Detected Concentrations Surface and Subsurface Soil Samples[2]	Surface and Subsurface Soil Background Screening Concentration (modified Industrial Use Cleanup Goal)
Inorganic Analytes (mg/kg)							
Arsenic	15/15	1.54	14/14	3.14	29/29	2.31	4.62

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed.
[2] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.

Notes: mg/kg = milligram per kilogram.

Table A-2
Comparison of Detected Arsenic Concentrations in Surface and Subsurface Soil Samples to Florida Soil Cleanup Goals

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Minimum Detected Concentration	Maximum Detected Concentration	Mean of Detected Concentrations	Soil Cleanup Goals for Florida (Residential)[1]	Soil Cleanup Goals for Florida (Industrial)[1]	Modified Industrial Use Cleanup Goal[2]
Inorganic Analyte (mg/kg)						
Arsenic	0.52	6.3	2.31	0.8	3.7	4.62

[1] Source: FDEP Memorandum from John Ruddell, Director Division of Waste Management, to District Directors and Waste Program Administrators. Subject: Applicability of Soil Cleanup Goals for Florida, January 19, 1996.
[2] The modified Industrial Use Cleanup Goal for arsenic is twice the mean of detected concentrations in the surface and subsurface soil samples.

Notes: mg/kg = milligram per kilogram.

APPENDIX B

APPENDIX B

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION'S RESPONSE AND ACCEPTANCE OF THE SITE-SPECIFIC SOIL CLEANUP GOAL FOR ARSENIC FOR DISPOSAL SITES AT NAS WHITING FIELD

Department of Environmental Protection

Lawton Chiles
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

April 27, 1998

Ms. Linda Martin
Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, PO Box 190010
North Charleston, SC 29419-9010

file: arsenic1.doc

RE: Request for Site-Specific Arsenic Soil Cleanup Levels: Covered Landfill Sites, NAS Whiting Field

Dear Ms. Martin:

I have reviewed the request for approval of a site-specific Soil Cleanup Goal for arsenic at the "covered landfill sites" at NAS Whiting Field from Mr. Gerald Walker, ABB Environmental Services, dated April 22, 1998 (received April 22, 1998). Based on the prior presentation to Department Staff and the summary information furnished in the letter and the attached Appendix I, the request is granted to utilize a site-specific Soil Cleanup Goal for arsenic of 4.62 mg/kg at Sites 1, 2, 9, 10, 11, 12, 13, 14, 15 and 16., with the following conditions:

1. The sites may be utilized for activities that involve less than full-time contact with the site. This may include, but is not limited to, a.) parks b.) recreation areas that receive heavy use (such as soccer or baseball fields) or, c.) agricultural sites where farming practices result in moderate site contact (approximately 100 days/year, or less).

2. The Navy must assure adherence to the land use by incorporating the site and conditions in a legally binding Land Use Contol agreement.

3. The above Soil Cleanup Goal shall not be utilized at any other site without specific Department approval.

If you have questions or require further clarification, please contact me at (904) 921-4230.

Sincerely,

James H. Cason, P.G.
Remedial Project Manager

APPENDIX C

APPENDIX C

COST CALCULATIONS FOR REMEDIAL ALTERNATIVES

ALTERNATIVE #1: NO ACTION

	Quantity	Unit	Unit Cost	Total Cost
FIVE YEAR SITE REVIEW COSTS				
Five-year Site Reviews (every 5 years for 30 years)				
Meetings (includes travel time)				
Senior Scientist	16	hrs	$90.00	$1,440
Mid-level Engineer	16	hrs	$60.00	$960
ODCs (includes per diem and rental car)	1	lump sum	$110.00	$110
Five-year Report				
Report				
Senior Scientist	20	hrs	$90.00	$1,800
Mid-level Engineer	30	hrs	$60.00	$1,800
ODCs (includes photocopying, etc.)	1	lump sum	$250.00	$250
Total 5-year costs				*$6,360*
Present Worth of 5-year costs at i= 6%				*$20,783*
TOTAL FIVE YEAR SITE REVIEW COSTS				**$20,783**
CONTINGENCY @ 10 PERCENT				**$2,078**
TOTAL COST OF ALTERNATIVE #1				**$22,862**

ALTERNATIVE #2: LUCs

	Quantity	Unit	Unit Cost	Total Cost
Five Year Site Review Costs				
Five-year Site Reviews (every 5 years for 30 years)				
Meetings (includes travel time)				
Senior Scientist	16	hrs	$90.00	$1,440
Mid-level Engineer	16	hrs	$60.00	$960
ODCs (includes per diem and rental car)	1	lump sum	$110.00	$110
Five-year Report				
Report				
Senior Scientist	20	hrs	$90.00	$1,800
Mid-level Engineer	30	hrs	$60.00	$1,800
ODCs (includes photocopying, etc.)	1	lump sum	$250.00	$250
Total 5-year costs				*$6,360*
Present Worth of 5-year costs at i=6%				*$20,783*
TOTAL FIVE YEAR SITE REVIEW COSTS				**$20,783**
Land Use Control Direct Costs				
Direct Costs				
Survey Plat	1	lump sum	$2,500.00	$2,500
Land Use Implementation Plan				
(includes components for closure plan)				
Senior Scientist	25	hrs	$90.00	$2,250
Mid-level Engineer	100	hrs	$60.00	$6,000
ODCs (includes photocopying, etc.)	1	lump sum	$750.00	$750
TOTAL LAND USE CONTROL DIRECT COSTS				$11,500
Land Use Control Annual O&M Costs				
(included for cost comparison only - may be performed by Facility or other agency)				
Quarterly Inspection				
Senior Scientist	0	hrs	$90.00	$0
Mid-level Engineer	40	hrs	$60.00	$2,400
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$320.00	$320
Quarterly Reporting				
Senior Scientist	8	hrs	$90.00	$720
Mid-level Engineer	32	hrs	$60.00	$1,920
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$1,000.00	$1,000
Annual Reporting				
Senior Scientist	2	hrs	$90.00	$180
Mid-level Engineer	8	hrs	$60.00	$480
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$250.00	$250
Total Annual Operation and Maintenance Costs				$7,270
Present Worth of Land Use Control costs at i=6%				*$100,072*
TOTAL LAND USE CONTROL O&M COSTS				**$111,572**

ALTERNATIVE #2: LUCs

	Quantity	Unit	Unit Cost	Total Cost
COST OF ALTERNATIVE #2				**$132,355**
CONTINGENCY @10 PERCENT				**$13,235**
TOTAL COST OF ALTERNATIVE #2				**$145,590**

ALTERNATIVE #3: SITE CLOSURE AND CAPPING, SITE 1

	Quantity	Unit	Unit Cost	Total Cost
CAPITAL COSTS				
TOTAL DIRECT COSTS				
Mobilization				
Miscellaneous				
Office Trailer	1	mon	$150.00	$150
Storage Trailer	1	mon	$150.00	$150
Trailer Delivery, Setup, Removal	1	each	$300.00	$300
Telephone Service	1	mon	$50.00	$50
Electrical Hookup/Power	1	mon	$50.00	$50
Toilet/Water Cooler Service	1	mon	$50.00	$50
Miscellaneous Equipment	1	LS	$2,500.00	$2,500
Labor (Site Preparation)				
Electrician (2 men @ 5 days @ 10 hrs/day)	100	hrs	$42.00	$4,200
Carpenter (2 men @ 5 days @ 10 hrs/day)	100	hrs	$42.00	$4,200
Foreman (1 man @ 5 days @10 hrs/day)	50	hrs	$60.00	$3,000
Equipment (Mobilization)				
Front End Loader	2	each	$500.00	$1,000
Dozer	2	each	$500.00	$1,000
Grad-all	2	each	$500.00	$1,000
Dump Truck (15 cyd)	5	each	$250.00	$1,250
Water Truck	1	each	$250.00	$250
Backhoe	1	each	$250.00	$250
Pressure Washer	1	each	$250.00	$250
Equipment	1	LS	$1,200.00	$1,200
General Site Mobilization	1	LS	$250.00	$250
Mobilization				**$21,100**
Site Preparation				
Labor (Site Preparation)				
Laborers (2 men @ 2 days @ 8 hrs/day)	32	hrs	$36.00	$1,152
Foreman (Labor included in Mobilization)				
Equipment and Disposal Costs				
Backhoe and Operator	2	days	$1,200.00	$2,400
Front End Loader and Operator	2	days	$700.00	$1,400
Micellaneous Tools	1	LS	$300.00	$300
Trans and Disposal - Steel Debris	3	tons	$69.00	$207
Trans and Disposal - Concrete Debris	6	tons	$69.00	$414
Silt fencing	1200	lf	$5.00	$6,000
Signs	4	ea	$50.00	$200
Site Preparation				**$12,073**

ALTERNATIVE #3: SITE CLOSURE AND CAPPING, SITE 1

	Quantity	Unit	Unit Cost	Total Cost
Clearing and Grubbing				
Foreman (1 wk @ 50 hrs/wk)	50	hrs	$60.00	$3,000
Grubbing, Removal and Stockpile (Labor Included)	1.5	acres	$3,500.00	$5,250
Transport and Disposal (Grub and Stumps)	100	tons	$69.00	$6,900
Clearing and Grubbing				**$15,150**
Soil Cover - 1.5 Acres				
Grade Site (2 Dozers and Operators)	4	dy	$1,650.00	$6,600
Common Fill - minimum 1.5' layer, Purchase & Haul	7065	cy	$10.00	$70,650
Common Fill - min. 1.5' layer, Spread & Compact	7065	cy	$2.00	$14,130
Site Superintendant (2.0 wks @ 50 hrs/wk)	100	hr	$60.00	$6,000
Soil Cover				**$97,380**
Vegetative Support Layer				
Topsoil - 0.5' layer, Purchase & Haul	1183	cy	$10.00	$11,830
Topsoil - 0.5' layer, Spread	1183	cy	$1.00	$1,183
Site Superintendant (3 days @ 10 hrs/day)	30	hrs	$60.00	$1,800
Vegetative Support Layer				**$14,813**
Dust Control				
Water Truck and Driver	2.5	wk	$550.00	$1,375
Dust Control				**$1,375**
Site Restoration				
Fertilize, Seed, Mulch	2	acres	$2,000.00	$4,000
Demob of equipment	1	LS	$10,000.00	$10,000
Site restoration				**$14,000**
Land Use Controls - Direct Costs (see Alt. #2)				
Total LOE for Implementation Plan				$8,250
Total ODCs for Implementation Plan				$750
Survey Plat				$2,500
Land Use Controls - Direct Costs				**$11,500**
TOTAL DIRECT COSTS				**$187,391**
INDIRECT COSTS				
Health and Safety (@3% of Direct Costs)				$5,622
Administrative Fees (@3% of Direct Costs)				$5,622
Engineering and Design (@10% of Direct Costs)				$18,739
Construction Support Services (@10% of Direct Costs)				$18,739
TOTAL INDIRECT COSTS				**$48,722**

ALTERNATIVE #3: SITE CLOSURE AND CAPPING, SITE 1

	Quantity	Unit	Unit Cost	Total Cost
TOTAL CAPITAL COSTS = Total Direct Costs + Total Indirect Costs				**$236,113**
OPERATION AND MAINTENANCE COSTS (annual)				
Soil Cover Inspection and Maintenance (Annual)				
Replacement of Soil	10	tons	$20.00	$200
Dump Truck and Driver	1	dy	$730.00	$730
Laborers (2 @ 2 dy @ 8hrs/dy))	32	hr	$32.00	$1,024
Subtotal Cost				$1,954
Present Worth (capitalized @ 6%, 30 years)				**$26,896**
5-Year Site Review (see Alternative #1)				
Total LOE				$6,000
Total ODCs				$360
Subtotal Cost				$6,360
Present Worth (capitalized @ 6%, 30 years)				**$20,783**
Land Use Controls - Quarterly and Annual Inspection and Reporting (see Alt. #2)				
Total LUCs Annual O&M Costs				$7,270
Present Worth (capitalized @ 6%, 30 years)				**$100,072**
TOTAL O&M COSTS (Soil Cover Ins., 5-Year Reviews, and LUCs)				**$147,751**
TOTAL CAPITAL COSTS AND O&M COSTS				**$383,864**
CONTINGENCY (@ 10%)				**$38,386**
TOTAL COST OF ALTERNATIVE #3				**$422,250**

PROJECT	COMP. BY	JOB NO.
NAS WHITING FIELD	BWA	2534.12
SITE 2 ALTERNATIVE 2 - NO ACTION	CHK. BY RCh	DATE 5/1/98

ESTIMATES (CONT):

FIVE YEAR SITE REVIEWS

- OTHER DIRECT COSTS PER MTG.

PREPARATION / 6 SITE REVIEWS

PHOTO COPYING, PRESENTATION MATERIAL, MISC.

$250/mtg * 1 mtg = $250 ✓

PARTICIPATION & PRESENTATION PER MTG

RENTAL VEHICLE 1 mtgs * $50/mtg = $50 ✓

PER DIEM 1 mtgs * 2 persons/mtg * $30/mtg = $60 ✓

TOTAL ODCs FOR PARTICIPATION, PREPARATION, AND PRESENTATION PER MTG

$250 + 50 + 60 = $360 ✓

- FIVE YEAR SITE REVIEW TOTAL COST PER MTG

TOTAL COST = COC + ODCs = $6,000 + 360 = $6,360 ✓

PRESENT WORTH ANALYSIS FIVE YEAR SITE REVIEWS

ANNUALIZE COST $A = P(A/P, 6\%, 5)$

$= 6,360 (0.2374)$ ✓

$= \$1,510/yr$ ✓

PRESENT WORTH $P = A(P/A, 6\%, 30)$

$= \$1510 (13.765)$ ✓

$= \$20,785/30yr \approx \$20,800/30yr$ ✓

10% Contingency 2080

Total $22,880 ✓

PROJECT	COMP. BY	JOB NO.
NAS WHITING FIELD	RAT	2534.12
SITE 2 ALTERNATIVE 2 - NO ACTION	CHK. BY RCL	DATE 5/1/98

ESTIMATES (cont):

ANNUAL GROUNDWATER MONITORING

TOTAL ANALYTICAL COSTS = 4500 yr

- TOTAL COST ANNUAL GROUNDWATER MONITORING

TOTAL COST = LOE + ODCs + ANALYTICAL

= $4380 + $1170 + $4500 = $10,050/yr

PRESENT WORTH ANALYSIS ANNUAL GROUNDWATER MONITORING

P = A (P/A, 6%, 30)

= $10,050 (13.765)

= 138,338 ≈ $138,300/30 yr

SUMMARY:

FIVE YEAR SITE REVIEWS

- TOTAL COST $6,360/5 yr ✓
- PRESENT WORTH $20,600 OVER 30 YEAR PERIOD ✓

~~GROUNDWATER MONITORING AND REPORTING~~

~~- TOTAL COST $10,050/yr~~

~~- PRESENT WORTH $138,300 OVER 30 YEAR PERIOD~~

~~TOTAL COST = $124,700 + $138,300 = $263,000~~

9/17

11/19

PROJECT	COMP. BY	JOB NO.
Cont.	Bwt	2534.12
	CHK. BY RCL	DATE 5/4/98

ESTIMATES:

FIVE YEAR SITE REVIEWS

- TOTAL LOE $6,000 (see ESTIMATE FOR ALT #1)
- TOTAL ODCs $ 360 (see ESTIMATE FOR ALT #1)
- TOTAL COST $6360 (")
- PRESENT WORTH $20,800 (") ✓

~~ANNUAL GROUNDWATER MONITORING FOR 30 YEARS~~

- ~~TOTAL LOE per year $4380 (see ESTIMATE FOR ALT #1)~~
- ~~TOTAL ODCs per year $1170 "~~
- ~~TOTAL ANALYTICAL COST per year $4500 "~~
- ~~TOTAL COST per year $10,050 "~~
- ~~PRESENT WORTH $138,300 "~~

LAND USE CONTROLS (LUCs)

- LOE FOR PREPARATION OF LAND USE IMPLEMENTATION PLAN (LUCIP)

  SR SCI/ENG 20 HRS * $90/HR = $1800 ✓

  SCI/ENG 40 HRS * $60/HR = $2400 ✓

- ODCs FOR PREPARATION OF LUCIP (copying, etc)

  1 REPORT * $250/REPORT = $250 ✓

- DIRECT COSTS FOR LUCIP

  SURVEY PLAT $2500 ✓

  ~~LAND USE RESTRICTION FEES (FILING, LEGAL, etc) $5000 ✓~~ ~~$7500~~

  TOTAL = ~~$11,950~~ ✓ 6950 ✓ Bwt

- LOE FOR QUARTERLY LUCIP INSPECTION & REPORTING

  SITE INSPECTION - LOE

  SCI/ENG (2 HRS/INSPECTION + 8 HRS/TRAVEL) * 4 EVENTS/YEAR * $60/HR = $2400/YR ✓

  SITE INSPECTION - ODCs

  1 CAR * $50/DAY * 1 DAY/EVENT * 4 EVENTS = $200/YR ✓

  - $30/DAY PER DIEM * 1 PERSON * 1 DAY/EVENT * 4 EVENTS = $120/YR ✓ 11/17 ~~13/19~~ Bwt

PROJECT	COMP. BY	JOB NO.
CONT.	Bult	2534.12
	CHK. BY RCV	DATE 5/4/98

ESTIMATES (CONT):

LAND USE CONTROLS (LUCS)

PRESENT WORTH ANALYSIS

P = A (P/A, 6%, 30) ✓

= TOTAL COSTS − LUCIP PREP (P/A, 6%, 30) ✓

= 19,220 − 11,950 (P/A, 6%, 30) ✓

= 7,270 (P/A, 6%, 30) ✓

= 7,270 (13.765) ✓

= $100,072 OVER 30 YEARS ✓

SITE CLOSURE PLAN

CLOSURE PLAN - LOE

ENG/SCI 20 HRS/REPORT * 1 REPORT * $60/HR = $1200 ✓

SR ENG/SCI 5 HRS/REPORT * 1 REPORT * $90/HR = $450 ✓

CLOSURE PLAN - ODCs (copying, etc)

$250/REPORT * 1 REPORT = $250 ✓

TOTAL = $1,700 ✓

SUMMARY:

	TOTAL
DIRECT COST	
LUCIP PREPARATION	$11,950 ✓
SITE CLOSURE PLAN	~~$1,900~~ ✓
TOTAL DIRECT COST	~~$13,650~~ ✓ 11,950
O&M COST	
5 YR SITE REVIEW	$ 6,360 ✓
~~ANNUAL GROUNDWATER MONITORING~~	~~$10,650~~
LUCIP INSPECTION/REPORTING	$ 7,270 ✓
PRESENT WORTH of O&M (20,800 + 100,072)	$120,872 ✓
TOTAL COST	~~$134,522~~ ✓
132822 + 13282 (10%) = $146104	$ 132,822

13/17

~~15/19~~

Bult

ABB Environmental Services, Inc.

PROJECT	COMP. BY	JOB NO.
NAS WHITING FIELD - SITE 2	BWA	2534.12
DETAILED ANALYSIS OF ALTERNATIVE #3-CAPPING VOLUME CALCS	CHK. BY RCL	DATE 5/7/98

OBJECTIVE: ESTIMATE VOLUME OF COMPACTED SOIL COVER (MINIMUM 1 ft THICK AT EDGE), VEGITATIVE SUPPORT LAYER, AND VEGITATIVE COVER REQUIRED TO COVER SITE 2, NAS WHITING FIELD.

ASSUMPTIONS: CURRENT TOPOGRAPHY AT SITE 2 LEVEL

COMPACTED VOLUME EQUALS 110% OF BULK VOLUME

MINIMUM 1 ft THICK COMPACTED SOIL COVER AT EDGE OF LANDFILL

0.5 ft THICK VEGITATIVE SUPPORT LAYER

AREAS FROM CAPPING SCHEMATIC CALCULATION USING PLANIMETER

ESTIMATES:

COMPACTED SOIL COVER

0-1 ELEVATION

USING AVG. END AREA METHOD

$$\frac{AREA_0 + AREA_1}{2} * LIFT = \frac{\overset{63,891}{62,568.456\,ft^2} + 59,132.615\,ft^2}{2} * \cancel{1\,ft}\ 1.5\,ft$$

BWA

$$= \cancel{60,851\,ft^3}$$ BWA

$$92,767.7$$ ✓

1-2 ELEVATION

USING AVG END AREA METHOD

$$\frac{AREA_1 + AREA_2}{2} * LIFT = \frac{59,132.615\,ft^2 + 33,945.066\,ft^2}{2} * 1\,ft$$

$$= 46,539\,ft^3$$ ✓

2-3 ELEVATION

$$\frac{AREA_2 + AREA_3}{2} * LIFT = \frac{33,945.066\,ft^2 + 15,138.363\,ft^2}{2} * 1\,ft$$

$$= 24,542\,ft^3$$ ✓

ABB Environmental Services, Inc.

~~17/19~~ BWA

PROJECT	COMP. BY	JOB NO.
CONT.	BWT	253412
	CHK. BY RCL	DATE 5/7/98

SUMMARY:

TOTAL COMPACTED SOIL VOLUME	~~5265 yd³~~ BWT	7,065 yd³ ✓
TOTAL VEGETATIVE SUPPORT LAYER	~~1,159 yd³~~ BWT ✓	1183 yd³ ✓
TOTAL VEGETATIVE COVER	~~1.4 acres~~ BWT ✓	1.5 acres ✓

17/17 ~~19/19~~ BWT

APPENDIX D

APPENDIX D

CONSIDERATION OF AFFECT OF RULE CHANGE FOR FAC, CHAPTER 62-785

CONSIDERATION OF AFFECT OF RULE CHANGE FOR FAC, CHAPTER 62-785

At the request of the Florida Department of Environmental Protection (FDEP), this appendix provides a comparison of the affect of the policy change from use of screening values based on the Soil Cleanup Goals for Florida (memorandum dated September 29, 1995, from John Ruddell, Director, Division of Waste Management to District Directors, Waste Program, FDEP) to screening values based on the Soil Cleanup Target Levels for Chapter 62-785, Florida Administrative Code (FAC).

Tables D-1 and D-2 summarize the analyte concentrations detected in the Site 1 surface soil samples and provides background screening concentrations, U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentrations (RBCs), Soil Cleanup Goals for Florida, and Soil Cleanup Target Levels (SCTLs) for Chapter 62-785, FAC. The human health risk assessment for Site 1 was completed prior to FDEP's implementation of the SCTLs for Chapter 62-785, FAC. Based on screening levels from USEPA Region II RBCs and Soil Cleanup Goals for Florida, the risk assessment identified two surface soil contaminants of potential concern (CPCs), arsenic and beryllium. The CPCs were identified based on exceedances of screening values for residential use soils. The detected analyte concentrations did not exceed soil screening values for industrial use soils.

As indicated on Table D-1, if the SCTLs for Chapter 62-785, FAC had been used as the screening values, one additional analyte, vanadium, would have been identified as a CPC. Similar to those of arsenic and beryllium, detected concentrations of vanadium exceed the screening values for residential use soils but not screening values for industrial use soils. Therefore, the overall impact of the use for the SCTLs for Chapter 62-785, FAC at Site 1 is negligible.

Table D-1
Statistical Summary and ARARs for Organic Analytes Detected in Site 15 Surface Soil Samples

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Detected Concentration Range[2]	Background Screening Concentration[4]	USEPA Region III RBCs[5] Residential/ Industrial	Soil Cleanup Goals for Florida Residential/Industrial[6]	Soil Cleanup Target Levels for Chapter 62-785, FAC Residential/Industrial
Volatile Organic Compounds (µg/kg)							
Acetone	1/30	10 to 22	11	NA	7,800,000/200,000,000	260,000/1,800,000	770,000/5,500,000
Methylene chloride	4/30	5 to 12	3 to 9	NA	85,000/760,000	16,000/23,000	16,000/23,000
Xylenes (total)	3/30	5 to 12	1 to 4	NA	160,000,000/1,000,000,000	13,000,000/92,000,000	290,000/290,000
Semivolatile Organic Compounds (µg/kg)							
Butylbenzylphthalate	1/30	350 to 430	240	NA	16,000,000/410,000,000	15,000,000/31,000,000	220,000/220,000
Dibutylphthalate	6/30	350 to 420	560 to 1,100	NA	7,800,000/200,000,000	7,300,000/140,000,000	110,000/110,000
bis(2-Ethylhexyl)phthalate	4/30	350 to 430	39 to 947.5*	NA	46,000/410,000	48,000/110,000	75,000/230,000
Pesticides and PCBs (µg/kg)							
4,4'-DDD	1/30	3.5 to 18	3.8	NA	2,700/24,000	45,000/17,000	4,500/17,000
4,4'-DDE	3/30	3.5 to 18	1.9 to 50	NA	1,900/17,000	3,000/11,000	3,200/12,000
4,4'-DDT	2/30	3.5 to 18	4.4 to 14	NA	1,900/17,000	3,100/12,000	3,200/13,000

See notes at end of table.

Table D-1 (Continued)
Statistical Summary and ARARs for Organic Analytes Detected in Site 15 Surface Soil Samples

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Organic values are one times the mean of the detected concentration. Organic values are included for comparison purposes only.
[5] For all listed chemicals, the U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) table for residential surface soil exposure per January 1993 guidance (*Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening*, EPA/903/R-93-001 [USEPA, 1993a]) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated October 1997, which are based on an excess lifetime cancer risk of 1×10^{-6} and an adjusted hazard quotient of 0.1 (USEPA, 1997a). For the essential nutrients, screening values were derived based on recommended daily allowances.
[6] Values are from Florida Department of Environmental Protection memoranda titled, Soil Cleanup Goals for Florida, dated September 29, 1995, and Applicability of Soil Cleanup Goals for Florida, dated January 19, 1996.

Notes: Samples: 15-SL-01 through 15-SL-05 and 15S00101 through 15S02501.
Duplicate samples: 15S00101D, 15S01701D, and 15S02001D.
Background samples: BKG-SL-02, BKG-SL-06, BKG-SL-07, BKG-SL-08, BKS00101, BKS00201, BKS00301, BKS00401, and BKS00501.
Background duplicate samples: BKS00201D.

μg/kg = micrograms per kilogram.
NA = not applicable.
* = average of sample and duplicate.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
FAC = Florida Administrative Code.

Table D-2
Statistical Summary and ARARs of Inorganic Analytes Detected in Site 15 Surface Soil Samples

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Detected Concentration Range[2]	Background Screening Concentration[4]	USEPA Region III RBCs[5] Residential/ Industrial	Soil Cleanup Goals for Florida Residential/Industrial[6]	Soil Cleanup Target Levels for Chapter 62-785, FAC Residential/Industrial
Inorganic Analytes (mg/kg)							
Aluminum	30/30	40	3,280 to 13,400	15,334	[11]7,800/100,000	75,000/NA	$72,000/1.0 \times 10^5$
Arsenic	30/30	2	0.75 to 6.8	4.6	[7]0.43/3.8	[7]0.8/[12]4.62	0.8/3.7
Barium	30/30	40	3.2 to 11.8	23.8	[10]550/14,000	5,200/84,000	105/87,000
Beryllium	3/30	0.5 to 1	0.07 to 0.09	0.36	[10]0.15/1.3	0.2/1.0	120/700
Calcium	18/30	1,000	22.05* to 262.6*	402	NA/NA	NA/NA	NA/NA
Chromium	30/30	2	2.8 to 14.4*	10.8	[8,11]39/1,000	[8]290/430	[11]290/430
Cobalt	11/30	0.33 to 10	0.49 to 1.2	3.0	[11]470/12,000	4,700/110,000	47,000/110,000
Copper	8/30	5	1.6 to 12.5	9.4	[11]310/8,200	2,900/72,000	$105/1.4 \times 10^4$
Iron	30/30	20	1,610 to 11,150*	8,588	[11]2,300/61,000	NA/NA	23,000/490,000
Lead	30/30	0.6 to 1	2.3 to 59.9	11.4	[9]400	500/1,000	500/920
Magnesium	30/30	1,000	43 to 156	258	NA/NA	NA/NA	NA/NA
Manganese	30/30	3	8.8* to 143	404	[11]180/4,700	370/5,500	1,600/20,000
Mercury	22/30	0.06 to 0.1	0.01 to 0.19	0.12	[11]2.3/61	23/480	3.7/28
Nickel	1/30	2.3 to 8	3.3	7.2	[11]160/4,100	1,500/26,000	105/28,000
Potassium	5/30	128 to 1,000	131 to 334.5*	177	NA/NA	NA/NA	NA/NA
Selenium	6/30	0.39 to 1	0.24 to 0.41	0.44	NA/NA	390/9,900	390/10,000
Silver	4/30	0.32 to 2	0.66 to 2	0.7	[11]39/1,000	390/9,000	390/9,100
Sodium	5/30	1,000	170 to 179	388	NA/NA	NA/NA	NA/NA
Vanadium	30/30	10	4.1 to 33.85*	21.2	[11]55/1,400	490/4,800	15/77,000
Zinc	28/30	4	2.4 to 15.9	15.4	[11]2,300/61,000	23,000/560,000	23,000/560,000
Cyanide	3/30	0.24 to 0.5	0.09 to 0.31	0.26	1,600/41,000	1,600/40,000	30/5,000

See notes at end of table.

Table D-2 (Continued)
Statistical Summary and ARARs of Inorganic Analytes Detected in Site 15 Surface Soil Samples

Feasibility Study
Site 1, Northwest Disposal Area
Naval Air Station Whiting Field
Milton, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), the U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) Table for residential surface soil exposure per January 1993 guidance (*Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening*, EPA/903/R-93-001 [USEPA, 1993a]) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated October 1997, which are based on an excess lifetime cancer risk of 1×10^{-6} and an adjusted hazard quotient of 0.1 (USEPA, 1997a). For the essential nutrients, screening values were derived based on recommended daily allowances.
[6] Values are from Florida Department of Environmental Protection (FDEP) memoranda titled Soil Cleanup Goals for Florida, dated September 29, 1995, and Applicability of Soil Cleanup Goals for Florida, dated January 19, 1996.
[7] The value is based on arsenic as a carcinogen.
[8] The value is based on hexavalent chromium form.
[9] The value for lead is based on the USEPA Office of Solid Waste and Emergency Response Directive No. 9355.4-12, "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (USEPA, 1994c).
[10] The values correspond to a human cancer risk level of 1 in 1,000,000
[11] The values correspond to a noncancer hazard quotient of 0.1.
[12] Value is an FDEP-approved site-specific soil cleanup goal (ABB-ES, 1998, Appendix I; FDEP, 1998)

Notes: The average of a sample and its duplicate is used for all table calculations.
Samples: 15-SL-01, 15-SL-02, 15-SL-03, 15-SL-04, 15-SL-05, 15S00101, 15S00201, 15S00301, 15S00401, 15S00501, 15S00601, 15S00701, 15S00801, 15S00901, 15S01001, 15S01101, 15S01201, 15S01301, 15S01401, 15S01501, 15S01601, 15S01701, 15S01801, 15S01901, 15S02001, 15S02101, 15S02201, 15S02301, 15S02401, and 15S02501.
Duplicate samples: 15S00101D, 15S01701D, and 15S02001D.
Background samples: BKG-SL-02, BKG-SL06, BKG-SL-07, BKG-SL-08, BKS00101, BKS00201, BKS00301, BKS00401, and BKS00501.
Background duplicate samples: BKS00201D.

mg/kg = milligrams per kilogram.
NA = not applicable.
* = average of sample and duplicate.
FAC = Florida Administrative Code.