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Feasibility Study Report
for
Site 43
Demolition Debris Disposal Area

Naval Air Station Pensacola
Pensacola, Florida

Contract Task Order 0022

July 2008

Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

FEASIBILITY STUDY REPORT
FOR
SITE 43 – DEMOLITION DEBRIS DISPOSAL AREA

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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This document, the Feasibility Study for Site 43, Demolition Debris Disposal Area, at Naval Air Station (NAS) Pensacola, Pensacola, Florida, was developed in accordance with commonly accepted procedures consistent with applicable standards of practice. The document was prepared under the supervision of a Registered Professional Engineer in the State of Florida and is based on information obtained by others. If conditions are determined to exist that are different than those described in this document, then the undersigned professional engineer should be notified to evaluate the effects of any additional information on the project described in this document. This document was prepared for Site 43 at NAS Pensacola, Pensacola, Florida, and should not be construed to apply to any other site.

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ACRONYMS

ARAR	Applicable or relevant and appropriate requirement
AWQC	Ambient Water Quality Criterion
BaPEq	Benzo(a)pyrene equivalent
bgs	Below ground surface
CAA	Clean Air Act
CCI	CH2M Hill Constructors, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
COPC	Chemical of potential concern
cPAH	Carcinogenic PAH
CSF	Cancer Slope Factor
CTO	Contract Task Order
Cu yd	Cubic Yard
CWA	Clean Water Act
DPT	Direct Push Technology
EPC	Exposure point concentration
ERA	Ecological risk assessment
°F	Degrees Fahrenheit
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FS	Feasibility Study
ft^2	Square feet
GCTL	Groundwater cleanup target level
GRA	General Response Action
HI	Hazard index
HQ	Hazard quotient
IAS	Initial Assessment Study
IEUBK	Integrated Exposure Uptake Biokinetic (Model)
ILCR	Incremental lifetime cancer risk
IRA	Interim Remedial Action
LDR	Land Disposal Restriction
LUC	Land use control
MCL	Maximum Contaminant Level

mg/kg	Milligrams per kilogram
µg/dl	Micrograms per deciliter
µg/kg	Micrograms per kilogram
mg/L	Milligrams per liter
µg/L	Micrograms per liter
NAAQS	National Ambient Air Quality Standard
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAVFAC SE	Naval Facilities Engineering Command Southeast
NCP	National Oil and Hazardous Substances Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NEPA	National Environmental Policy Act
NESHAP	National emission standards for hazardous air pollutant
NPW	Net present worth
NTTC	Naval Technical Training Center
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OSR	Off-site Rule
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated Biphenyl
PPE	Personal protective equipment
PRG	Preliminary Remedial Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Reference Dose
RG	Remedial Goal
RI	Remedial Investigation
SCTL	Soil Cleanup Target Level
SLERA	Screening Level Ecological Risk Assessment
SMCL	Secondary MCL
SPLP	Synthetic Precipitation Leaching Procedure
Sq ft	Square Feet
SSL	Soil Screening Level
SWMU	Solid Waste Management Unit
SVOC	Semivolatile organic compound

TAL	Target Analyte List
TBC	To be considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TRW	Technical Review Group
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total suspended solids
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper confidence limit
U.S. EPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UTS	Universal Treatment Standard
UXO	Unexploded ordnance
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This Feasibility Study (FS) Report for the Demolition Debris Disposal Area (Site 43) at Naval Air Station (NAS) Pensacola in Pensacola, Florida, has been prepared by Tetra Tech NUS, Inc. (TtNUS) for the Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0022. This report describes the basis for the development of and evaluation of remedial action alternatives for soil and groundwater at Site 43.

E.1 SITE BACKGROUND AND IDENTIFICATION OF CONTAMINANTS OF CONCERN

Site 43 is located in a developed area of the base. The history begins in 1992 with the discovery of a partially buried drum. Subsequent investigations for magnetic anomalies determined the existence of several areas where buried objects were suspected to be present. During a site characterization field event, test pitting revealed the presence of several drums, which were removed. An interim remedial action (IRA) followed, and debris and contaminated soil to a depth of 2 feet from the surface were removed. A remedial investigation (RI) in 2005 and 2006 provided data indicating the presence of residual surface soil and shallow subsurface soil contamination to a depth not exceeding 4 feet from the surface.

The following chemicals were identified in surface soils exceeding Florida Soil Cleanup Target Levels (SCTLs) under Florida Administrative Code (F.A.C.) Chapter 62-777:

- Residential SCTL - carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Industrial SCTL - lead

The following chemicals were identified in subsurface soils exceeding SCTLs:

- Residential SCTL - carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Industrial SCTL - carcinogenic PAHs, lead
- Recreational SCTL - carcinogenic PAHs

The following chemicals were identified as potential COCs for groundwater based on a comparison of maximum concentrations to Florida's Groundwater Cleanup Target Levels (GCTLs):

- Iron
- Lead
- Manganese

However, lead was the only COC identified to exceed MCLs, while iron and manganese have only secondary MCLs.

E.2 REMEDIAL ACTION OBJECTIVES AND ESTIMATION OF CONTAMINATED MEDIA VOLUMES

The site was used for recreational purposes until 2003. Future site uses are industrial/commercial or residential. Therefore, the following remedial action objectives (RAOs) were developed for Site 43:

- Prevent unacceptable human health risk associated with exposure to soil containing lead, PAHs, and arsenic at concentrations greater than Florida SCTLs.

- Prevent unacceptable human health risk associated with the exposure to groundwater containing lead concentrations greater than the FDEP GCTL or U.S. EPA Action Level.

The extent of soil contamination was estimated based on exceedances of SCTLs. The volume of soil exceeding residential SCTLs was 1,200 cubic yards and the volume of soil exceeding industrial SCTLs was 120 cubic yards.

One location in groundwater was identified with lead concentrations exceeding its GCTL and U.S. EPA action level of 15 µg/L. Other locations also contained iron and manganese exceeding GCTLs; however, these constituents have only secondary MCLs and the estimated hazard quotients (HQs) for non-carcinogenic health effects were not found to be unacceptable. A conservative estimate of lead plume volume was calculated.

E.3 SELECTION OF TECHNOLOGIES AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

Considering the relatively small volume of soil present at the site and the mixture of organic and inorganic contaminants, on-site treatment technologies were considered unsuitable to meet RAOs. Similarly, in-situ treatment technologies were considered ineffective for addressing the mixture of contaminant types at the site. Considering the need for future site uses, on-site consolidation technologies were considered unsuitable to meet RAOs. Consequently, excavation and off-site disposal were selected as most suitable to meet RAOs for soil. However, considering the current site conditions as a paved parking area, and the Navy's intention to continue the current site use, containment is also being considered to meet RAOs.

Most of the general response actions for groundwater were considered unsuitable considering its minimal extent. However, in addition to institutional controls to prohibit groundwater use, and monitoring to evaluate the effect of natural processes or active treatment on contaminant concentrations, in-situ treatment was retained for further evaluation. In-situ precipitation of lead was included to attain the RAO for groundwater.

The following alternatives were developed for soil, including No Action, which is required as a baseline for comparison, under the National Contingency Plan (NCP):

- Alternative S-0: No Action
- Alternative S-1: Excavation and Offsite Disposal to meet Florida Industrial/Commercial SCTLs, and LUCs
- Alternative S-2: Excavation and Offsite Disposal to meet Florida Residential SCTLs
- Alternative S-3: Limited Excavation and Off-site Disposal, and Maintenance of Pavement to meet Florida Industrial/commercial SCTLs; and LUCs.

The following remedial alternatives were developed for groundwater, including No Action:

- Alternative G-0: No Action
- Alternative G-1: Land Use Controls (groundwater use restrictions) and Long-Term Monitoring
- Alternative G-2: In-situ Groundwater Treatment and Short-Term Land Use Controls (groundwater use restrictions) with Monitoring.

E.4 EVALUATION OF REMEDIAL ALTERNATIVES

The remedial alternatives were evaluated using the nine criteria of the NCP under 40 CFR Part 300. In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-term Effectiveness
- Implementability
- Cost

- State Acceptance (to be evaluated after receipt of comments)
- Community Acceptance (to be evaluated after receipt of comments)

Summaries of the comparison of soil alternatives and groundwater alternatives are presented in Tables E-1 and E-2, respectively.

TABLE E-1

SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES
SITE 43 FEASIBILITY STUDY REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

Evaluation Criteria	Alternative S-0: No Action	Alternative S-1: Excavation and Off-site Disposal to Meet Florida Industrial/Commercial SCTLs and LUCs	Alternative S-2: Excavation and Off-site Disposal to Meet Florida Residential SCTLs	Alternative S-3: Limited Excavation and Off-site Disposal and Maintenance of Pavement to Meet Florida Industrial/ Commercial SCTLs; and LUCs
Overall Protection of Human Health and Environment	Not protective	Protective	More protective than Alternative S-1	Would be somewhat less protective than Alternative S-1
Compliance with Chemical-Specific ARARs and TBCs	Would not comply	Would comply	Would comply	Would comply
Compliance with Location-Specific ARARs and TBCs	Would not comply	Would comply	Would comply	Would comply
Compliance with Action-Specific ARARs and TBCs	Not applicable	Would comply	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	More effective than Alternative S-1	Somewhat less effective than Alternative S-1
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	Treatment of a portion of soil determined to be hazardous	Treatment of a potentially greater volume of hazardous soil	Treatment of a smaller portion of soil determined to be hazardous compared to Alternative S-1
Short-Term Effectiveness	No relevant issues to address	Would be effective. Minimum potential for short-term risks. Would attain RAOs in 6 months.	Would be effective. Greater potential for short-term risks than Alternative S-1. Would attain RAOs in 6 months.	Would be effective. Least potential for short-term risks among all alternatives. Would attain RAOs in 6 months
Implementability	Nothing to implement	Poses long-term administrative concerns	Poses short-term technical concerns	Poses long-term administrative and maintenance concern
Costs:				
Capital	$0	$348,000	$706,000	$180,000
NPW of O&M	$0	$77,000	NA	$96,000
NPW	$0	$425,000	NA	$276,000

NOTES:

ARARs Applicable or Relevant and Appropriate Requirements
LUCs Land use controls
NPW Net present worth
O&M Operation and maintenance
RAOs Remedial Action Objectives
TBCs To Be Considered (criteria)

TABLE E-2

SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES
SITE 43 FEASIBILITY STUDY REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

Evaluation Criteria	Alternative GW-0: No Action	Alternative G-1: Land Use Controls (groundwater use restrictions) and Long-Term Monitoring	Alternative G-2: In-situ Groundwater Treatment and Short-Term Land Use Controls (groundwater use restrictions) with Monitoring
Overall Protection of Human Health and Environment	Not protective	Protective	More protective
Compliance with Chemical-Specific ARARs and TBCs	Would not comply	Would eventually comply	Would comply
Compliance with Location-Specific ARARs and TBCs	Would not comply	Would comply	Would comply
Compliance with Action-Specific ARARs and TBCs	Not applicable	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	More effective than G-1
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	None	Reduces toxicity
Short-Term Effectiveness	No relevant issues to address	Would be effective. Minimum potential for short-term risks. The RAO would be met immediately and eventual compliance with the cleanup goal would be determined by monitoring.	Would be effective. Short-term risks can be adequately addressed. The RAO would be met immediately. Treatment goals would be attained within 2 years.
Implementability	Nothing to implement	Readily implementable, although long-term administrative controls would be required.	Somewhat more difficult to implement technically compared to G-1. However, no long-term administrative concerns exist.
Costs:			
Capital	$0	$ 114,000	$ 286,000
NPW of O&M	$0	$92,000	$21,000
NPW	$0	$206,000	$327,000

NOTES:

O&M Operation and maintenance
ARARs Applicable or Relevant and Appropriate Requirements
LUCs Land use controls
TBCs To be considered (criteria)
NPW Net present worth

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF REPORT

This Feasibility Study (FS) Report for the Demolition Debris Disposal Area (Site 43) at Naval Air Station (NAS) Pensacola in Pensacola, Florida, has been prepared by Tetra Tech NUS, Inc. (TtNUS) for the Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-04-D-0055, Contract Task Order (CTO) 0022. This report describes the basis for the development and evaluation of remedial action alternatives for soil and groundwater at Site 43.

This FS was conducted to establish Remedial Action Objectives (RAOs) and cleanup goals, to screen remedial technologies, and to assemble, evaluate, and compare remedial alternatives. The FS focuses on the soil and groundwater contamination at Site 43 presented in the remedial investigation (RI) report (TtNUS, 2006). Department of the Navy Environmental Restoration Program (NERP) Manual (2006) was used as guidance for this FS.

1.2 SITE BACKGROUND

Figure 1-1 provides a general facility location map for NAS Pensacola. Figure 1-2 shows features in the vicinity of Site 43 and Figure 1-3 provides the general arrangement of the site.

1.2.1 Site Description

NAS Pensacola (Figure 1-1) is located in Escambia County in Florida's northwest coastal area, approximately 5 miles west of the Pensacola City limits. The federal government established the Navy Yard at Pensacola in 1825. The Navy Yard was placed in caretaker status in 1911. Naval aviation operations began at the facility in 1914. The facility was expanded in the 1930s as an NAS.

Current land use at NAS Pensacola consists of various military housing, training, and support facilities as well as large industrial complexes for major repairs and refurbishment of aircraft engines and frames.

Other land uses on base include training activities, equipment and materials storage, maintenance areas, and recreational facilities for military personnel. Land use in the off-base areas adjacent to NAS Pensacola is primarily residential.

Site 43 (Figure 1-2) is located at the southwestern corner of Murray and Taylor Roads and north of Road Q, which provides access to the NAS Pensacola Officer's Quarters. Site 43 is located adjacent to

several housing areas; therefore, recreational users as well as site and maintenance workers are expected to use the site. The site lies on the eastern slope of a low area between Murray and Taylor roads and across the street from the entrance to the Officers' Quarters. The area covers approximately 40,000 square feet and the site elevation is approximately 20 feet above mean sea level. There is approximately 10 feet of vertical relief across the site. The area is grass covered with oak trees scattered throughout the site. Previously the site contained a tennis court and a building foundation/basketball court; however, in 2003 the tennis and basketball courts were removed by the facility. Overhead utilities are not present within the site area; however, an underground water line traverses the site in a general west-to-east direction.

A housing area located adjacent to the southern side of the site is referred to as the Warrington Housing and was constructed in 1930's. Previously, the Town of Warrington, which was built by Navy Yard workers on the federal reservation, occupied this general area. Warrington was moved across Bayou Grande as the base expanded in the 1930s, and the town cemetery was moved to Barrancas National Cemetery.

Three water wells are located on NAS Pensacola to provide an emergency backup potable water supply (NEESA, 1984). The backup water supply wells are completed at depths ranging from 224 to 250 feet below ground surface (bgs) and extract groundwater from the sand and gravel aquifer. The nearest potable water well to Site 43 is Well 2, located approximately 1,600 feet west-southwest. The main source of potable water for the base is the Navy-owned well field located at Naval Technical Training Center (NTTC) Corry Station, which is located approximately 3 miles of NAS Pensacola on the northern side of Bayou Grande.

Site 43 is located in a developed area of the base. A paved parking lot covers approximately 31,000 square feet of the Site area. No wetlands are located in the vicinity of Site 43. On-site wildlife may temporarily use Site 43, but due to lack of suitable cover, wildlife use is assumed to be infrequent.

1.2.2 Site History

The history of Site 43 begins in December 1992, when a child using a metal detector discovered a partially exposed drum east of the tennis court. A site reconnaissance found an additional partially buried drum. One drum was in a vertical position; and its end was punctured revealing standing water in the interior. The second drum also appeared to be in a vertical position but was not obviously punctured. A third iron object resembling a drum rim was observed east of the tennis court. Smaller, rusted metal debris was observed at the surface. No odors, visible soil stains, or other indications of contaminant release were observed. The area surrounding the buried drums was fenced to prevent general access

until further investigations could be conducted. Prior to the most recent use as a recreational area, the site's use is unknown.

1.2.3 Site Characteristics

The following sections discuss the site-specific physical characteristics of Site 43, including surface hydrology, geology, soil characteristics, and groundwater hydrogeology.

NAS Pensacola is located in the extreme southeastern portion of Escambia County, Florida, which lies within the Coastal Plain Province of the United States. As described in the Initial Assessment Study (IAS) of NAS Pensacola (Naval Energy and Environmental Support Activity [NEESA], 1983), NAS Pensacola lies within the coastal lowland characterized by a series of broad, nearly level marine terraces that extend several miles from the coast and merge with narrow terraces along the Escambia and Perdido Rivers. NAS Pensacola is located on a peninsula with gently sloping terrain. The land surface elevations on the peninsula range from sea level to approximately 40 feet above mean sea level.

Escambia County has a warm, humid-temperate climate (USDA, 2004). Along the coast, the Gulf of Mexico moderates high temperatures in the summer and low temperatures in the winter. Total annual precipitation is about 62 inches. The greatest amount of rain falls in July and August. Occasionally, short droughts occur in late spring.

1.2.3.1 Surface Hydrology

NAS Pensacola is bordered on the south by Big Lagoon, on the south and east by Pensacola Bay, and on the north by Bayou Grande (NEESA, 1983). Sandy surface soil in this area allows a high proportion of rainfall to infiltrate into the ground and consequently there are few streams. The surface topography has little dissection, and the natural drainage system is poorly developed. Much of the surface drainage has been constructed or modified to accommodate structures on base. Swampy areas exist on or near the western portion of NAS Pensacola, and man-made drainage ways and storm drains feed into the short intermittent streams emptying into Pensacola Bay and Bayou Grande. No perennial streams enter or exit NAS Pensacola, but marshy areas and three small lakes on the golf course retain water throughout the year.

Site 43 is located on the eastern slope of a shallow closed depression bound by paved roads on all four sides. Surface water features are not present at the site, and overland runoff is to the west into the depression. A designated wetland and a drainage ditch located approximately 500 feet east of the site are the nearest surface water bodies.

1.2.3.2 Geology and Soil Characteristics

The surficial geology of the area consists of Pleistocene marine deposits made up of light brown to tan, fine quartz sand with associated stringers and lenses of gravel and clay. Underlying these deposits, increasing with age, are the Citronelle Formation, the Miocene Coarse Clastics, the Pensacola Clay, the Tampa Formation, the Chickasawhay Limestone, the Bucatunna Clay member of the Byram Formation, the Ocala Group, the Lisbon equivalent, the Tallahatta Formation, and the Hatchetigbee Formation. The Pleistocene deposits and Citronelle formation are often impossible to differentiate, and together range in thickness from approximately 30 feet to 800 feet across the county (NEESA, 1983).

The lithologies observed during drilling of Site 43 monitoring wells are typical of the undifferentiated Pleistocene marine deposits. The ground surface to 4 feet bgs at most of the monitoring well locations showed signs of disturbance either from the waste disposal activities at the site or the Interim Remedial Action (IRA) excavation. Below 4 feet, typical lithologies included medium to fine silty or clayey sand ranging from light gray or tan to dark brown in color. Significant clay or gravel horizons were not encountered.

Soils at Site 43 are from the Lakeland Series, which consists of very deep, excessively drained soils formed in sandy marine sediments (USDA, 2004). These soils are on the summits and side slopes of ridges in uplands and on low ridges and knolls in coastal lowlands. The soil mapping unit at Site 43 is the Lakeland Sand 0-5 percent slopes, which is found on nearly level summits and gently sloping shoulder slopes of broad ridges. Slopes are long and smooth. Typically the surface layer is dark grayish brown sand about 5 inches thick. The substratum to a depth of 80 inches is yellowish brown and brownish yellow sand.

1.2.3.3 Groundwater

The groundwater in the surficial aquifer is at a depth of approximately 15 feet bgs. The general groundwater flow direction is towards the east. The average groundwater flow velocity was estimated to be 0.88 feet/day in the RI.

1.2.4 Environmental Investigations

This section summarizes previous investigations performed at Site 43 at NAS Pensacola, including a geophysical survey and a site characterization, prior to the Interim Remedial Action (IRA), and most recently a Remedial Investigation (RI). This subsection summarizes the findings of the geophysical survey and the site characterization investigation.

In March 1994, a geophysical investigation using gradient and total magnetic surveys was conducted to assess the size of the disposal area and number of drums buried around the drum discovered in 1992. A total of 25 individual geophysical anomalies were identified; however, the actual number of drums disposed in the area was not determined. The report concluded that the drum disposal area, and several magnetic anomalies discovered outside the disposal area should be further explored by test pitting or trenching (EnSafe/Allen & Hoshall, 1994).

In October 1999, TtNUS conducted a site characterization sampling event to investigate the magnetic anomalies, to collect surface and subsurface soil samples from the anomaly locations, to install temporary micro wells, and to collect groundwater samples from the micro wells(TtNUS, 2004). Test pits revealed the presence of drums, and a total of 14 drums were removed, of which 12 contained insufficient material to sample. The two drums were sampled and contained polycyclic aromatic hydrocarbons (PAHs) and metals at concentrations exceeding the Soil Cleanup Target Levels (SCTLs) under Florida Department of Environmental Protection (FDEP) regulations. Surface soil, subsurface soil samples from depths of 2 to 3.5 feet bgs (beneath the drum disposal depth), and deeper subsurface soil samples above the water table were collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and cyanide. Several metals and PAHs were found in surface and shallow subsurface soil samples at concentrations exceeding Florida Residential SCTLs, and two metals (antimony and nickel) were also found at concentrations exceeding Florida SCTL for leachability to groundwater. However, none of the deeper subsurface soil samples contained any chemical exceeding Florida SCTLs or NAS Pensacola background levels. Furthermore, groundwater samples did not contain PAHs or metal at concentrations exceeding Florida Groundwater Cleanup Target Levels (GCTLs) except for aluminum and iron, of which only iron was found to also exceed the NAS Pensacola background levels.

1.2.5 Interim Remedial Action

Following the completion of the site characterization investigation, an IRA was completed by CH2M HILL Constructors, Inc. (CCI) to remove metal debris and contaminated surface and subsurface soils at the site. The removal action area is shown on Figure 1-4. The interim removal action is summarized in the Interim Removal Action Report, Excavation of Contaminated Soil and Groundwater Monitoring at Site 43, Naval Air Station Pensacola, Pensacola, Florida dated September 2003 (CCI, 2003).

Prior to initiating the IRA fieldwork, CCI developed remedial goals (RGs) for some Chemicals of Concern (COCs) at the site using 95 percent Upper Confidence Limits (UCLs) for surface soils. Based on these RGs, samples were collected to delineate the extent of contamination prior to excavation activities. Forty-one surface soil samples and 21 subsurface soil samples were collected in the vicinity of the

identified remedial areas for source delineation of metal COCs. Based on the laboratory results, the areas of excavation were defined (CCI, 2003).

Of the initial 15 anomalous areas characterized for contamination, six areas exceeded the initial cleanup criteria. These areas included Anomaly Areas 4, 14, 15, 16, 20, and 22. From April through May 3, 2001, a total of 657 cubic yards of soil and debris were removed from these areas at Site 43. The excavated soil was either temporarily stockpiled or loaded directly onto transport vehicles. Soil that was determined to be hazardous for lead was manifested accordingly. Approximately 20 to 25 rusted metal drums and drum parts and inert ornamental ordnance and munitions were uncovered in addition to the original 14 drums identified and previously removed. Following excavation activities, the excavated areas were backfilled to 1 foot bgs with a clean clayey soil to serve as a liner in the excavated area and topsoil for the upper 1 foot surface completion. Following testing for appropriate density, the excavated areas were hydro-seeded with grass seed and fertilizer (CCI, 2003).

Baseline groundwater sampling was conducted prior to excavation activities, and a subsequent round of semi-annual groundwater sampling was conducted after excavation activities were completed. Groundwater samples were analyzed for iron only. Detected iron concentrations for both sampling events were less than the established NAS Pensacola background concentrations of 1,707 micrograms per liter (µg/L) (CCI, 2003).

Following excavation activities, the cleanup criteria were re-evaluated and revised. Consequently, it was determined that nine other areas (Anomaly Areas 11, 12, 13, 17, 18, 19, 21, 23, and 24) contained contaminants that exceeded the revised cleanup criteria. Areas with exceedances of the revised criteria that were not excavated included 11, 12, 13, 17, 23, and 24 (CCI, 2003). In addition, excavation activities were completed to a depth of 2 feet bgs; however, subsurface soil samples collected within the excavation area at depths ranging from 2 feet bgs to 3.5 feet bgs during the characterization study had exceedances of the revised RGs.

Because of the revised lower RGs established for the site after the soil removal activities were completed, CCI recommended that an RI/FS be conducted at Site 43 to delineate COC contamination and to identify a final remedy for the site (CCI, 2003).

1.3 REMEDIAL INVESTIGATION

Following the IRA, TtNUS conducted a remedial investigation (RI) at Site 43 (TtNUS, 2006) to determine the nature and extent of contamination and risk assessment to support an FS. During the RI, field activities consisted of soil and groundwater sampling. Twenty surface soil samples were collected at 0 to 1 ft bgs from the perimeter of the anomaly areas and analyzed for Target Compound List (TCL) SVOCs,

and inorganic analytes. Twenty soil borings were advanced at geophysical anomaly/test pit locations. Two subsurface soil samples were submitted for laboratory analysis from each soil boring; shallow subsurface soil samples were collected at the soil excavation limit of approximately 2 feet bgs and deeper subsurface soil samples were collected from between 4 and 9 feet bgs. All subsurface soil samples were analyzed for TCL SVOCs and selected metals. Eight shallow monitoring wells were installed to an approximate depth of 25 feet bgs. In addition, two deep permanent monitoring wells were installed to an approximate depth of 50 feet bgs. Groundwater samples were collected from the existing micro wells and the newly installed monitoring wells. The groundwater samples were analyzed for TCL VOCs and Target Analyte List (TAL) metals.

A human health risk assessment (HHRA) and a screening-level ecological risk assessment (SLERA) were conducted for Site 43. Metals and carcinogenic PAHs were detected in surface soil and subsurface soil samples at concentrations exceeding risk-based screening criteria. Metals in groundwater samples exceeded risk-based screening criteria (lead) and secondary standards (iron and manganese). The HHRA and SLERA identified risks to human and ecological receptors, respectively, exceeding U.S. EPA and FDEP benchmarks. The RI recommended measures to eliminate or minimize exposure to address risks. The RI also recommended that a detailed evaluation of alternatives to achieve this goal should be presented in a Feasibility Study (FS) for the site. Finally, in acknowledgement of comments received from regulators on the RI, it also recommended that a confirmation sampling and analysis protocol be incorporated in the FS to verify that the selected remedy for Site 43 is effective for the nature and extent of contaminants at the site.

1.4 NATURE AND EXTENT OF CONTAMINATION

This section presents a discussion of the Chemicals of Potential Concern (COPCs) and their extent in the soil and groundwater at Site 43. Figures 1-4 and 1-5 present a visual depiction of the distribution of COPCs as identified in the RI for the surface and subsurface soil, respectively at Site 43. Figure 1-6 presents a similar depiction of COPCs as identified in the RI for groundwater at Site 43.

1.4.1 Soil

The RI concluded that the release of contaminants at Site 43 appears to have resulted from undocumented burning and disposal of unknown materials. The source and nature of materials and the time of disposal are unknown. Ten surface soil samples had exceedances of one or more residential and/or industrial SCTLs (RSCTLs/ISCTLs) for arsenic, barium, copper, lead, vanadium, and carcinogenic PAHs. Six shallow subsurface soil samples had exceedances of one or more SCTLs. Contaminant concentrations in deeper subsurface soil samples from depths greater than 4 feet bgs were less than SCTLs.

Table 1-1 summarizes the locations of surface soil samples (collected within the 0 to 1 foot bgs interval) where exceedances of Florida SCTLs occurred for one or more chemicals. Except for lead, concentrations of all other chemicals (arsenic, barium, copper, vanadium, and PAHs) exceeded only their RSCTLs. Concentrations of lead exceeded its ISCTL at several locations. Table 1-2 summarizes the locations of shallow subsurface soil samples (1 to 4 feet bgs) where exceedances of Florida SCTLs occurred for one or more chemicals. Similar to the findings for surface soil, only lead concentrations exceeded its ISCTL in shallow subsurface soil, albeit at fewer locations.

Figure 1-7 provides a comprehensive depiction showing the locations where occurrences of COPCs exceeded SCTLs. Appendix A contains a complete printout of the soil database from the RI.

1.4.2 Groundwater

In most of the monitoring wells sampled during the RI, iron was detected at concentrations exceeding the GCTL, which is a secondary standard, but less than the NAS Pensacola background concentration. Iron concentrations exceeding the background concentration were detected in three monitoring wells. These wells are located upgradient and sidegradient of the known disposal area, which would suggest that the iron concentrations in these wells are naturally occurring rather than due to site activity. Manganese was detected in each of the groundwater samples collected at Site 43. The reported manganese concentrations in two shallow wells exceeded the GCTL, which is a secondary standard. Lead was detected in only two groundwater samples collected at Site 43. Lead only exceeded its GCTL in the sample collected from PEN-43-13S, which is located at the center of Anomaly Area 11, where surface and subsurface soil samples had lead concentrations exceeding residential and industrial SCTLs. Appendix A contains a printout of groundwater data from the RI.

1.5 RISK ASSESSMENT

A human health risk assessment (HHRA) and a screening-level ecological risk assessment (SLERA) were conducted for Site 43. This section summarizes the findings of these two tasks.

1.5.1 Summary of Human Health Risk Assessment

An HHRA was conducted for the chemical concentrations detected in surface soil, subsurface soil, and groundwater samples. The evaluation was conducted using both U.S. EPA and State of Florida regulations and guidelines for HHRA. The U.S. EPA risk assessment considered five receptors, the hypothetical future resident, typical industrial worker, construction worker, maintenance worker, and trespasser/recreational user, and assumed exposure via the ingestion, dermal contact, and inhalation

routes of exposure. Maintenance workers and trespassers/recreational users are considered to be the most likely receptors at Site 43 under current land use.

The list of COPCs for Site 43 included the following:

- Surface Soil – carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Subsurface Soil – carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Groundwater – chloroform, iron, lead, and manganese

Based on the U.S. EPA evaluation, lead was determined to be the predominant COPC detected in soil and groundwater at Site 43 and the primary chemical warranting further consideration as a site contaminant. Lead concentrations exceeding the Office of Solid Waste and Emergency Response (OSWER) Soil Screening Level (SSL) of 400 mg/kg were detected at six surface soil sampling locations (average concentration of 2,525 mg/kg) and at six subsurface soil locations (average concentration of 1,350 mg/kg). Lead was detected in 2 of 12 groundwater samples, with the concentration in one sample exceeding the 15 µg/L U.S. EPA action level. Because published toxicity criteria are not available for lead, exposure to lead in soil was evaluated by the Integrated Exposure Uptake Biokinetic (IEUBK) Model and the Technical Review Group (TRW) adult lead model for residential and non-residential exposure scenarios, respectively. Results of the IEUBK and TRW adult lead model analyses indicate that exposure to average lead concentrations in surface and subsurface soil and the maximum detected concentration in groundwater would result in risks (i.e., probabilities) exceeding U.S. EPA benchmarks.

Quantitative estimates of non-carcinogenic and carcinogenic risks were developed for the receptors listed above for exposure to COPCs in soil and groundwater. Cancer risk estimates, total incremental lifetime cancer risks (ILCRs) developed for excavation/construction workers and maintenance workers exposed to COPCs in surface and subsurface soil were less than $1x10^{-6}$. Total ILCRs for full-time commercial/industrial workers, lifelong recreational users, and future residents hypothetically exposed to COPCs in soil and groundwater were within the U.S. EPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. The primary risk drivers were carcinogenic PAHs and arsenic in soil and chloroform in groundwater. However, there is considerable uncertainty associated with the risks calculated for arsenic and chloroform. The arsenic concentrations detected in soil exceeded facility background concentrations but were well within naturally occurring levels in the United States (the average Site 43 soil concentration is approximately 3 mg/kg). In addition, the soil background data set for NAS Pensacola consists of only two locations and therefore, background levels may not be adequately characterized. As stated above, chloroform was detected in only 2 of 12 samples; the maximum concentration is well below the U.S. EPA MCL and the Florida GCTL. It is likely that carcinogenic PAHs are a “hotspot” contamination issue only because elevated concentrations of carcinogenic PAHs were detected mainly in subsurface soil sample

PEN-43-SB1401. Average carcinogenic PAH concentrations outside this area (approximately 0.08 mg/kg) slightly exceeded the Region 9 residential soil Preliminary Remediation Goal (PRG) (0.062 mg/kg) screening level, but were less than the FDEP Residential Soil SCTL (0.1 mg/kg). This sample (SB1401) also contained the maximum detected concentrations of lead and other metals in subsurface soil.

Noncancer risk estimates (total Hazard Indices [HIs]) developed on a target organ/effect basis for all receptors evaluated were less than unity (1.0). Consequently, adverse non-carcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The risk assessment conducted per the State of Florida regulations and guidelines evaluated risks to a hypothetical future resident and a typical industrial worker using the published SCTLs for the residential and industrial land use scenario, respectively. Risks to a hypothetical future recreational user were evaluated using SCTLs specifically developed for this risk assessment as stipulated in the State of Florida regulations and guidelines. The following chemicals were identified as potential COCs for surface soils based on a comparison of maximum concentrations or Exposure Point Concentrations (EPCs) to these SCTLs:

- Residential SCTL - carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Industrial SCTL - lead

The following chemicals were identified as potential COCs for subsurface soils based on a comparison of maximum concentrations or EPCs to SCTLs:

- Residential SCTL - carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium
- Industrial SCTL - carcinogenic PAHs, and lead
- Recreational SCTL - carcinogenic PAHs

The following chemicals were identified as potential COCs for groundwater based on a comparison of maximum concentrations to GCTLs:

- Iron
- Lead
- Manganese

Note that iron and manganese were identified as potential COCs for groundwater because the maximum concentrations exceeded GCTLs ,which are equivalent to U.S. EPA Secondary MCLs. Secondary MCLs

are criteria based not on health effects but rather on aesthetic effects such as taste and odor. Also, note that Hazard Quotients (HQs) for iron and manganese calculated in the U.S. EPA evaluation were less than the U.S. EPA and Florida goal of unity (1.0) for non-carcinogenic health effects.

Chemicals detected in soil were also evaluated for the potential to impact groundwater quality at the site by comparing maximum concentrations to FDEP SCTLs for migration from soil to groundwater. This evaluation indicated that that the concentrations of constituents detected in soil were unlikely to adversely impact groundwater quality.

1.5.2 Summary of Screening Level Ecological Risk Assessment

The SLERA identified surface soil concentrations of barium, copper, and lead that may pose risks to invertebrates and plants, especially from the cumulative toxicity of multiple metals. The locations where elevated concentrations exist are primarily limited to three small isolated areas: within the vicinity of location PEN-43-SS21 (located within the former tennis court boundaries), Anomaly Area 11, and Anomaly Area 23. No impacts to plants and invertebrates at Site 43 are expected at other locations.

Potential risks to insectivorous small mammals and birds from copper and lead were evaluated. Based on food-chain modeling results, lead concentrations in eight soil samples pose potential risks to insectivorous small mammals and birds that forage exclusively at Site 43. These eight samples were collected from primarily three isolated areas: the vicinity of location PEN-43-SS21 (located within the former tennis court boundaries), Anomaly Area 11, and Anomaly Area 23. The precise extent to which birds and mammals forage at Site 43 is uncertain, but due to the poor habitat at the site, birds and mammals probably do not forage to a significant extent there.

1.6 CONCLUSION

The site characterization and risk assessments indicate that there are potential risks to human health from exposure to surface and shallow subsurface soil at the site. These risks are driven by the presence of PAHs and several metals and are the basis for the development of remedial action objectives in Section 2.0. The presence of contaminants in groundwater does not pose a threat to human health because of the presence of a potable water supply at the base and because of the unlikelihood of the surficial groundwater being used as a source of drinking water. However, the contamination in groundwater needs to be addressed because of Applicable or Relevant and Appropriate Requirements (ARARs) governing the protection of drinking water, also as discussed in Section 2.0.

TABLE 1-1

SUMMARY OF SURFACE SOIL LOCATIONS EXCEEDING SCTLs
SITE 43 FEASIBILITY STUDY
NAS PENSACOLA, PENSACOLA FLORIDA

Surface Soil Location	Arsenic (mg/kg)	Barium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Vanadium (mg/kg)	PAHs (expressed as Benzo[a]pyrene equivalents) (ug/kg)
PEN-43-SS-18	NE	NE	NE	NE	NE	147
PEN-43-SS-19	3.5	NE	NE	NE	NE	NE
PEN-43-SS-21	4.2	710	240	2080	NE	NE
PEN-43-SS-24	7.6	346	889	1990	NE	277
PEN-43-SS-25	4.8	243	381	1490	NE	252
PEN-43-SS-26	NE	NE	NE	NE	NE	105
PEN-43-SS-27	6	310	NE	3850	NE	NE
PEN-43-SS-28	8	726	NE	7360	73.1	288
PEN-43-SS-29	NE	NE	NE	417	NE	NE
PEN-43-SS-34	NE	NE	261	500	NE	NE
Residential SCTL/ Industrial SCTL	2.1/12	120/130,000	150/89,000	400/1400	67/10,000	100/700

Notes:

ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
PAHs = polycyclic aromatic hydrocarbons
SCTLs = Soil Cleanup Target Levels (Florida's)
1 NE: No exceedance for that chemical
2 Shaded cells indicate an exceedance of Residential SCTLs and Industrial SCTLs
Entries in remaining cells indicate exceedance of only Residential SCTLs

TABLE 1-2

SUMMARY OF SHALLOW SUBSURFACE SOIL LOCATIONS EXCEEDING SCTLs
SITE 43 FEASIBILITY STUDY
NAS PENSACOLA, PENSACOLA FLORIDA

Shallow Subsurface Soil Location	Arsenic (mg/kg)	Barium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Vanadium (mg/kg)	PAHs (expressed as Benzo[a]pyrene equivalents) (ug/kg)
PEN-43-SB-0601	2.6	188J	529J	519	NE	NE
PEN-43-SB-0801	NE	138J	300J	427	NE	NE
PEN-43-SB-1101	4.2	306J	3380	1370	NE	362
PEN-43-SB-1401	11.4	939J	1220	5500J	156	NE
PEN-43-SB-1701	7.3	366J	500	1460	NE	491
PEN-43-SB-2501	NE	884J	448J	1340	NE	114
Residential SCTL/ Industrial SCTL	2.1/12	120/130,000	150/89,000	400/1400	67/10,000	100/700

Notes:

ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
PAHs = polycyclic aromatic hydrocarbons
SCTLs = Soil Cleanup Target Levels (Florida's)

1 NE: No exceedance for that chemical
2 Shaded cells indicate exceedance of Residential SCTLs and Industrial SCTLs
Entries in remaining cells indicate exceedance of only Residential SCTLs
3 J= Estimated value

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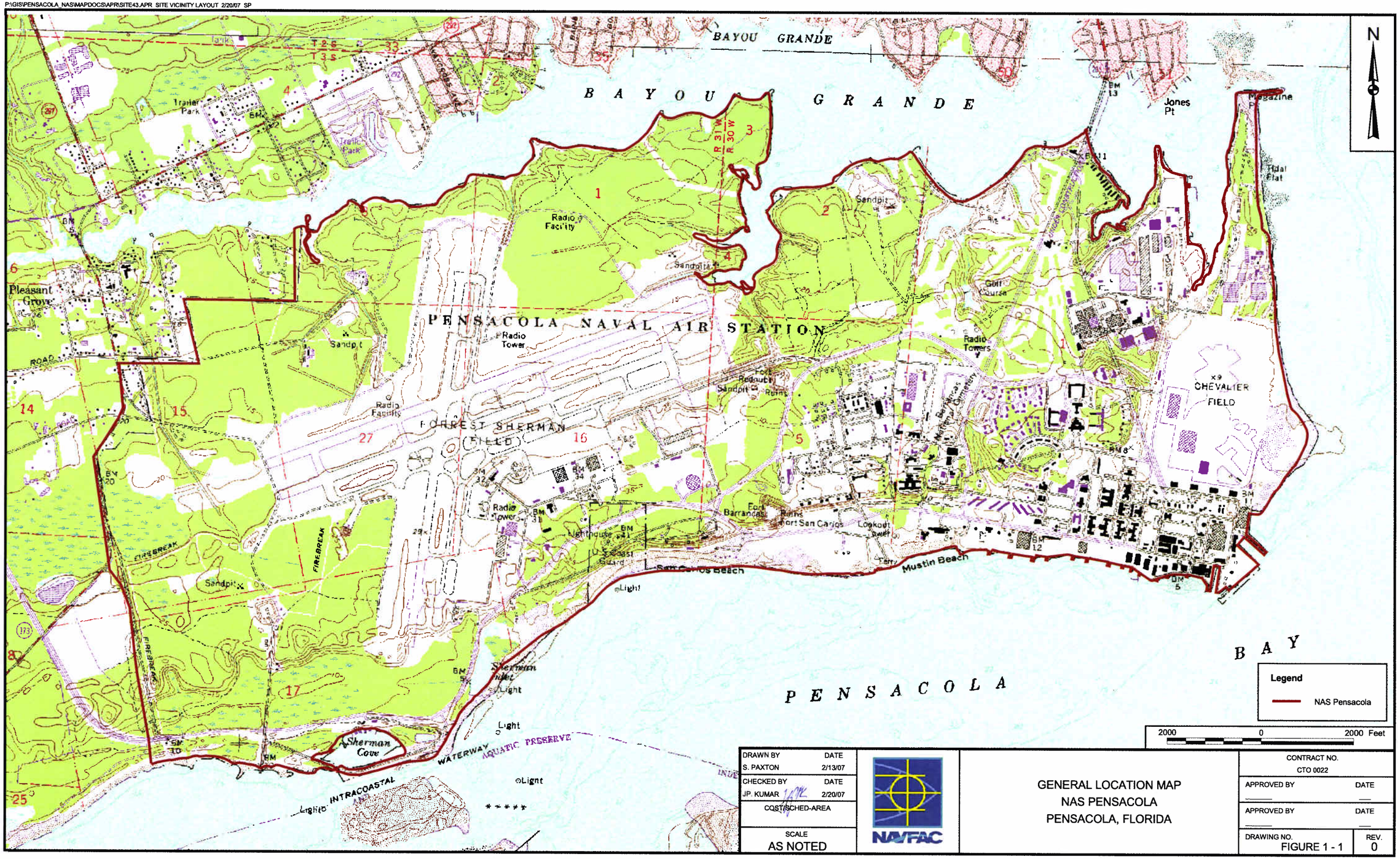

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CHECKED BY JP. KUMAR	DATE 2/20/07		APPROVED BY / DATE
CQST/SCHED-AREA			APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 1 - 1 / REV. 0

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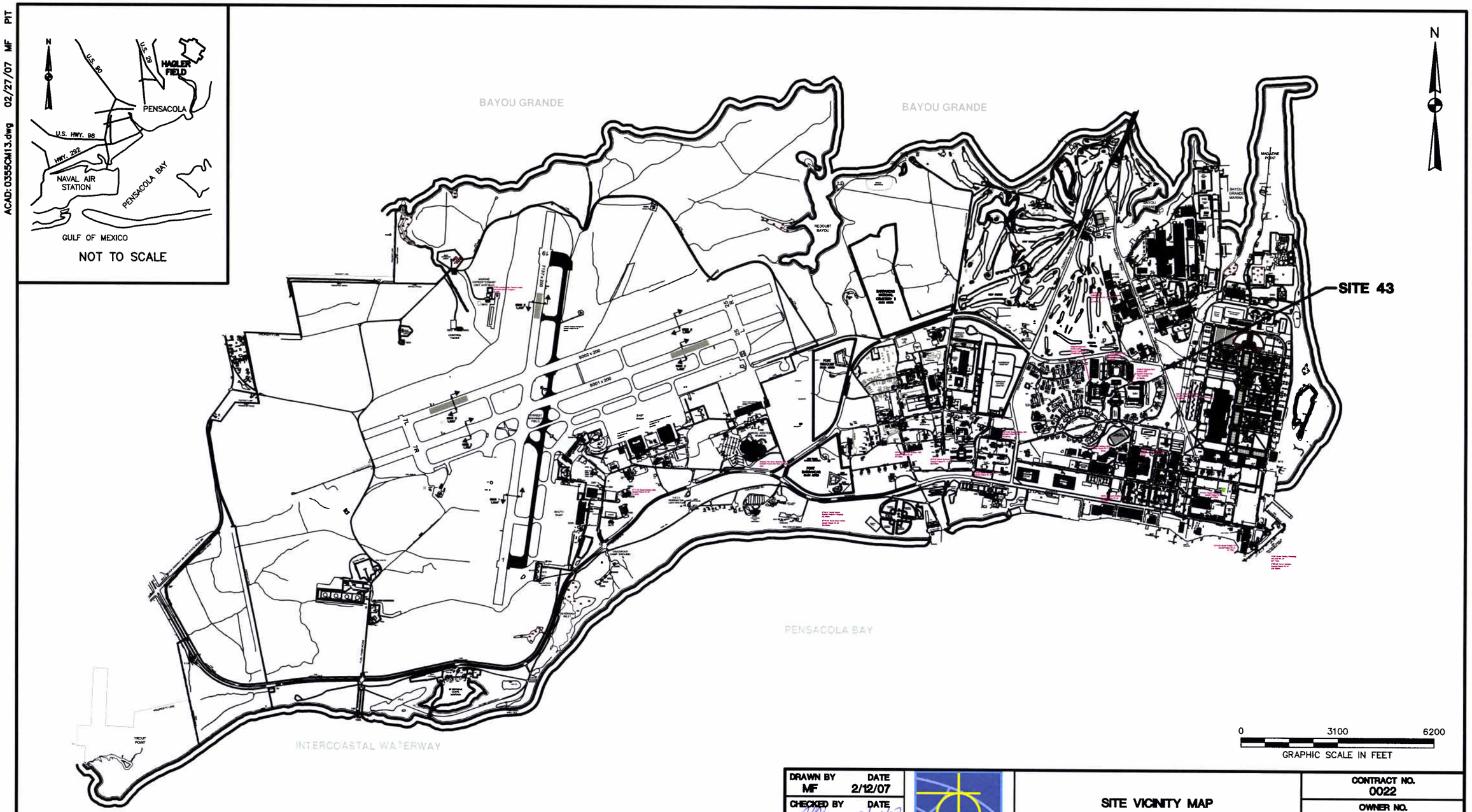

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REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-2 / REV. 0

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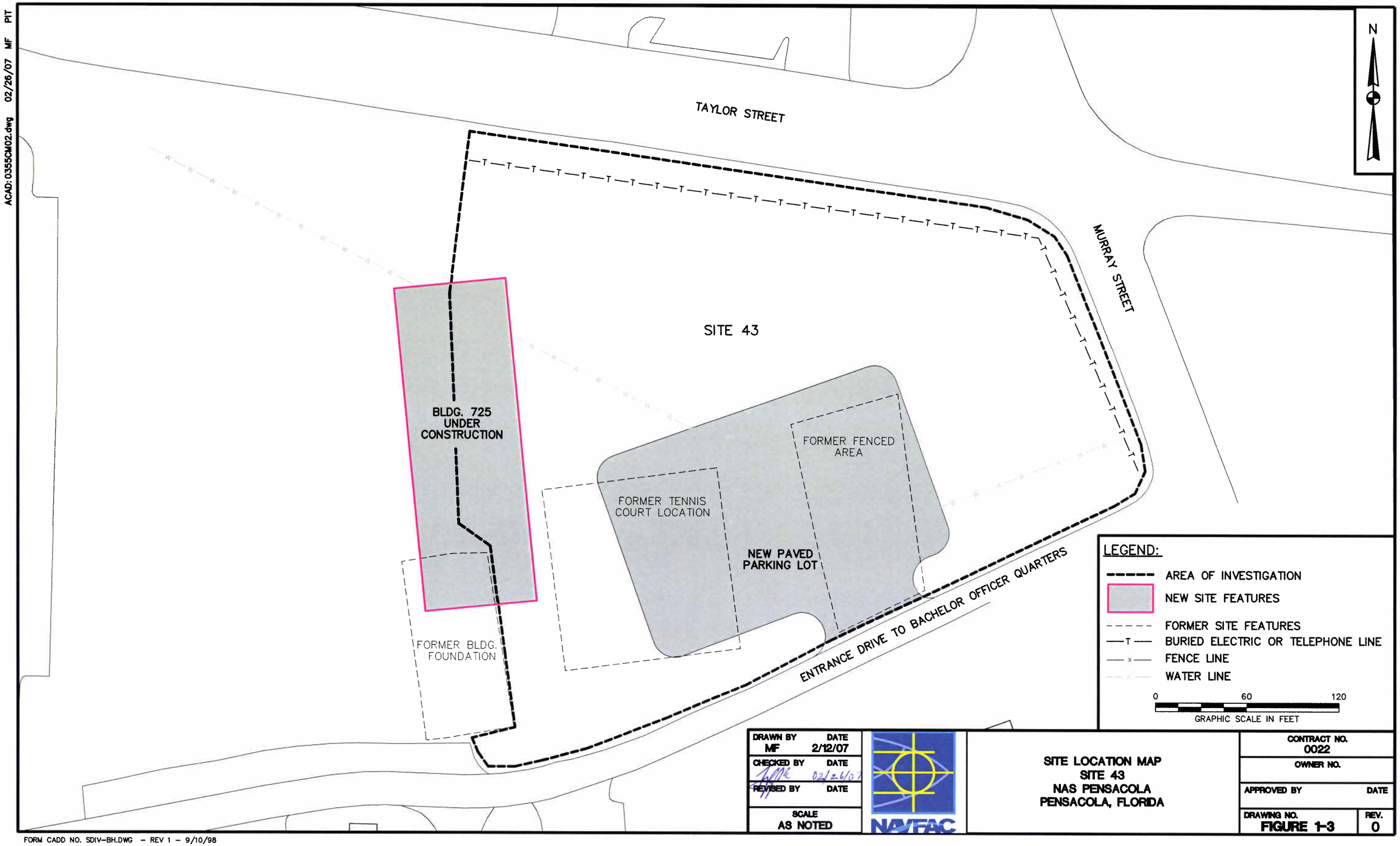

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REVISED BY	DATE
SCALE	
AS NOTED	

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SITE LOCATION MAP
SITE 43
NAS PENSACOLA
PENSACOLA, FLORIDA

CONTRACT NO.	
0022	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 1-3	0

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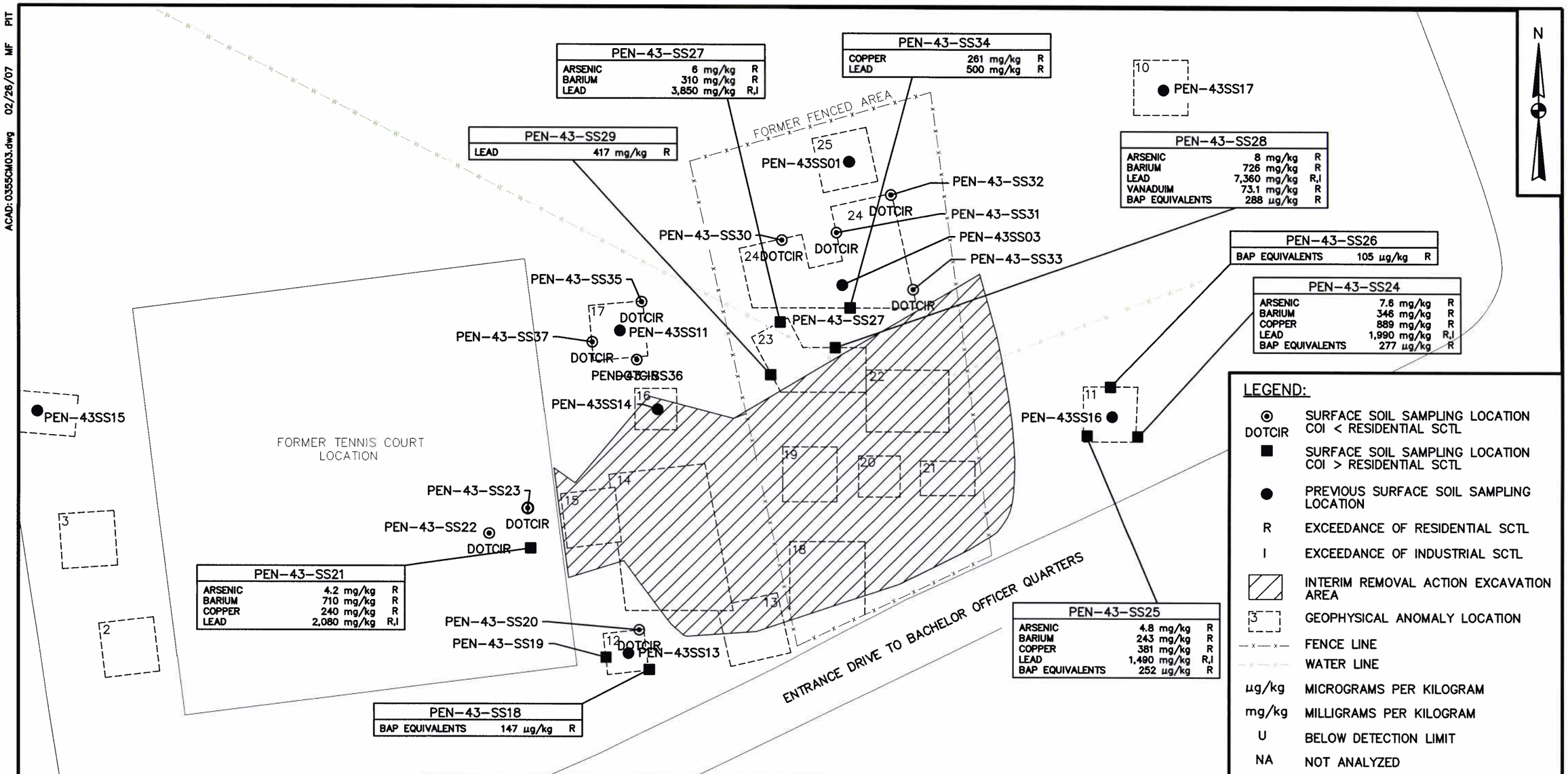

CLEANUP TARGET LEVELS		
CONSTITUENTS	RESIDENTIAL SCTL	INDUSTRIAL SCTL
ARSENIC (mg/kg)	2.1	12
BARIUM (mg/kg)	120	130,000
COPPER (mg/kg)	150	89,000
LEAD (mg/kg)	400	1,400
VANADIUM (mg/kg)	67	10,000
BAP EQUIVALENTS (µg/kg)	100	700

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CHECKED BY	DATE 2/28/07	
REVISED BY	DATE	
SCALE AS NOTED		

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CONTRACT NO. 0022	
OWNER NO.	
APPROVED BY	DATE
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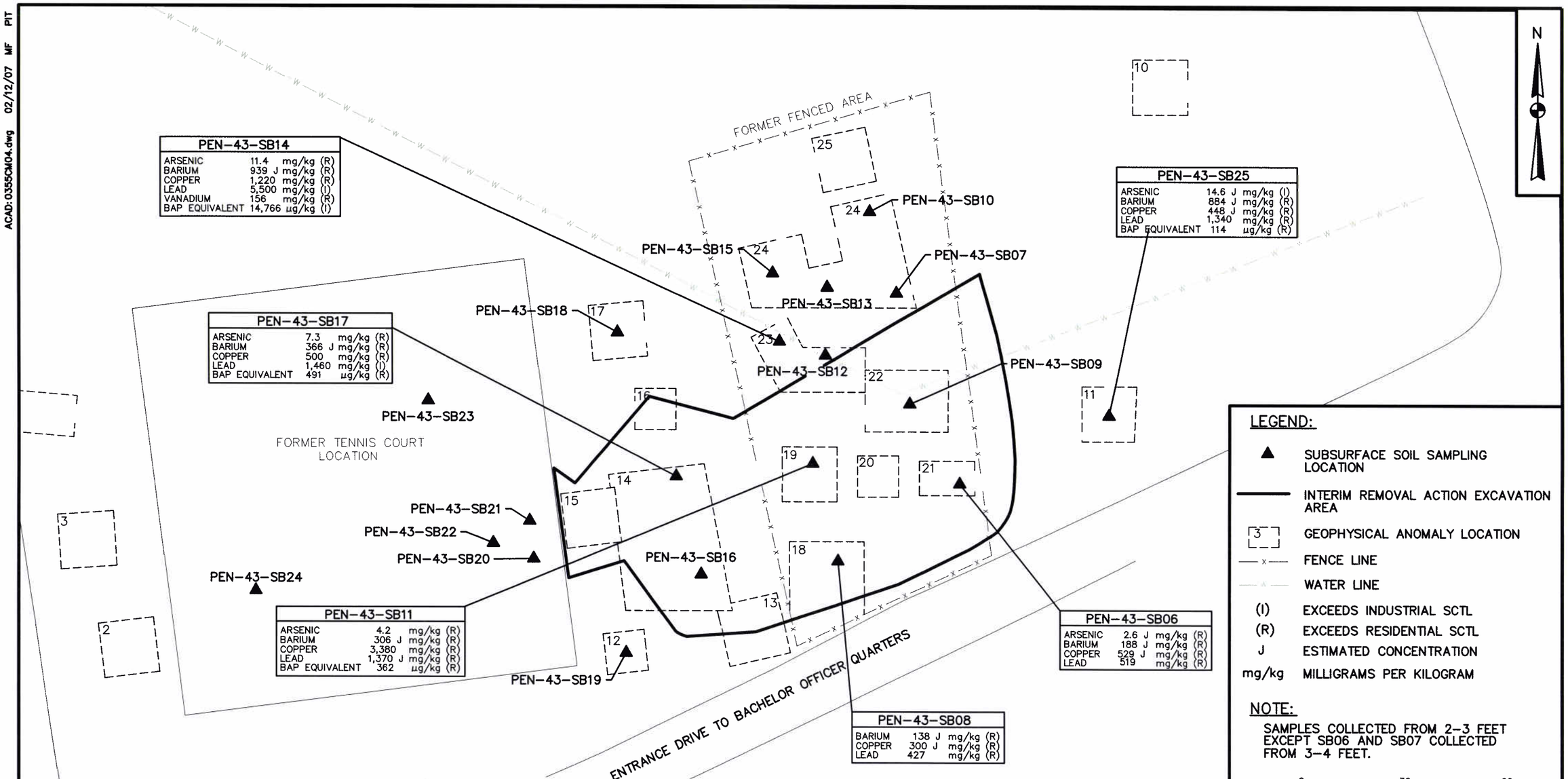

PEN-43-SB14		
ARSENIC	11.4	mg/kg (R)
BARIUM	939 J	mg/kg (R)
COPPER	1,220	mg/kg (R)
LEAD	5,500	mg/kg (I)
VANADIUM	156	mg/kg (R)
BAP EQUIVALENT	14,766	µg/kg (I)

PEN-43-SB25		
ARSENIC	14.6 J	mg/kg (I)
BARIUM	884 J	mg/kg (R)
COPPER	448 J	mg/kg (R)
LEAD	1,340	mg/kg (R)
BAP EQUIVALENT	114	µg/kg (R)

PEN-43-SB17		
ARSENIC	7.3	mg/kg (R)
BARIUM	366 J	mg/kg (R)
COPPER	500	mg/kg (R)
LEAD	1,460	mg/kg (I)
BAP EQUIVALENT	491	µg/kg (R)

PEN-43-SB11		
ARSENIC	4.2	mg/kg (R)
BARIUM	306 J	mg/kg (R)
COPPER	3,380	mg/kg (R)
LEAD	1,370 J	mg/kg (R)
BAP EQUIVALENT	362	µg/kg (R)

PEN-43-SB06		
ARSENIC	2.6 J	mg/kg (R)
BARIUM	188 J	mg/kg (R)
COPPER	529 J	mg/kg (R)
LEAD	519	mg/kg (R)

PEN-43-SB08		
BARIUM	138 J	mg/kg (R)
COPPER	300 J	mg/kg (R)
LEAD	427	mg/kg (R)

LEGEND:

- ▲ SUBSURFACE SOIL SAMPLING LOCATION
- INTERIM REMOVAL ACTION EXCAVATION AREA
- 3 GEOPHYSICAL ANOMALY LOCATION
- FENCE LINE
- WATER LINE
- (I) EXCEEDS INDUSTRIAL SCTL
- (R) EXCEEDS RESIDENTIAL SCTL
- J ESTIMATED CONCENTRATION
- mg/kg MILLIGRAMS PER KILOGRAM

NOTE:

SAMPLES COLLECTED FROM 2–3 FEET EXCEPT SB06 AND SB07 COLLECTED FROM 3–4 FEET.

0 30 60
GRAPHIC SCALE IN FEET

CLEANUP TARGET LEVELS		
CONSTITUENTS	RESIDENTIAL SCTL	INDUSTRIAL SCTL
ARSENIC (mg/kg)	2.1	12
BARIUM (mg/kg)	120	130,000
COPPER (mg/kg)	150	89,000
LEAD (mg/kg)	400	1,400
VANADIUM (mg/kg)	67	10,000
BAP EQUIVALENTS (µg/kg)	100	700

DRAWN BY MF	DATE 2/12/07
CHECKED BY	DATE 02/26/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

SHALLOW SUBSURFACE SOIL CONTAMINANTS OF POTENTIAL CONCERN
SITE 43
NAS PENSACOLA
PENSACOLA, FLORIDA

CONTRACT NO. 0022	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 1-5	REV. 0

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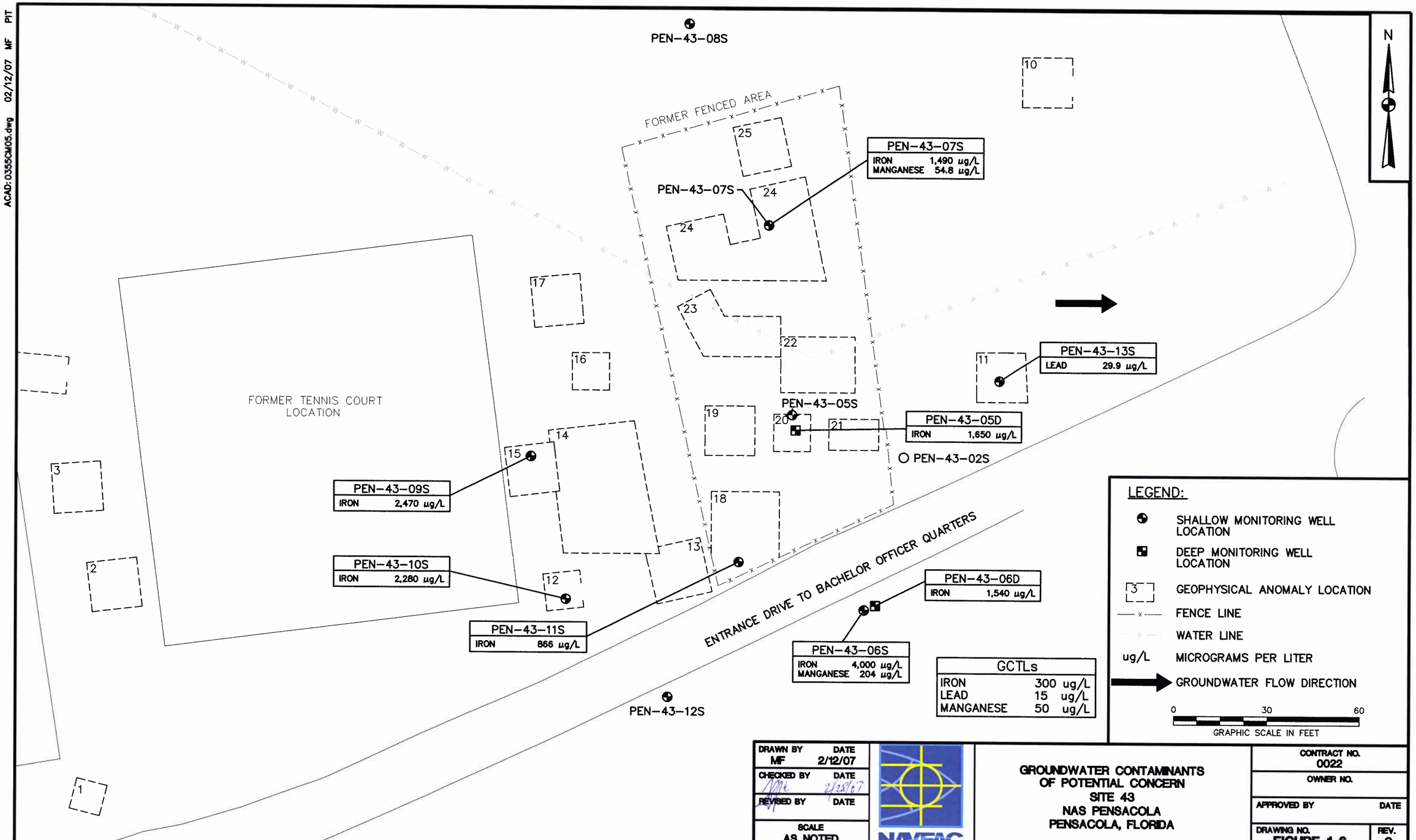


GCTLs	
IRON	300 ug/L
LEAD	15 ug/L
MANGANESE	50 ug/L

DRAWN BY	DATE
MF	2/12/07
CHECKED BY	DATE
	2/28/07
REVISED BY	DATE
SCALE	
AS NOTED	

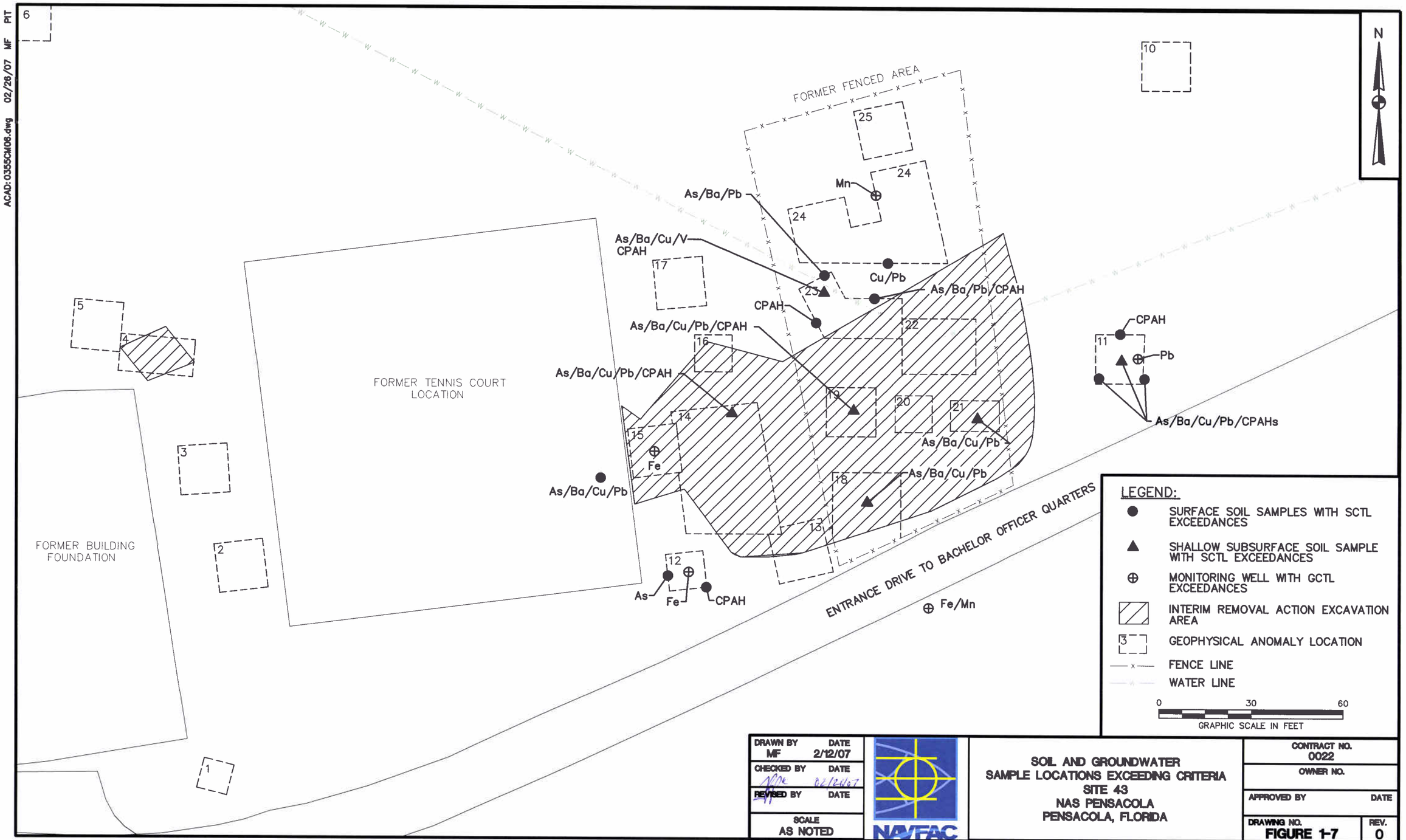
NAVFAC

GROUNDWATER CONTAMINANTS OF POTENTIAL CONCERN
SITE 43
NAS PENSACOLA
PENSACOLA, FLORIDA

CONTRACT NO.	
0022	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 1-6	REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

ACAD:0355CM06.dwg 02/26/07 MF PIT



DRAWN BY MF	DATE 2/12/07	SOIL AND GROUNDWATER SAMPLE LOCATIONS EXCEEDING CRITERIA SITE 43 NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0022
CHECKED BY	DATE 02/26/07		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-7 / REV. 0

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FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section develops Remedial Action Objectives (RAOs) for soil and groundwater for Site 43 based on the site conditions presented in Section 1.0. The RAOs provide the basis for selecting appropriate General Response Actions (GRAs) that may be suitable to achieve the site-wide cleanup goals for soil and groundwater.

The regulatory requirements and guidance (chemical-, location-, and action-specific Applicable or Relevant and Appropriate Requirements, or ARARs) and To Be Considered (TBC) criteria that may potentially govern remedial activities are also presented in this section. In addition, this section presents the chemicals of concern (COCs) and the conceptual pathways through which these chemicals may affect human health, and the environmental media of concern. Finally, this section presents an estimate of the volume of contaminated soil and groundwater.

2.1 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs for Site 43. Development of RAOs is an important step in the FS process. The RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable contaminant levels for the site. Section 2.1.1 presents the RAOs developed for Site 43.

The development of RAOs takes into consideration ARARs and TBC criteria. Section 2.1.2 identifies the ARARs and TBC criteria, Section 2.1.3 identifies the media of concern, and Section 2.1.4 identifies the COCs for remediation.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. This FS addresses soil and groundwater contamination at Site 43. The RAOs were developed based on the current land use as industrial/commercial property and future potential land use as residential property, with the objective of protecting the public from potential current and future health risks, as well as to protect the environment.

The following RAOs were developed for Site 43:

- Prevent unacceptable human health risk associated with exposure to soil containing lead, PAHs, and arsenic at concentrations greater than Florida SCTLs.

- Prevent unacceptable human health risk associated with exposure to groundwater containing lead concentrations greater than the FDEP GCTL or U.S. EPA Action level under National primary Drinking Water Regulations.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

TBC criteria are nonpromulgated, nonenforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment. Examples of TBC criteria include U.S. EPA's Drinking Water Health Advisories, Reference Doses (RfDs), and Cancer Slope Factors (CSFs).

One of the primary concerns during the development of remedial action alternatives for hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or "Superfund" is the degree of human health and environmental protection offered by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements.

2.1.2.1 Definitions

The definitions of ARARs and TBCs are as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law. While these relevant and appropriate requirements are not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstance at a CERCLA site, they address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

- TBCs are a category created by U.S. EPA that includes nonpromulgated criteria, advisories, and guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. However, pertinent TBCs will be considered along with the ARARs in determining the necessary level of cleanup or technology requirements.

Under CERCLA Section 121(d)(4), the U.S. EPA may waive compliance with an ARAR if one of the following conditions can be demonstrated.

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion.

- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.

- Compliance with the requirement is technically impracticable from an engineering perspective.

- The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through the use of another method or approach.

- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions within the state.

- Compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Superfund money for response at other facilities (fund-balancing). This condition only applies to Superfund-financed actions.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) identifies the following three categories of ARARs [40 Code of Federal Regulations (CFR) Section 300.400 (g)]:

- Chemical-Specific: Health-risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include MCLs under National Primary Drinking Water Regulations and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQCs).

- Location-Specific: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of these areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

- Action-Specific: Technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include wastewater discharge standards and performance or design standards, controls, or restrictions on particular types of activities.

This section discusses chemical- and location-specific ARARs and TBC criteria. Action-specific ARARs and TBC criteria are presented in Section 2.3 along with the discussion of GRAs.

2.1.2.2 Chemical-Specific ARARs and TBC Criteria

Tables 2-1 and 2-2 present lists of federal and State of Florida chemical-specific ARARs and TBC criteria for this FS. These ARARs and TBC criteria provide some medium-specific guidance on “acceptable” or “permissible” concentrations of contaminants.

2.1.2.3 Location-Specific ARARs and TBC Criteria

These ARARs and TBC criteria place restrictions on concentrations of contaminants or the conduct of activities solely based on the site’s particular characteristics or location. The Coastal Zone Management Action (CMZA) was evaluated because the facility adjoins the Pensacola Bay. Florida’s Coastal Management Program (CMP), which was developed to be consistent with the federal act, provides beach protection rules, construction setbacks from high water lines, construction standards to protect against 100-year storm surges, etc. Considering that the site is located about 2,000 to 3,000 feet from the bay and that the site is located in a highly developed area with several buildings in between the site and the water, the CMP would not be an ARAR. Therefore, Tables 2-3 and 2-4 note that no location-specific ARARs or TBC have been identified under federal or State of Florida regulations.

2.1.3 Media of Concern

Based on the discussion in Section 1.0 involving toxicity and risk assessment for human receptors, media of concern at Site 43 were determined to be soil within the 0- to 4- foot bgs interval and shallow groundwater.

2.1.4 Chemicals of Concern for Remediation

The risk assessment conducted per State of Florida regulations and guidelines evaluated risks using published SCTLs for residential and industrial land use scenarios. Carcinogenic PAHs and certain metals were identified as potential residential COCs for surface soils based on a comparison of maximum concentrations or EPCs to these SCTLs. Lead was also identified as a potential industrial COC. Carcinogenic PAHs, arsenic, barium, copper, lead, and vanadium were identified as potential residential COCs for subsurface soils based on comparisons of maximum concentrations or EPCs to SCTLs. Carcinogenic PAHs and lead were also identified as potential industrial COCs. Iron, lead, and manganese were identified as potential COCs for groundwater based on comparisons of maximum concentrations to GCTLs. However, HQs for iron and manganese calculated in the U.S. EPA evaluation were less than the U.S. EPA and Florida goal of unity (1.0) for non-carcinogenic health effects. Therefore, iron and manganese are not retained as COCs.

2.2 CLEANUP GOALS

Cleanup goals are concentrations of contaminants in environmental media that, when attained, should achieve RAOs. In general, cleanup goals are established with consideration to the following:

- Protecting human receptors from adverse health effects
- Protecting the environment from detrimental impacts from site-related contamination
- Compliance with federal and state ARARs

2.2.1 Soil Cleanup Goals

Surface soil and subsurface soil cleanup goals were determined for the COCs identified in Section 2.1.4. Often it is justifiable to develop site-specific cleanup goals that would help define the areas of contamination that need to be remediated. Furthermore, if adequate data is available, the areas to be remediated may be further refined using “pickup values” for each COC, which when applied to the site, can be shown to achieve an overall statistical representation of the residual COC concentration for the site that will meet its site-specific cleanup goal. However, considering the limited area of Site 43 (less than 1 acre), the limited area of contamination within the site, and that a portion of the surface soil within

this area of contamination has already been removed during the IRA, it was judged that the development and negotiation of site-specific cleanup goals and pickup values for the remaining soil was not warranted. Therefore, the FDEP Residential SCTLs (RSCTLs) and Industrial SCTLs (ISCTLs), which are normally guidance values provided under the Florida Administrative Code (F.A.C.) Chapter 62-777, are being adopted as conservative, not-to-exceed cleanup goals for the purposes of estimating volumes of contaminated soil. These SCTLs for residential and industrial exposure scenarios are presented in the table below:

Cleanup Goals for Site 43		
COC	**Residential SCTL**	**Industrial SCTL**
Carcinogenic PAHs (expressed as Benzo(a) pyrene equivalents or BaPEqs)	100 µg/kg	700 µg/kg
Lead	400 mg/kg	1,400 mg/kg
Arsenic	2.1 mg/kg	12 mg/kg
Barium	120 mg/kg	NA
Copper	150 mg/kg	NA
Vanadium	67 mg/kg	NA

NA: Not Applicable because the chemical is not present at concentrations exceeding the SCTL.

In applying these cleanup goals during remediation, site-wide concentrations would need to meet average concentrations or 95% UCLs as specified under FAC Chapter 62-780. Sufficient number of samples would be collected during confirmatory sampling in the excavated areas to demonstrate that following backfilling with clean soil, the site-wide concentrations would meet these cleanup goals.

2.2.2 Groundwater Cleanup Goals

For Site 43, groundwater cleanup goals were established based on protection of human health from direct exposure to contaminated groundwater and compliance with ARARs and TBCs to the extent practicable. The FDEP GCTL and U.S. EPA Action Level for lead, the only groundwater COC at Site 43, is 15 µg/L.

2.3 GENERAL RESPONSE ACTIONS AND ACTION-SPECIFIC ARARs

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with one or more of the others) to attain RAOs. Action-specific ARARs and TBC criteria are those regulations,

criteria, and guidances that must be complied with or taken into consideration during remedial activities on site.

2.3.1 General Response Actions

GRAs describe categories of actions that could be implemented to satisfy or address a component of an RAO for the site. Remedial action alternatives will then be composed using GRAs individually or in combination to meet the RAOs. The remedial action alternatives, composed of GRAs, will be capable of achieving the RAOs for contaminated soil and groundwater at Site 43.

The following GRAs will be considered for soil:

- No Action
- Limited Action: Land Use Controls (LUCs)
- Removal
- Containment
- Off-site Treatment/ Disposal

Consolidation is not included because it would be incompatible with proposed future site uses. Furthermore, Ex-situ (on-site) Treatment is not included because the mixture of organic and inorganic contaminants would require a series of treatment technologies, resulting in a complex treatment train that would not be justifiable considering the relatively small volume of contaminated soil to be addressed to meet RAOs at this site.

The following GRAs will be considered for groundwater:

- No Action
- Limited Action: LUCs and Monitoring
- In-situ Treatment

Ex-situ Treatment (pump-and-treat) is not included because the Navy generally considers it ineffective for restoring groundwater quality at a site. Moreover, because of the limited groundwater contamination present at the site, one cannot justify the construction and operation of an on-site treatment plant. Groundwater Containment is not required as a GRA because prevention of off-site migration of groundwater is not an RAO.

2.3.2 Action-Specific ARARs

Action-specific ARARs and TBC criteria are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Tables 2-5 and 2-6 present a list of federal and State of Florida action-specific ARARs and TBCs for this FS.

2.4 ESTIMATED VOLUMES OF CONTAMINATED MEDIA

2.4.1 Estimated Volume of Contaminated Soil

Preliminary surface areas and volumes of soil that would need to be remediated to allow for the planned future uses of Site 43 were estimated. Areas of contamination (depicted on Figure 2-1) have been designated A1 through A8 to differentiate between exceedances of ISCTLs or only RSCTLs and the potential depths of these exceedances.

Based on the information provided in the Site 43 RI (TtNUS, 2006) an area of approximately 13,000 sq ft is estimated to contain soil at concentrations exceeding SCTLs. As shown by the data summary tables from the RI (TtNUS, November 2006), presented in Appendix A of this FS, no exceedances of SCTLs were observed in samples deeper than 3 feet; therefore, it is assumed that 4 feet bgs would be an adequate depth for estimating the volume of soil in most areas at this site. Exceptions are areas A3, A5, and A6 where inadequate surface soil data was identified in the RI. However, shallow subsurface contamination did not exceed SCTLs at A6. The concern at A3 and A5 perceived in the RI was that nearby locations exhibited concentrations exceeding RSCTLs for certain metals in the surface soil. Therefore, the depth of contamination at these three locations will be assumed to be 2 feet bgs because the shallow subsurface soil did not contain any chemical exceeding SCTLs. It is acknowledged that during the actual implementation of a selected alternative, confirmatory sampling will be conducted to verify the depth of excavation.

The areas of contamination are illustrated on Figure 2-1 and summarized as follows:

- Metal- and PAH-contaminated soil (represented as BaPEq) concentrations greater than RSCTLs are present in an area surrounding the previous removal action up to a depth of 4 feet bgs and below the previous removal action area in the 2- to 4- foot bgs range. The total area including the previous removal action area (A1) is estimated to be 12,700 sq ft. Within A1, the removal action area (A2) is estimated to be 8,200 sq ft.

- Area A3 (adjoining the northern edge of A2) is included as a potential area where arsenic, barium, and vanadium may be present in surface soil (from 0 to 2 feet bgs) exceeding RSCTLs. Area A3 is estimated to be approximately 1,000 square feet.

- Three smaller areas A4, A6, and A7 with approximate areas of 390 sq ft, 225 sq ft, and 225 sq ft, respectively have been identified within A1 exceeding the ISCTL for lead. These locations also contain other metals exceeding their respective RSCTLs. The depth of contamination at A4 is estimated to be from 0 to 4 feet bgs. The depth of contamination at A6 is expected to be limited to 2 feet bgs. The contamination at A7 is expected to be from 2 to 4 feet bgs.

- Area A5 is included as another potential area where arsenic, barium and vanadium may be present in surface soil at concentrations exceeding RSTLs. Area A5 is estimated to be approximately 225 square feet. The depth of contamination is expected to be limited to 2 feet bgs. Note that this area is already included in the area within A1 surrounding A2.

- A8, a smaller area east of A1 has been identified with concentrations exceeding ISCTLs with an approximate area of 225 sq ft. The depth of contamination at A8 is estimated to be from 0 to 4 feet bgs.

The estimated volume of soil that contains COCs exceeding residential SCTLs is 1,200 cubic yards. The estimated volume of soil that contains COCs exceeding commercial/industrial SCTLs is 120 cubic yards. Details of the calculations are presented in Appendix B.

2.4.2 Estimated Volume of Contaminated Groundwater

Only one location (PEN-43-13S) has been identified where lead was detected in excess of its GCTL of 15 µg/L. However, another location (Anomaly 23) where lead concentrations in the soil are known to be elevated may also be of concern. Therefore, for FS purposes, it is assumed that two locations each of 50 feet by 50 feet with an aquifer thickness of 10 feet within a 0.3 porosity may contain contaminated groundwater. A total pore volume of 112,000 gallons is estimated for the purposes of this FS. Details of the calculations are provided in Appendix B.

TABLE 2-1

FEDERAL CHEMICAL-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Safe Drinking Water Act (SDWA) Regulations, Maximum Contaminant Levels (MCLs)	40 Code of Federal Regulations (CFR) Part 141	Relevant and Appropriate	Establishes enforceable standards for potable water for specific contaminants that have been determined to adversely affect human health.	Would be used as protective levels for groundwater that is a potential drinking water source.
SDWA Regulations, National Secondary Drinking Water Standards (SMCLs)	40 CFR Part 143	To Be Considered (TBC)	Establishes welfare-based standards for public water systems for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water.	Would be considered for groundwater that is a potential drinking water source.
U.S. EPA Office of Drinking Water, Health Advisories	-	Potential TBC	Guidance values on non-carcinogenic health effects due to consumption of contaminated drinking water over specific durations.	Would be considered for contaminants in groundwater that could be used as a potable drinking water source.
Cancer Slope Factors (CSFs)		TBC	CSFs are guidance values used to evaluate the potential carcinogenic hazards caused by exposure to contaminants.	CSFs would be considered for development of human health protection cleanup goals for media at this site.
Reference Doses (RFDs)		TBC	RFDs are guidance values used to evaluate the potential non-carcinogenic hazards caused by exposure to contaminants.	RFDs would be considered for development of human health protection cleanup goals for media at this site.

Note:

ARARs = Applicable or Relevant and Appropriate Requirements

TABLE 2-2

FLORIDA CHEMICAL-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Contaminant Cleanup Target Levels Rule	FAC Chapter 62-777	To Be Considered	This document provides guidance for soil, groundwater, and surface water cleanup levels that can be developed on a site-by-site basis.	These guidelines would be used in determining cleanup goals.
Florida Drinking Water Standards	FAC Chapter 62-550	Applicable	This rule adopts federal primary and secondary drinking water standards.	These regulations would apply to cleanup goals for potential sources of drinking water.
Contaminated Site Cleanup Criteria	FAC Chapter 62-780	Applicable	The purpose of this chapter is to prevent adverse effects on human health, public safety, and the environment that may be caused by contaminants that have been released or discharged into the environment.	These guidelines would be used in determining remediation procedures for the site. In particular, Chapter 62-780-650 states that cleanup below site background levels shall not be required,

Note:

FAC = Florida Administrative Code

TABLE 2-3

FEDERAL LOCATION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Evaluation/Action to be Taken
There are no ecological or historical/archaeological resources of concern at this site. No further action need be taken to address location-specific ARARs.

TABLE 2-4

FLORIDA LOCATION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Evaluation/Action to be Taken
There are no ecological or historical/archaeological resources of concern at this site. No further action need be taken to address location-specific ARARs.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Resource Conservation and Recovery Act (RCRA) Regulations, Identification and Listing of Hazardous Wastes	40 Code of Federal Regulations (CFR) Part 261	Potentially Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA. Appendix II contains the Toxicity Characteristic Leaching Procedure.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations. These would apply to response actions that include removal and off-site disposal of excavated material from Site 43.
Clean Air Act (CAA) Regulations, National Ambient Air Quality Standards (NAAQs)	40 CFR Part 50	Potentially Relevant and Appropriate	Establishes primary (health-based) and secondary (welfare-based) air quality standards for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides emitted from a major source of air emissions. The NAAQs form the basis for all regulations promulgated under the CAA. However, the NAAQs themselves are non-enforceable and are not ARARs.	Site remediation activities must comply with NAAQs. The principal application of these standards is during remedial activities resulting in exposures through dust and vapors. In general, emissions from CERCLA activities are not expected to qualify as a major source and are therefore not expected to be applicable requirements. However, the requirements may be determined to be relevant and appropriate for non-major sources with significantly similar emissions.
RCRA Regulations, Land Disposal Restrictions (LDRs)	40 CFR Part 268	Potentially Applicable	This regulation prohibits the land disposal of untreated hazardous wastes and provides criteria for the treatment of hazardous waste prior to land disposal.	Response actions that involve excavating, treating, and redepositing hazardous soil would comply with LDRs.
Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Potentially Relevant and Appropriate	NESHAPs are a set of emissions standards for specific chemicals from specific production activities.	Emissions of hazardous air pollutants that may be emitted during response actions would be minimized by fugitive dust control

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Air/Superfund National Technical Guidance	EPA Guidance: EPA/450/1-89/001-EPA/450/1-89/004	To Be Considered	This guidance describes methodologies for predicting risks due to an air release at a Superfund site.	These guidance documents would be considered when risks due to air releases from fugitive dust are being evaluated.
Procedures for planning and implementing off-site response actions. (CERCLA Off-site Rule or OSR)	40 CFR 300.440	Potentially Applicable	The OSR establishes the criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA wastes from response actions authorized or funded under CERCLA. The OSR establishes compliance criteria and release criteria, and establishes a process for determining whether facilities are acceptable based on those criteria. The OSR also establishes procedures for notification of unacceptability, reconsideration of unacceptability determinations, and re-evaluation of unacceptability determinations.	Response actions that involve off-site treatment/disposal of wastes from Site 43 will follow these requirements.
Occupational Safety and Health Act (OSHA) Regulations, General Industry Standards	29 CFR Part 1910	Applicable	Requires establishment of programs to assure worker health and safety at hazardous waste sites, including employee training requirements.	These regulations would apply to all response actions.
OSHA Regulations, Occupational Health and Safety Regulations	29 CFR Part 1910, Subpart Z	Potentially Applicable	Establishes permissible exposure limits for workplace exposure to a specific listing of chemicals.	Standards are applicable for worker exposure to OSHA hazardous chemicals during all response actions.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
OSHA Regulations, Recordkeeping, Reporting, and Related Regulations	29 CFR Part 1904	Potentially Applicable	Provides recordkeeping and reporting requirements applicable to remedial activities.	These requirements apply to all site contractors and subcontractors and must be followed during all site work.
OSHA Regulations, Health and Safety Standards	29 CFR Part 1926	Potentially Applicable	Specifies the type of safety training, equipment, and procedures to be used during site investigation and remediation.	All phases of the response actions would be executed in compliance with this regulation.
RCRA Regulations, Contingency Plan and Emergency Procedures	40 CFR 264, Subpart D	Potentially Relevant and Appropriate	Outlines requirements for emergency procedures to be followed in case of an emergency.	The administrative requirements established in this rule would be met for response actions involving the management of hazardous waste.
RCRA Regulations, General Facility Standards	40 CFR Subpart B, 264.10-264.18	Potentially Applicable	Sets the general facility requirements including general waste analysis, security measures, inspections, and training requirements. Section 264.18 establishes that a facility located in a 100-year floodplain must be designed, constructed, and maintained to prevent washout of any hazardous wastes by a 100-year flood.	If the response action involves construction of an on-site treatment facility, the substantive requirements of this rule would be applicable requirements. A permitted treatment facility must be selected for off-site treatment of hazardous wastes.
RCRA Regulations, Miscellaneous Units	40 CFR Part 264, Subpart X	TBC	These standards are applicable to miscellaneous units not previously defined under existing RCRA regulations. Subpart X outlines performance requirements that miscellaneous units be designed, constructed, operated, and maintained to prevent releases to the	The design of proposed treatment alternatives, not specifically regulated under other subparts of RCRA, must prevent the release of hazardous constituents and future impacts on the environment. This subpart would apply to on-site construction of any treatment facility that is not previously defined under the RCRA regulation.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
			subsurface, groundwater, and wetlands that may have adverse effects on human health and the environment.	
RCRA Regulations, Preparedness and Prevention	40 CFR Part 264, Subpart C	Potentially Applicable	Outlines requirements for safety equipment and spill control for hazardous waste facilities. Facilities must be designed, maintained, constructed, and operated to minimize the possibility of an unplanned release that could threaten human health or the environment.	Safety and communication equipment would be incorporated into all aspects of any response action and local authorities would be familiarized with site operations.
RCRA Regulations, Releases from Solid Waste Management Units (SWMUs)	40 CFR Part 264, Subpart F	Potentially Relevant and Appropriate	Establishes the requirements for SWMUs at RCRA-regulated Treatment, Storage, and Disposal Facilities (TSDFs). The scope of the regulation encompasses groundwater protection standards, point of compliance, compliance period, and requirements for groundwater monitoring.	These regulations would be relevant for monitoring of releases from the site if hazardous constituents are left behind following a response action.
RCRA Regulations, Standards for Owners and Operators of Hazardous Waste TSDFs.	40 CFR Part 264	Potentially Applicable	Establishes minimum national standards defining the acceptable management of hazardous wastes for owners and operators of facilities that treat, store, or dispose of hazardous wastes.	If remedial actions involving management of RCRA wastes at an off-site TSDF or if RCRA wastes are managed on site, the requirements of this rule would be followed.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, Use and Management of Containers	40 CFR Part 264, Subpart I	Potentially Applicable	Sets standards for the storage of containers of hazardous waste.	This requirement would apply if a remedial alternative involves the storage of a hazardous waste (i.e., contaminated soil) in containers prior to treatment or disposal.

TABLE 2-6

FLORIDA ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Hazardous Waste Rules – October 1993	FAC Chapter 62-730	Potentially Applicable	Adopts by reference sections of the federal hazardous waste regulations and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation and disposal of hazardous wastes.	These regulations would apply if waste on site was deemed hazardous and needed to be stored, transported, or disposed.
Florida Solid Waste Management Facilities	FAC Chapter 62-701	Potentially Applicable	Sets the facility standards for construction, operation, and closure of SWMUs.	These requirements would apply if on-site waste was deemed a nonhazardous solid waste and needed to be stored, transported, or disposed.
Florida Air Pollution Rules – October 1992	FAC Chapter 62-2	Potentially Relevant and Appropriate	Establishes permitting requirements for owners or operators of any source that emits any air pollutant. This rule also establishes ambient air quality standards for sulfur dioxide, carbon monoxide, lead, and ozone.	Although this rule is directly applicable to industrial polluters, these requirements are relevant and appropriate for a response action that could result in release of regulated contaminants to the atmosphere, such as may occur during excavation.
Florida Regulation of Stormwater Discharge – May 1993	FAC Chapter 62-25	Potentially Relevant and Appropriate	Establishes requirements for discharges of untreated stormwater to ensure protection of the surface water of the state.	Guidelines for erosion and sedimentation control during excavation may be relevant to response actions.

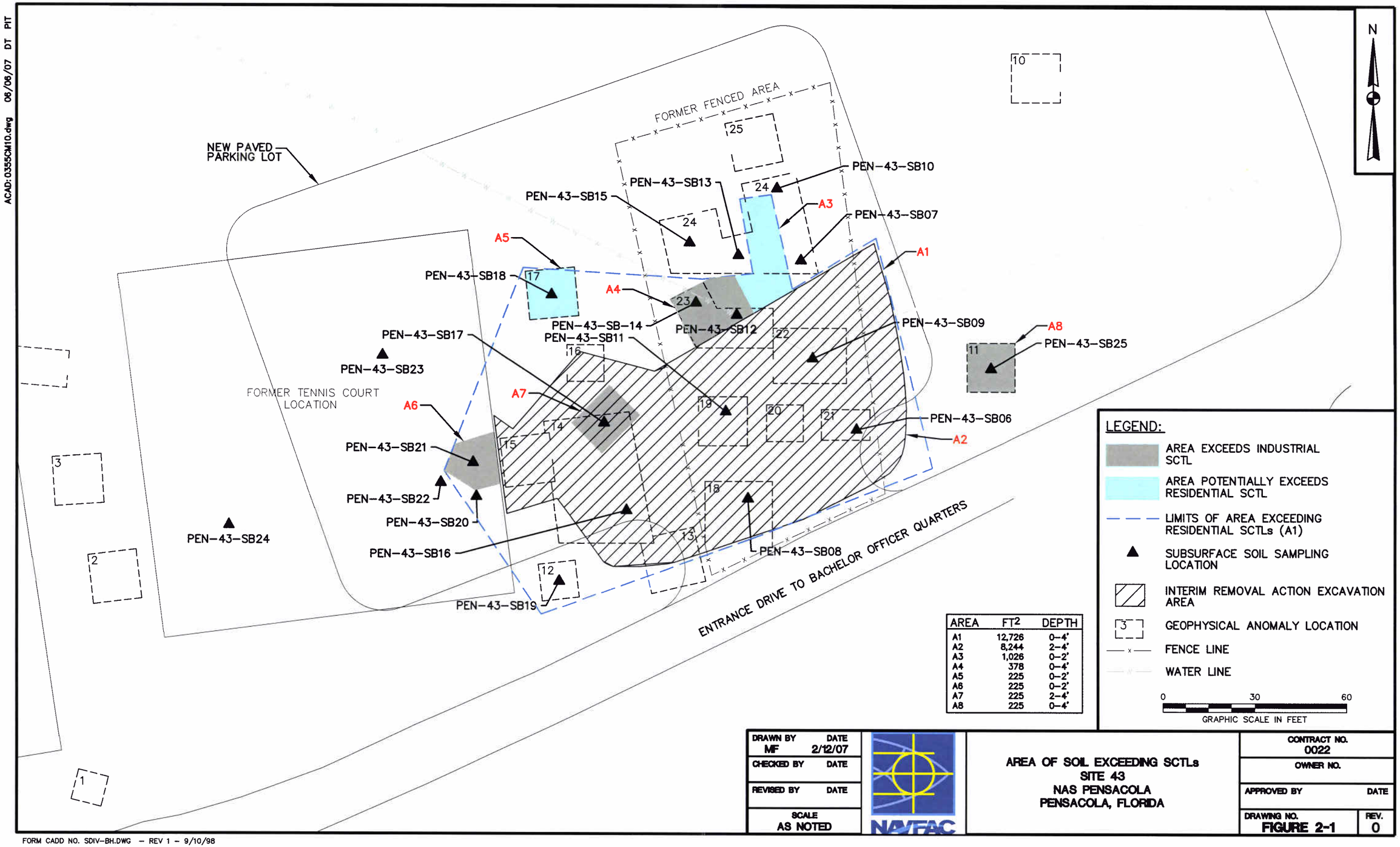
TABLE 2-6

FLORIDA ACTION-SPECIFIC ARARs
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Ambient Air Quality Standards – December 1994	FAC Chapter 62-272	Potentially Applicable	Establishes ambient air quality standards necessary to protect human health and public welfare. It also establishes maximum allowable increases in ambient concentrations for subject pollutants to prevent significant deterioration of air quality in areas where ambient air quality standards are being met. Approved air quality monitoring methods are also specified.	These ambient air quality standards would be met for response actions involving the possible release exposure of contaminants to the atmosphere.
Florida Underground Injection Control (2002)	FAC Chapter 62-528	Potentially Applicable	Provides standards for construction, operation, monitoring, and abandonment of underground injection wells. The intent is to provide protection of drinking-water aquifers and prevent cross-contamination.	The standards under Class V for aquifer remediation projects would be applicable to a response action that includes the injection of chemicals to achieve in-situ remediation. The standards are authorized by a remedial action plan that includes all the applicable construction, operation, monitoring, and abandonment requirements.
Air Pollution Episodes – September 1994	FAC Chapter 62-273	Potentially Relevant and Appropriate	This rule classifies an air episode as an air alert, warning, or emergency and establishes criteria for determining the level of the air episode. It also establishes response requirements for each level.	These regulations may be relevant if particulate matter emissions may occur during response actions.

Note: FAC = Florida Administrative Code

ACAD:0355CM10.dwg 06/06/07 DT PIT



AREA	FT2	DEPTH
A1	12,726	0–4'
A2	8,244	2–4'
A3	1,026	0–2'
A4	378	0–4'
A5	225	0–2'
A6	225	0–2'
A7	225	2–4'
A8	225	0–4'

DRAWN BY MF	DATE 2/12/07	AREA OF SOIL EXCEEDING SCTLs SITE 43 NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0022
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 2-1 / REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

3.0 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to develop the remedial alternatives for Site 43 at NAS Pensacola. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that will be used for developing the remedial alternatives.

The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Development of RAOs
- Identification of ARARs
- Identification of COCs
- Development of Cleanup Goals
- Identification of GRAs
- Identification of volumes or areas of media of concern

Technology screening evaluation is performed in this section with the completion of the following analytical steps:

- Identification and preliminary screening of remedial technologies and process options.
- Detailed screening of remedial technologies and process options that pass the preliminary screening step.
- Evaluation and selection of representative process options.

In this section, a variety of technologies and process options are identified under each GRA (discussed in Section 2.3.1) and screened. The selection of technologies and process options for initial screening is based on the Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA (U.S. EPA, 1988). The screening is first conducted at a preliminary level to focus on relevant technologies and process options. Then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of technologies and process options that have been retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

- Effectiveness
  - Protection of human health and environment; reduction in toxicity, mobility, or volume; and permanence of the solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated media.
  - Ability of the technology to meet the cleanup goals identified in the RAOs.
  - Technical reliability (innovative versus proven) with respect to contaminants and site conditions.

- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, mobile units, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term maintenance and operation requirements.

- Cost (Qualitative)
  - Capital cost.
  - Operation and Maintenance (O&M) costs.

Technologies and process options will be identified for the remediation of soil and groundwater in the following sections.

3.1 PRELIMINARY SCREENING OF SOIL AND GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens technologies and process options for soil and groundwater at a preliminary stage based on implementation with respect to site conditions and COCs. Table 3-1 summarizes the preliminary screening of technologies and process options applicable to soil. Table 3-2 summarizes the preliminary screening of technologies and process options applicable to groundwater. The tables present the GRAs, identify the technologies and process options, and provide a brief description of each process option followed by the screening comments. The technologies and process options that pass the initial screening step are retained for detailed screening as necessary (depending on the complexity of the technology) in Section 3.2 and 3.3 for soil and groundwater, respectively.

The technologies and process options for remediation of soil and groundwater that were retained for detailed screening are presented in Table 3-3.

3.2 DETAILED SCREENING OF SOIL TREATMENT TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and develops the representative process options, following a detailed screening of technologies, that will be used in the formulation of remedial alternatives to accomplish the RAOs and meet the cleanup goals identified for soil in Section 2.0.

3.2.1 No Action

No Action consists of maintaining the status quo at the site. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison of alternatives and their effectiveness in mitigating risks posed by site contaminants.

Effectiveness

No Action would not be effective in meeting the soil RAOs. No Action would not actively reduce the toxicity of contaminants in soil and therefore the potential risk would remain. Furthermore, there would be no reduction in risk through exposure control. Contaminant concentrations may attenuate slowly over time because of natural processes; however, there would be no monitoring to verify if this is occurring.

Implementability

There would be no implementability concerns because no remedial action would be implemented.

Cost

There would be no costs associated with No Action.

Conclusion

No Action is retained because of NCP requirements, although it would not be effective.

3.2.2 Limited Action

This GRA consists of Land Use Controls (LUCs) to limit or restrict site use.

3.2.2.1 Land Use Controls

LUCs would be developed through the implementation of a LUC Remedial Design (RD) to prevent the site from being used in the future for purposes that are not consistent with the residual risk after

implementation of the final remedy. Signage would be required to show the boundaries of the contamination so that adjacent uncontaminated areas may be used without transgressing into contamination.

Effectiveness

LUCs alone would not reduce the toxicity, mobility, or volume of COCs in soil. Contaminant concentrations may decrease over time because of natural processes. LUCs would clearly state what type of site use is prohibited following the remedial action. For example, if only industrial/commercial risks are addressed by the remedial action, then the LUCs would state that residential use of the site is prohibited.

Implementability

LUCs would be readily implementable. The implementability of these controls would be more of a concern if the site is transferred to private ownership. Provisions would be incorporated into property transfer documents to insure the continued implementation of institutional controls. Resources are readily available for the preparation of a LUC RD.

Cost

Costs of LUCs would be low.

Conclusion

LUCs are retained for use in combination with other process options for the development of remedial alternatives.

3.2.3 Removal

The technology considered under this GRA is excavation.

3.2.3.1 Excavation

A variety of equipment, such as front-end loaders, backhoes, grade-alls, etc. could be used to perform the excavation. The type of equipment selected would take into consideration several factors such as the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of removal, the required rate of removal, and the elevation of the groundwater table. Excavation is the technology of choice for the removal of well-consolidated material, such as soil

from well-defined areas of ground with significant load-bearing capacity (i.e., greater than 1,500 pounds per square foot).

The logistics of excavation must take into account the available space for operating the equipment, loading and unloading of the excavated material, location of the site, etc. After excavation is completed, the void is filled and graded with clean fill material or treated soils.

Effectiveness

Excavation is a well-proven and effective method of removing contaminated material from a site. A properly designed excavation would remove soil with concentrations of COCs greater than cleanup levels followed by suitable use of clean soil as backfill within the excavated areas. Following excavation and backfilling, the overall site concentrations would not pose an unacceptable risk to human health or the environment.

Implementability

Excavation of contaminated soil at Site 43 would be implementable. Excavation equipment is readily available from multiple vendors. This technology is well proven and established in the construction/remediation industry. Prior to excavation, a utility survey would be required and utilities clearly marked so that the excavation does not impact any utility. During excavation, site-specific health and safety procedures and regulations would have to be complied with to ensure that the exposure of the workers to COCs is minimized. Pre-excavation screening for UXO is not expected to be required, because a previous interim remedial action exposed suspected UXO, which were found to be merely ornamental and inert munitions.

Cost

Cost of excavation at Site 43 on a unit volume basis would be low because of the shallow excavation depth (up to 4 feet bgs) and the presence of sandy soils. Moreover, because the depth to the water table is approximately 15 feet bgs, requirements for dewatering would not exist under dry weather conditions. Finally, the lack of above-ground structures further eases concerns for excavation.

Conclusion

Excavation is retained in combination with other process options for the development of remedial alternatives.

3.2.4 Disposal

The technologies considered under this GRA are off-site landfilling and beneficial reuse.

3.2.4.1 Off-site Landfilling

Off-site landfilling would consist of transporting the excavated soil for disposal at an off-site Treatment/Storage/Disposal Facility (TSDF). Excavated soil characterized as non-hazardous waste under Resource Conservation and Recovery Act (RCRA) regulations could be disposed in a RCRA Subtitle D solid waste landfill. Excavated soil characterized as hazardous waste under RCRA would have to be disposed in a RCRA Subtitle C hazardous waste landfill. Treatment would be employed as necessary to meet Land Disposal Restrictions (LDRs) as required by regulations prior to land disposal. At Site 43, because of the potential presence of UXO, the excavated soil would require mechanical screening to remove any such material prior to offsite landfilling of the soil.

Effectiveness

Off-site landfilling does not permanently or irreversibly reduce contaminant concentrations. Although the CERCLA preference for treatment relegates landfilling to a less preferable option, this technology can be an effective option for addressing small quantities of contaminated soil at a site. Off-site landfills are only permitted to operate if they meet certain requirements regarding design and operation governing the foundation, liner, leak detection, leachate collection and treatment, daily cover, post-closure inspections and monitoring, etc., which ensure the effectiveness of these facilities. The requirements of a RCRA hazardous (Subtitle C) landfill are typically more stringent than those of a RCRA non-hazardous (Subtitle D) solid waste landfill. For soil failing Toxicity Characteristic Leachate Procedure (TCLP) limits, treatment (typically using chemical fixation/solidification) would be employed to meet LDRs prior to landfilling at the RCRA Subtitle C facility. Thereby, the hazardous characteristic of constituents such as lead present in the soil would be treated prior to land disposal.

Implementability

Off-site landfilling would be easily implementable. Facilities and services are available. Disposal at a RCRA Subtitle D landfill may require certain pre-treatment, mainly the removal of free liquids but, because soil would only be excavated to a depth of 4 feet, no associated water should be present under dry weather conditions, and this requirement should be easy to meet. In addition, a waste profile would have to be prepared, indicating the contaminant concentrations and their leachability. Disposal of any soil containing lead with TCLP levels exceeding hazardous criteria would require pre-treatment to meet LDRs prior to landfilling. If treatment achieves Universal Treatment Standards (UTS), then disposal of

the treated soil in a RCRA Subtitle D landfill would be permissible. If not, the treated soil would need to disposed in a RCRA Subtitle C landfill.

Cost

The cost of off-site landfilling would be low to moderate depending on volume. The unit cost for disposal at a RCRA Subtitle C facility is typically higher than the cost for disposal at a RCRA Subtitle D facility.

Conclusion

Off-site landfilling is retained for use in combination with other process options for the development of remedial alternatives.

3.2.4.2 Beneficial Reuse

Under this technology, site soil would be reused following treatment or if clean soil is excavated to expose deeper contamination, the soil would be segregated and reused on site. At Site 43, the clean soil layer from the previous interim removal action (IRA) would be excavated using common excavating equipment and stockpiled for reuse. The clean soil from the stockpile would be placed back in the excavated areas along with additional clean backfill that would be necessary to replace contaminated soil.

Effectiveness

This technology would be effective within the IRA area at Site 43. The soil present within a depth of 2 feet from the surface would be suitable for reuse during site restoration.

Implementability

According to the Project Completion Report (CCI, 2002), the IRA area has been surveyed and therefore the limits of excavation can be readily determined. However, during the IRA, a geotextile separation layer was not used to separate the clean soil from underlying layers of soil. Therefore, excavation would require a judicious operator and observant attendant to determine when the bottom of the clean fill has been encountered. Excavation equipment is commonly available and backfilling with compaction can be readily performed.

Cost

Beneficial reuse would result in cost savings and achieve resource recovery.

Conclusion

Beneficial Reuse is retained if excavation within the IRA area at Site 43 is required under one of the alternatives.

3.3 DETAILED SCREENING OF GROUNDWATER TREATMENT TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and develops the representative process options, following a detailed screening of technologies that will be used in the formulation of groundwater remedial alternatives to accomplish the groundwater RAOs identified in Section 2.

3.3.1 No Action

No Action consists of maintaining the status quo at the site.

Effectiveness

No Action would not be effective in meeting the groundwater RAOs. No controls would be present to prohibit the use of groundwater as a drinking-water source at Site 43, and therefore this options potentially would not be protective of human health.

Implementability

There would be no implementability concerns because no remedial action would be implemented.

Cost

There would be no costs associated with No Action.

Conclusion

No Action is retained for comparison to other options.

3.3.2 Limited Action

This GRA consists of restrictions on groundwater use by implementing Land Use Controls and Monitoring.

3.3.2.1 Land Use Controls (groundwater use restriction)

Groundwater use restrictions would be developed in an RD for the remedy under the LUC component to prevent exposure to contaminated groundwater underlying Site 43 including, but not limited to, human consumption and other industrial uses, unless prior written approval is obtained from the Navy, U.S. EPA, and FDEP.

Effectiveness

Groundwater use restrictions alone would not reduce the toxicity of contaminants in the groundwater. Lead contamination would remain and may dissipate through natural processes over time. Prohibiting the use of the surficial aquifer at the site would effectively prevent the occurrence of unacceptable risks to human receptors from direct exposure to contaminated groundwater. Groundwater migration has not been identified as a concern for downgradient receptors; however, monitoring would provide adequate warning of the potential of such a migration so that additional action may be taken.

Implementability

Groundwater use restrictions would be readily implementable. The implementability of these controls would be more of a concern if the site is transferred to private ownership. Provisions would be incorporated in property transfer documents to insure the continued implementation of institutional controls. Resources are readily available for the preparation of an LUC RD including groundwater use restrictions.

Cost

Costs of groundwater use restrictions would be low.

Conclusion

Groundwater use restrictions using LUCs are retained in combination with other process options for the development of groundwater remedial alternatives.

3.3.2.2 Monitoring

Monitoring could also be used to monitor reductions in lead concentrations at Site 43 due to natural processes or if an in-situ treatment process is employed. Sampling and analysis of groundwater in the area of lead contamination could also be used to evaluate potential migration of this COC.

Effectiveness

Monitoring would not reduce the toxicity of contaminants in the groundwater by itself; however, it would allow the evaluation of potential off-site migration of contaminants and the potential reductions in contaminant concentrations through natural processes or via in-situ treatment.

Implementability

A groundwater monitoring program could be readily implemented at Site 43. Local permits would be required for monitoring well installation.

Cost

Capital and O&M costs of monitoring would be low.

Conclusion

Monitoring is retained in combination with other process options for the development of groundwater remedial alternatives.

3.3.3 In-situ Treatment

Under this GRA, physical/chemical treatment using precipitation is being evaluated.

3.3.3.1 In-situ Precipitation

Metals cannot be destroyed (unlike organic contaminants); therefore, the toxicity caused by their presence in groundwater can be addressed only by their removal into a different phase or by changing their oxidation state to a less toxic form. In-situ precipitation is a process wherein a metallic contaminant is made less soluble by the use of precipitating agents. In this process, a relatively innocuous chemical would be introduced throughout the groundwater plume to react with the dissolved metal of concern. The resultant precipitate would bind with the soil particles and render the metal less available to be brought to the surface under a groundwater use scenario.

The precipitating chemical would be prepared as an aqueous solution at the site and injected using Direct Push Technology (DPT) at several locations within the plume. After a period of a few months, the groundwater would be sampled to evaluate the effectiveness of the process, and a followup round of injections would be performed, with any adjustments to the chemical concentrations or addition of other chemicals as required to improve the effectiveness of the process. The second round of injections would

be followed by additional rounds of monitoring and injections (if necessary) until satisfactory monitoring results are achieved over several months.

Effectiveness

This is a relatively innovative approach for treatment of metals in groundwater. Its effectiveness at a site depends on the relative concentrations of lead present as particulates versus its dissolved form. At Site 43, the slightly acidic pH of groundwater (in the range of 5.2 to 6.2 [CCI 2002]) indicates that a greater fraction of lead may be present in the dissolved form. Therefore, the use of an alkaline precipitating chemical may render conditions suitable to reduce the solubility of lead sufficiently to attain its cleanup goals. At a minimum, preliminary bench-scale testing using groundwater and soil obtained from the saturated zone and one or more chemical precipitants should be performed before determining whether the process will be effective.

Among the chemicals that may be effective for reducing the solubility of lead are hydroxides/oxyhydroxides, sulfides, and phosphates. The least soluble precipitates are formed by sulfides; however chemicals that provide the sulfide anions are often very toxic, unstable, and difficult to handle. Hydroxides/oxyhydroxides are not stable under neutral to slightly acidic pH conditions in the groundwater. Phosphates such as ammonium phosphate are relatively less prone the problems posed by the other chemicals and should be more stable under the slightly acidic pH conditions as present at Site 43.

Implementability

The equipment required for injection of chemicals into the groundwater is readily available. The chemicals that would be used to precipitate lead are commonly available in the manufacturing and chemical industry. Typically these chemicals would not pose a human health hazard if appropriate health and safety protection measures are taken.

Cost

Typically in-situ treatment is more cost effective than ex-situ treatment. The costs would be moderate in the range of in-situ groundwater treatment technologies.

Conclusion

In-situ groundwater treatment using precipitation is retained for further consideration.

3.4 SELECTION OF REPRESENTATIVE PROCESS OPTIONS FOR SOIL AND GROUNDWATER

Soil

The following GRA, technologies, and process options are retained for the development of soil remedial alternatives:

- No Action
- Limited Action: LUCs
- Removal: Excavation
- Disposal: On-site Beneficial Reuse, Off-site RCRA Non- Hazardous (Subtitle D) Landfill, and Off-site RCRA Hazardous (Subtitle C) Landfill

Groundwater

The following GRA, technologies, and process options are retained for the development of groundwater remedial alternatives:

- No Action
- Limited Action: LUCs and Monitoring
- In-situ Treatment: In-situ Precipitation

The next step is to select representative process options from each technology to assemble an adequate variety of alternatives and to evaluate the alternatives in sufficient detail to aid in the final selection process. All process options listed in Table 3-3 are retained for the formulation of alternatives because the processes are sufficiently varied in their functions.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
No Action	None	Not applicable	No activities conducted at the site to address contamination. Biodegradation of PAHs may occur through natural attenuation processes, but this will not be verified.	Required by law. Retain for baseline comparison to other technologies.
Limited Action	Land Use Controls (LUCs)	Engineered Controls: Physical Barriers/ Security Guards	Fencing, markers, warning signs, and monitoring to restrict site access.	Eliminate fencing because it would impede NAS's acceptable uses of the Site 43 property. Retain signage to show adjacent property users of the limits of contamination at Site 43.
		Administrative Controls: Deed or Site Use Restrictions	Administrative action using property deeds or other land use prohibitions to restrict future site activities. Five-year reviews would be conducted to evaluate whether additional remedial actions would be required.	Retain. May be used in conjunction with certain remedial alternatives to control future site development.
	Monitoring	Sampling and Analysis	Sampling and analysis of groundwater, to evaluate whether additional remedial actions would be warranted.	Addressed in Table 3-2.
Containment	Horizontal Barriers	Covers	Use of clean soil or other suitable material to provide a barrier for human exposure to surface soil contaminants.	Retain. Existing paved parking lot can be suitable as a barrier for site users to prevent direct contact with surface soil contaminants.
		Infiltration Barriers (Caps)	Use of low-permeability layers to provide a barrier to infiltration of rainfall into underlying soil containing contaminants capable of being mobilized.	Eliminate. Reduction of infiltration is not required to meet RAOs.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Removal	Excavation	Mechanical	Means for removal of contaminated soils by backhoe, bulldozer, loader, etc.	Retain for removal of contaminated soil.
In-situ Treatment	Thermal	Vitrification/	Use of high-temperature melting to fuse inorganic contaminants into a glass matrix within vadose zone or the use of moderate temperature heating to volatilize contaminants and remove them from the vadose zone.	Eliminate. Typically used for highly contaminated or radioactive materials. Vitrified material may affect future uses of Site 43.
		Radiofrequency Heating	Use of radio-frequency energy to heat soil and cause volatilization of contaminants	Eliminate. Not applicable for treatment of metals or heavier PAHs.
		Electrical Heating	Use of an electrical blanket or electrical heating elements within slotted pipes to volatilize contaminants	Eliminate. Not applicable for treatment of metals or heavier PAHs.
	Physical/ Chemical	Soil Flushing/ Chemical Extraction	Use of water/solvents to remove contaminants from the vadose zone by flushing and collecting the contaminated wastewater in the saturated zone followed by above-ground pump and treat.	Eliminate. The result of this technology would be the migration of COCs from the soil to the groundwater. Not recommended when the groundwater is relatively "clean" compared to the COCs present in the unsaturated zone soil.
		Dynamic Underground Stripping	Steam injection at the periphery of the contaminated area resulting in the vaporization of volatile compounds bound to soil and the movement of contaminants to a centrally located extraction well.	Eliminate. No applicable for treatment of metals or heavier PAHs.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
In-situ Treatment (Continued)	Physical/ Chemical (Continued)	Soil Vapor Extraction	Use of vacuum and possibly air sparging to volatilize contaminants.	Eliminate. This technology is better suited to volatile organic contaminants than the PAHs at Site 43. In addition, it is not applicable to the treatment of metals.
		Chemical Fixation/ Solidification	Mixing of chemical agents in the vadose zone to chemically bind, solidify, and reduce contaminant mobility.	Eliminate. Mobility of soil COCs is not a concern at this site. Moreover, the treated material would not be suitable for future site uses.
		Electrokinetic Separation	Use of electrodes with the application of direct current-based electrical fields that can induce the migration of metallic contaminants from soil towards electrodes or to induce electrochemical reactions to destroy selected organic contaminants.	Eliminate. May be applicable for lead, but not applicable for the treatment of PAHs.
	Biological	Biodegradation	Nutrients and amendments are added to surface soil to promote biodegradation of PAHs.	Eliminate. Would be difficult to achieve cleanup levels for PAHs. Not effective for treatment of metals.
		Phytoremediation	Use of selected plants cultivated in contaminated soil to facilitate uptake of metallic contaminants or enhancement of biodegradation of organic contaminants by indigenous microorganisms in the root zone.	Eliminate. This innovative technology has limited demonstrated effectiveness for the variety of metals and PAHs present at Site 43.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Disposal	Off-site	Hazardous/ Nonhazardous waste landfilling	Disposal of excavated wastes and treatment residuals in a permitted RCRA "C" or RCRA "D" facility.	Retain landfilling to be used in conjunction with other remedial technologies.
	On-site	Beneficial Reuse	Reuse of treated soil as fill material.	Retain. Although onsite ex-situ treatment of soil is not included as a GRA, any clean backfill material that was used as surface soil during the IRA will be reused, if excavated.

Notes:

COCs = Contaminants of Concern
PAHs = Polycyclic Aromatic Hydrocarbons
GRA = General Response Action
IRA = Interim Remedial Action
RCRA = Resource Conservation and Recovery Act

TABLE 3-2

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
No Action	None	Not applicable	No activities conducted at the site to address contamination.	Required by law. Retain for baseline comparison to other technologies.
Limited Action	Monitoring	Sampling and Analysis	Periodic sampling and analysis of groundwater and other media to track the spread of contamination.	Retain to assess natural attenuation and/or migration of contaminants from the site and evaluate remedial actions.
	Land Use Controls (LUCs)	Administrative Controls: Deed and Groundwater Use Restrictions	Administrative action using property deeds to restrict future site activities and use of groundwater as source of drinking water.	Retain to limit human exposure to contaminated groundwater.
In-situ Treatment	Physical/Chemical	In-situ Precipitation	Reduction of the solubility of lead to precipitate and allow it to bind to soil particles.	Retain. May be used to reduce the concentrations of lead available in the soluble phase in groundwater.
	Biological	Phytoremediation	Use of selected plants cultivated in contaminated soil to facilitate uptake of metallic contaminants.	Eliminate. This is an innovative technology that has not been proven for uptake of lead from groundwater. At Site 43 a deep roo tzone 15-25 feet bgs would be required, which cannot be established in a reasonable remediation time frame.
		Aerobic/anaerobic biodegradation	Use of in-situ microbial populations to biologically breakdown organic contaminants.	Eliminate. Lead is the only COC in groundwater and it is an inorganic constituent.

TABLE 3-3

TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DETAILED SCREENING
SITE 43 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remedial Technology	Process Option
Soil		
No Action	None	Not Applicable
Limited Action	Land Use Controls (LUCs)	Administrative Controls: Deeds and Site Use Restrictions
Containment	Horizontal Barrier	Covers
Removal	Excavation	Mechanical
Disposal	Off-site	Hazardous/Non-hazardous Waste Landfill
	On-site	Beneficial Reuse
Groundwater		
No Action	None	Not Applicable
Limited Action	LUCs	Administrative Controls: Deeds and Groundwater Use Restrictions
	Monitoring	Sampling and Analysis
In-situ Treatment	In-situ Precipitation	Ammonium Phosphate

4.0 DEVELOPMENT AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section discusses the development of the remedial alternatives developed from each of the process options retained in Section 3.0 and provides a description of the conceptual design for the alternatives. This section also presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 CFR Part 300, as revised in 1990. The criteria, and the relative importance of these criteria, are also discussed in this section.

4.1 DEVELOPMENT OF ALTERNATIVES

4.1.1 Soil

The technologies and process options retained after detailed screening in Section 3.0 were assembled into alternatives. The GRAs, remedial technologies, and process options retained are as follows:

- No Action
- Limited Action: LUCs
- Containment: Cover
- Removal: Excavation
- Disposal: On-site Beneficial Reuse, Off-site RCRA Non-Hazardous (Subtitle D) Landfill, and Off-site Treatment/RCRA Hazardous (Subtitle C) Landfill

The following remedial alternatives have been assembled and developed with the rationale discussed below:

S-0 No Action:
This alternative is required by the NCP as a baseline for comparison to other alternatives.

S-1 Excavation and Offsite Disposal to meet Florida Industrial/Commercial SCTLs and Land Use Controls:
This alternative was developed to address the “hotspot” areas of soil contamination exceeding the Industrial/Commercial SCTLs. This would be the minimum soil volume required to allow the continued use of the site as an industrial area without placing health and safety restrictions on the NAS Pensacola’s employees. However, the site would require LUCs preventing residential land use because the residual contaminants would continue to exceed Residential SCTLs. It is assumed that all of the soil would need to be treated and disposed at a RCRA Subtitle C facility

because of the presence of high concentrations of lead that could cause the soil to exceed TCLP limits.

S-2 Excavation and Offsite Disposal to meet Florida Residential SCTLs :
This alternative was developed to address all of the contamination exceeding Residential SCTLs to allow unrestricted site use. No LUCs would be required. A portion of the soil containing high concentrations of lead may fail TCLP and require treatment/disposal at a RCRA Subtitle C facility; and the remainder would be disposed of at a RCRA Subtitle D facility without treatment.

S-3 Limited Excavation and Offsite Disposal, and Maintenance of Pavement to meet Florida Industrial/commercial SCTLs; and LUC:
This alternative was developed to address the hot spots exceeding Industrial/commercial SCTLs by using the existing cover (pavement) as a barrier for site users, with a minimal excavation outside of the paved area. LUCs would be required because contamination would continue to exceed both Industrial/commercial and Residential SCTLs.

4.1.2 Groundwater

The technologies and process options retained after detailed screening in Section 3.0 were assembled into alternatives. The GRAs, remedial technologies, and process options retained are as follows:

- No Action
- Limited Action: LUCs and Monitoring
- In-situ Treatment: In-situ Precipitation

The following groundwater alternatives have been developed for the Site 43 FS:

G-0. No Action:
This alternative is required by the NCP as a baseline for comparison to other alternatives.

G-1. Land Use Controls (groundwater use restrictions) and Long-Term Monitoring:
This alternative was developed to address the minimum requirements to meet the groundwater RAO. Groundwater concentrations would be monitored for any attenuation and potential migration of the plume for an indefinite period of time or until site conditions become suitable for an exit strategy to be implemented. Administrative controls would be used to prohibit groundwater use.

G-2. In-situ Groundwater Treatment; and Short-term Land Use Controls (groundwater use restrictions) and Monitoring

This alternative was developed to eliminate long-term groundwater use controls and monitoring by implementing in-situ precipitation of lead. If the concentrations of lead can be shown to have decreased to less than the cleanup goal, then the groundwater use controls and monitoring would be terminated.

4.2 DESCRIPTION AND DETAILED ANALYSIS OF ALTERNATIVES

This section presents a description of the conceptual design of each alternative, followed by a detailed analysis using the nine criteria of the NCP under 40 CFR Part 300. Supporting conceptual design calculations are presented in Appendix B. Cost Estimates are presented in Appendix C. Supplemental responses to comments on the RI that show how the remedial alternatives address the data gaps identified in the RI are presented in Appendix D. The evaluation criteria are discussed below.

4.2.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and environment, in the short and the long term, from unacceptable risks posed by hazardous substances or contaminants present at the site by eliminating, reducing, or controlling exposure to levels exceeding remediation goals. Overall protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws. If one or more regulations that are applicable cannot be complied with, a waiver must be invoked. Grounds for invoking a waiver would depend on the following circumstances:

- The alternative is an interim measure and will become part of a total remedial action that will attain the ARAR.
- Compliance will result in greater risk to human health and the environment.
- Compliance is technically impracticable from an engineering perspective.
- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.
- A state requirement has not been consistently applied or the State has not demonstrated the intention to consistently apply the promulgated requirement in similar circumstances at other remedial actions within the state.
- For Superfund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Superfund monies to respond to other sites that may present a threat to human health and the environment.

Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with a degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

Magnitude of Residual Risk

This refers to risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

Adequacy and Reliability of Controls

Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. These include an evaluation of the uncertainties associated with land disposal for providing long-term protection from residuals, the assessment for the potential need to replace technical components of the alternative such as a cap, a slurry wall, or a treatment system, and the potential exposure pathways and risks posed should the remedial action need replacement.

Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that they will treat.
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.
- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and a specification of which reduction(s) is occurring.
- The degree to which the treatment is irreversible.
- The type and quantity of residuals that will remain following treatment considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.
- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

Short-Term Effectiveness

The short-term impacts of the alternative shall be assessed considering the following:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigation measures during implementation.
- Time until protection is achieved.

Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors, as appropriate:

- Technical feasibility including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials including the availability of adequate off-site treatment capacity, storage capacity, and disposal capacity and services, the availability of necessary equipment and specialists, and provisions to ensure necessary additional resources, the availability of services and materials, and availability of prospective technologies.

Cost

Capital costs shall include both direct and indirect costs. Annual O&M costs shall be provided. A net present worth (NPW) value of the capital and O&M costs shall also be provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

State Acceptance

The State's concerns must be assessed with respect to the following:

- The State's position and key concerns related to the preferred alternative and other alternatives.
- State comments on ARARs or the proposed use of waivers.

State's acceptance cannot be evaluated at this time because the State has not reviewed and commented on the FS. Following review and approval of the FS, these concerns will be addressed to the extent possible, in the Proposed Plan to be issued for public comment.

Community Acceptance

This assessment consists of responses of the community to the Proposed Plan. This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment can only be done after comments on the Proposed Plan are received from the public.

4.2.1.1 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two criteria, state acceptance and community acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria can only be evaluated after the State of Florida has reviewed this FS and after the Proposed Plan has been through a public comment period. Therefore, this document addresses only seven of the nine criteria.

4.2.2 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan submitted to the community for review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the review of the comments on the Proposed Plan and consultation with the State of Florida to determine whether or not the preferred alternative continues to be the most appropriate remedy for the site.

4.3 SOIL

4.3.1 Alternative S-0: No Action

4.3.1.1 Description of Alternative S-0

This alternative is a "walk-away" alternative that is required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use.

4.3.1.2 Detailed Analysis of Alternative S-0

Overall Protection of Human Health and Environment

Alternative S-0 would not be protective of human health and the environment. Concentrations of PAHs and metals would remain in the surface soil at levels that exceed SCTLs for human health, thereby not achieving the RAO for protection of human health from exposure to soil contaminants.

Compliance with ARARs

There are no chemical-specific ARARs for this site; however, Alternative S-0 would allow concentrations of lead to remain at levels that would cause predicted unacceptable blood levels for certain receptors under U.S. EPA benchmarks. Also, Alternative S-0 would not achieve human health SCTLs (TBCs) provided in the guidance under FAC Chapter 62-777 for carcinogenic PAHs and several heavy metals including lead.

Long-term Effectiveness and Permanence

Alternative S-0 would not be effective in the long term because soil COCs would remain on site and pose potential human health hazards. Although concentrations of soil COCs might gradually decrease to acceptable levels over a long period of time because of natural processes, monitoring would not be performed to verify its occurrence.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-0 does not employ any treatment; however, there would most likely be some reduction in toxicity (i.e., concentrations) of COCs over time due to natural attenuation, which cannot be measured under this alternative.

Short-term Effectiveness

There are no short-term effectiveness issues under Alternative S-0 because no action would occur.

Implementability

There are no implementability concerns for Alternative S-0 because no action would be implemented.

Cost

There are no costs associated with Alternative S-0.

4.3.2 Alternative S-1: Excavation and Offsite Disposal to meet Florida Industrial/Commercial SCTLs and Land Use Controls

4.3.2.1 Description of Alternative S-1

Alternative S-1 would involve the excavation of soil such that the site concentrations can meet Industrial/Commercial SCTLs for the COCs. Areas delineated to be excavated to meet these SCTLs are shown on Figure 4-1. Four components are included in this alternative as follows:

- Initial delineation of excavation areas
- Excavation
- Off-site Treatment/Disposal
- LUCs

Component 1: Initial Delineation of Excavation Areas

The soil around the perimeter of each identified excavation area will be sampled and analyzed for PAHs, lead and arsenic with rapid turn analysis in a fixed-based laboratory. An X-Ray Fluorescence (field-portable) Spectrometer (XRF) will be used to obtain real-time concentrations of lead, which is the COC determining the extent of contamination. The data obtained via XRF will be correlated with fixed-laboratory data for additional confidence in the extent of excavation.

Component 2: Excavation of Soil to meet Industrial/Commercial SCTLs

Utility clearance would be conducted in the proposed areas of excavation, at a minimum for water, communication, and electrical lines. Following the utility clearance, excavation would occur at four locations ranging in area from 225 sq ft to 380 sq ft and up to a maximum depth of 4 feet, for a total of approximately 120 (in-situ) cubic yards of soil. The previous IRA revealed the presence of ornamental ordnance and inert munitions at the site, however, as a precaution an UXO specialist will be present to verify that any debris excavated from the four locations do not contain UXO. Excavated soil would be visually checked for UXO and mechanically screened at a suitable location on site. Dust control measures and appropriate health and safety measures would be implemented during the excavation and screening. Samples of soil from the side walls and bottoms of the excavated areas would be collected for confirmatory analysis of concentrations of lead, arsenic, and PAHs.

Component 3: Off-site Treatment/Disposal

The excavated soil would be tested for TCLP characteristics. For costing purposes, it is assumed that all of the soil would exceed TCLP limits and require treatment, possibly using chemical fixation/solidification to meet land disposal requirements at a RCRA Subtitle C facility.

Approximately 120 cubic yards of excavated void would be filled with clean backfill (with some minor allowance for clean surface soil recovered from areas within the IRA area), covered with top soil, and seeded with grass.

Component 4: LUCs

A LUC RD would be prepared to establish and implement methods and procedures to prevent residential use of Site 43. Signs would be installed at selected locations around the perimeter of the site to indicate where the site area begins so that if adjacent areas outside the perimeter are released for unrestricted use, the geographical limits of the unrestricted use would be clear. LUCs would be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated October 2, 2003 from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, U.S. EPA. Implementation of this alternative would therefore require a survey of the site, annual visual inspections, and five-year reviews with report preparation.

4.3.2.2 Detailed Analysis of Alternative S-1

Overall Protection of Human Health and Environment

Alternative S-1 would be protective of human health and the environment. After excavation and removal of soil to meet Industrial/Commercial SCTLs for lead, arsenic, and PAHs, future industrial users would be protected. The use of LUCs would prohibit residential use, and thereby prevent potential residential receptors from being exposed to unacceptable levels of residual PAHs, arsenic, lead, and other heavy metals that would remain outside the excavated areas. Thereby, all of the RAOs for Site 43 would be met.

Compliance with ARARs

There are no chemical-specific ARARs for this site; however Alternative S-1 would reduce lead concentrations such that the predicted blood levels for construction workers would no longer remain unacceptable compared to U.S. EPA benchmarks (TBCs). Also, Alternative S-1 would achieve the

Industrial/Commercial SCTLs provided in FAC Chapter 62-777 (TBCs). The guidance will be used to demonstrate that the site-wide concentrations (averages or 95 percent UCLs) meet these SCTLs.

No location-specific ARARs have been identified. Action specific ARARs would be complied with in substance, in particular, the following:

- RCRA regulations including the following: Identification and Listing of Hazardous Wastes, and LDRs,
- OSHA regulations
- Florida Air Pollution Rules

Long-term Effectiveness and Permanence

Alternative S-1 would be effective in the long term because, following the remedial action, the site would be protective of industrial/commercial uses; and maintenance of LUCs would prevent unacceptable exposure of residential receptors to residual contamination in soil.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-1 would employ treatment of soil to meet LDRs prior to disposal. Approximately 120 cubic yards of soil are assumed to require treatment using chemical fixation/solidification prior to disposal.

Short-term Effectiveness

Alternative S-1 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation and mechanical screening for ordnance. Erosion control measures would minimize the potential migration of COCs into nearby drains. Workers on site would be adequately protected if suitable health and safety procedures are followed. Potential concern for UXO is minimal, based on previous findings at the site. The time frame for implementation of this alternative is estimated to be approximately one month. Approximately 6 months is assumed to be required for formal implementation of LUCs, at which time the remedy will achieve RAOs.

Implementability

Alternative S-1 is implementable. Excavation and screening equipment considered under this alternative are typical in the construction industry and are readily available from several local sources. The ordnance (if any) that may be excavated, is expected to be of ornamental type or inert, and therefore an Explosives Safety Submittal (ESS) or ESS waiver is not anticipated. Off-site borrow locations for clean soil can be

identified. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, U.S. EPA, FDEP, and potential future site owners who might be affected by deed restrictions.

Cost

Estimated costs for Alternative S-1 are as follows:

- Capital: $ 348,000
- 30-Year Net-Present Worth (NPW) of O&M: $ 77,000
- 30-Year NPW of Alternative S-1: $ 425,000

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A more detailed breakdown of these cost estimates is provided in Appendix C.

4.3.3 Alternative S-2: Excavation and Off-site Disposal to meet Florida Residential SCTLs

4.3.3.1 Description of Alternative S-2

Alternative S-2 would involve the excavation of soil such that the site concentrations can meet Residential SCTLs for the COCs. Areas delineated to be excavated to meet these SCTLs are shown on Figure 4-2. Three components are included in this alternative as follows:

- Initial delineation of excavation areas
- Excavation
- Off-Site Treatment/Disposal

Component 1: Initial Delineation of Excavation Areas

The soil around the perimeter of each identified excavation area will be sampled and analyzed for PAHs, lead, arsenic, barium, copper, and vanadium with rapid turn analysis in a fixed-based laboratory. An X-Ray Fluorescence (field- portable) Spectrometer (XRF) will be used to obtain real-time concentrations of lead which is the COC determining the extent of contamination. Other metals may also be analyzed via XRF for informational purposes. The data for lead obtained via XRF will be correlated with fixed-laboratory data for additional confidence in the extent of excavation.

Component 2: Excavation of Soil to meet Residential SCTLs

Utility clearance would be conducted in the proposed areas of excavation, at a minimum for water, communication, and electrical lines. Following the utility clearance, excavation would occur over an area of 12,700 square feet, which includes the former IRA area, to depths varying from 2 to 4 feet bgs. To the east of this area, an additional area of approximately 225 square feet of soil would be excavated to a depth of 4 feet bgs. The previous IRA revealed the presence of ornamental ordnance and inert munitions at the site; however, as a precaution an UXO specialist will be present to verify that any excavated debris does not contain UXO. A total of 1,800 cubic yards would be excavated, of which approximately 600 cubic yards would be clean surface soil from the IRA area. The clean soil will be stockpiled separately for later reuse as backfill. The remaining excavated soil consisting of 1,200 (in-situ) cubic yards would be visually checked for unexploded ordnance (UXO) and mechanically screened at a suitable location onsite. Dust control measures and appropriate health and safety measures would be implemented during the excavation and screening. Samples of soil from the side walls and bottom of the excavated areas would be collected for confirmatory analysis of concentrations of lead, arsenic, barium, copper, vanadium, and PAHs.

Component 3: Off-site Treatment/Disposal

The excavated soil would be tested for TCLP characteristics. It is assumed that 120 (in-situ) cubic yards of the soil would require treatment, possibly using chemical fixation/solidification to meet land disposal requirements at a RCRA Subtitle C facility. The remaining contaminated soil consisting of 1,080 (in-situ) cubic yards of soil is assumed to be suitable for disposal at a nonhazardous waste disposal (RCRA Subtitle D) facility.

Approximately 1,800 cubic yards of excavated void would be filled with clean backfill (including 600 cubic yards of clean surface soil recovered from areas within the IRA), covered with top soil, and seeded with grass.

4.3.3.2 Detailed Analysis of Alternative S-2

Overall Protection of Human Health and Environment

Alternative S-2 would be protective of human health and the environment. The removal of contamination to meet Residential SCTLs would protect all potential receptors from exposure to unacceptable levels of PAHs, lead, and other metals. All of the RAOs for soil at Site 43 would be met.

Compliance with ARARs

There are no chemical-specific ARARs for this site; however Alternative S-2 would reduce lead concentrations such that the predicted blood levels for all receptors would no longer remain unacceptable compared to U.S. EPA bench marks (TBCs). Also, Alternative S-2 would achieve the Residential SCTLs provided in FAC Chapter 62-777 (TBCs). The guidance will be used to demonstrate that the site-wide concentrations (averages or 95 percent UCLs) meet these SCTLs.

No location-specific ARARs have been identified. Action specific ARARs would be complied with in substance, in particular, the following:

- RCRA regulations including the following: Identification and Listing of Hazardous Wastes, and LDRs,
- Occupational Safety and Health Act (OSHA) regulations
- Florida Air Pollution Rules

Long-term Effectiveness and Permanence

Alternative S-2 would be effective in the long term because, following the excavation and removal of contaminated soil, no residual levels would exceed concentrations that would pose a threat to any human receptor.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-2 would employ treatment of soil to meet LDRs prior to disposal. Approximately 120 cubic yards of soil are assumed to require treatment using chemical fixation/solidification prior to disposal.

Short-term Effectiveness

Alternative S-2 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation and mechanical screening for ordnance. Erosion control measures would minimize the potential migration of COCs into nearby drains. Workers on site would be adequately protected if suitable health and safety procedures are followed. Potential concern for UXO is minimal, based on previous findings at the site. The time frame for implementation of this alternative is estimated to be approximately one month. Approximately 6 months is assumed to be required for formal implementation of LUCs, at which time the remedy will achieve RAOs.

Implementability

Alternative S-2 is implementable. The large volume of soil to be screened would require significant support areas for stockpiling and screening. The bottom of the clean backfill soil in the IRA area would require careful differentiation between the higher clay content of the lower portion of the surface soil and the underlying silty/clay site soil. Aside from these issues, excavation and screening equipment considered under this alternative are typical in the construction industry and are readily available from several local sources. The ordnance (if any) that may be excavated, is expected to be of ornamental type or inert, and therefore an Explosives Safety Submittal (ESS) or ESS waiver is not anticipated. Off-site borrow locations for clean soil can be identified.

Cost

Estimated costs for Alternative S-2 are as follows:

- Capital: $ 706,000

No O&M costs will be required; therefore, NPW for Alternative S-2 is the same as its capital cost.

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A detailed breakdown of these cost estimates is provided in Appendix C.

4.3.4 Alternative S-3: Limited Excavation and Offsite Disposal, and Maintenance of Pavement to meet Florida Industrial/Commercial SCTLs; and Land Use Controls

4.3.4.1 Description of Alternative S-3

Alternative S-3 would involve the maintenance of the pavement over a currently existing asphalt parking lot over most of the contaminated area and the excavation of contaminated soil over a limited area remaining outside the pavement such that exposure to site concentrations exceeding Industrial/Commercial SCTLs for the COCs does not occur. Areas delineated to be maintained as a parking lot or to be excavated to meet these SCTLs are shown on Figure 4-3. Five components are included in this alternative as follows:

- Initial delineation of excavation area
- Excavation
- Off-site Treatment/Disposal
- Maintenance of Pavement
- LUCs

Component 1: Initial Delineation of Excavation Areas

The soil around the perimeter of the identified excavation area will be sampled and analyzed for lead and arsenic with rapid turn analysis in a fixed-based laboratory. An X-Ray Fluorescence (field- portable) Spectrometer (XRF) will be used to obtain real-time concentrations of lead, which is the COC determining the extent of contamination. The data obtained via XRF will be correlated with fixed-laboratory data for additional confidence in the extent of excavation.

Component 2: Excavation of Soil to meet Industrial/Commercial SCTLs

Utility clearance would be conducted in the proposed areas of excavation, at a minimum for water, communication, and electrical lines. Following the utility clearance, excavation would occur in area of 225 sq ft up to a depth of 4 feet, for a total of approximately 33 (in-situ) cubic yards of soil. The previous IRA revealed the presence of ornamental ordnance and inert munitions at the site, however, as a precaution an UXO specialist will be present to verify that any debris excavated from the location do not contain UXO. Excavated soil would be visually checked for UXO and mechanically screened at a suitable location on site. Dust control measures and appropriate health and safety measures would be implemented during the excavation and screening. Samples of soil from the side walls and bottoms of the excavated areas would be collected for confirmatory analysis of concentrations of lead and arsenic.

Component 3: Off-site Treatment/Disposal

The excavated soil would be tested for TCLP characteristics. For costing purposes, it is assumed that all of the soil would exceed TCLP limits and require treatment, possibly using chemical fixation/solidification to meet land disposal requirements at a RCRA Subtitle C facility.

Approximately 33 cubic yards of excavated void would be filled with clean backfill, covered with top soil, and seeded with grass.

Component 4: Maintenance of Asphalt

A majority of the area of soil contamination exceeding Florida Industrial/Commercial SCTLs at the site is covered by an asphalt parking lot. Continued maintenance of this pavement will be required to prevent exposure to the underlying surface soil contamination. Periodic patching/repairing of the asphalt and occasional replacement of all layers of the pavement throughout the parking lot may be required. The area to be maintained is shown in Figure 4-3.

Component 5: LUCs

A LUC RD would be prepared to establish and implement methods and procedures to prevent residential use of Site 43. This LUC RD would also include requirements for inspection and maintenance of the pavement, and requirements to prohibit unauthorized excavation. Signs would be installed at selected locations around the perimeter of the site to indicate where the site area begins so that if adjacent areas outside the perimeter are released for unrestricted use, the geographical limits of the unrestricted use would be clear. Signs would also note that unauthorized excavation in the parking lot is also prohibited. LUCs would be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated October 2, 2003 from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, U.S. EPA. Implementation of this alternative would therefore require a survey of the site, annual visual inspections, and five-year reviews with report preparation.

4.3.4.2 Detailed Analysis of Alternative S-3

Overall Protection of Human Health and Environment

Alternative S-3 would be protective of human health and the environment. After excavation and removal of soil and by continued maintenance of pavement with prohibition for unauthorized excavation to prevent exposure to contaminated soil exceeding Industrial/Commercial SCTLs for lead, arsenic, and PAHs, future industrial users would be protected. The use of LUCs would prohibit residential use, and thereby prevent potential residential receptors from being exposed to unacceptable levels of residual PAHs, arsenic, lead, and other heavy metals that would remain outside the excavated and covered areas. Thereby, all of the RAOs for Site 43 would be met.

Compliance with ARARs

There are no chemical-specific ARARs for this site; however Alternative S-3 would reduce exposure to contaminated soil such that the predicted blood levels of lead for construction workers would no longer remain unacceptable compared to U.S. EPA benchmarks (TBCs). Also, Alternative S-3 would prevent exposure to contaminant concentrations exceeding Industrial/Commercial SCTLs provided in FAC Chapter 62-777 (TBCs). The guidance will be used to demonstrate that the site-wide concentrations (averages or 95 percent UCLs) meet these SCTLs in the area of limited excavation.

No location-specific ARARs have been identified. Action specific ARARs would be complied with in substance, in particular, the following:

- RCRA regulations including the following: Identification and Listing of Hazardous Wastes, and LDRs,
- OSHA regulations
- Florida Air Pollution Rules

Long-term Effectiveness and Permanence

Alternative S-3 would be effective in the long term because, following the remedial action, the site would be protective of industrial/commercial uses as long as the pavement remains in place; and maintenance of LUCs would prevent unacceptable exposure of industrial and residential receptors to contamination in soil. Contaminant concentrations would remain at concentrations exceeding Industrial/Commercial SCTLs.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-3 would employ treatment of soil to meet LDRs prior to disposal. Approximately 33 cubic yards of soil are assumed to require treatment using chemical fixation/solidification prior to disposal.

Short-term Effectiveness

Alternative S-3 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation and mechanical screening for ordnance. Erosion control measures would minimize the potential migration of COCs into nearby drains. Workers on site would be adequately protected if suitable health and safety procedures are followed. Potential concern for UXO is minimal, based on previous findings at the site. The time frame for implementation of this alternative is estimated to be approximately one month. Approximately 6 months is assumed to be required for formal implementation of LUCs, at which time the remedy will achieve RAOs.

Implementability

Alternative S-3 is implementable. Excavation and screening equipment considered under this alternative are typical in the construction industry and are readily available from several local sources. The ordnance (if any) that may be excavated, is expected to be of ornamental type or inert, and therefore an Explosives Safety Submittal (ESS) or ESS waiver is not anticipated. Off-site borrow locations for clean soil can be identified. Maintenance of the pavement poses no significant obstacles and may be implemented easily.

Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, U.S. EPA, FDEP, and potential future site owners who might be affected by deed restrictions. LUCs to maintain the pavement and prevent unauthorized excavation would need to be included under appropriate documents (such as a facility master plan) and in the future deed restriction.

Cost

Estimated costs for Alternative S-3 are as follows:

- Capital: $ 180,000
- 30-Year Net-Present Worth (NPW) of O&M: $ 96,000
- 30-Year NPW of Alternative S-3: $ 276,000

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A more detailed breakdown of these cost estimates is provided in Appendix C.

4.4 GROUNDWATER

4.4.1 Alternative G-0: No Action

4.4.1.1 Description of Alternative G-0

This alternative is a "walk-away" alternative that is required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use.

4.4.1.2 Detailed Analysis of Alternative G-0

Overall Protection of Human Health and Environment

Alternative G-0 would not be protective of human health and the environment. Concentrations of lead would remain in groundwater at levels that exceed the GCTL and U.S. EPA Action Level.

Compliance with ARARs

Although chemical-specific ARARs would eventually be attained through natural attenuation, compliance would not be verified through monitoring. No location-specific ARARs have been identified. Action-specific ARARs are not applicable to this alternative.

Long-term Effectiveness and Permanence

Alternative G-0 would not be effective in the long term because lead would remain on site and no controls would exist to prevent human exposure to contaminated groundwater. Moreover, data would not be available to evaluate whether the lead contamination is migrating.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative G-0 does not employ any treatment.

Short-term Effectiveness

There are no relevant short-term effectiveness issues under Alternative G-0 because no action would occur.

Implementability

There are no implementability concerns for Alternative G-0 because no activity would be implemented.

Cost

There are no costs associated with Alternative G-0.

4.4.2 Alternative G-1: Land Use Controls (groundwater use restrictions) and Long-Term Monitoring:

4.4.2.1 Description

Alternative G-1 would consist of administrative actions and monitoring. Figure 4-4 shows the existing monitoring well network and the additional monitoring wells that may be installed. The following are the three major components of this alternative:

- Initial Plume Delineation
- Installation of Additional Monitoring Wells
- LUCs for groundwater use restrictions and Long-term Monitoring

Component 1: Initial Plume Delineation

The initial plume delineation would consist of determining the extent of a lead plume around PEN-43-13S (if one exists) and the verification of the presence of contamination, followed by delineation of the plume (if one exists) around PEN-43-SB14 where a very high concentration of lead was detected in the soil during the RI. The delineation of the lead plumes will be conducted using several temporary well points (assumed to be 12 for cost estimation purposes) around these locations. A DPT rig will be mobilized and groundwater samples will be collected within the surficial aquifer in the 15 to 25 ft bgs range. Unfiltered samples will be sent to the laboratory for quick-turnaround time analysis of lead. The lead plume will be delineated around one or both locations to provide direction for installation of permanent monitoring wells.

Component 2: Installation of Additional Monitoring Wells

Three additional monitoring wells would be installed to a depth of approximately 25 feet bgs each with 10-foot screens. One new monitoring well (PEN-43-MW-101S) would be installed hydraulically downgradient (east) of PEN-43-13S outside the plume area (if one exists), a second monitoring well (PEN-43-MW-102S) would be installed adjacent to the location of former boring PEN-43-SB14 if the initial plume delineation indicates the presence of groundwater contamination, and a third monitoring well (PEN-43-MW-103S) would be installed far downgradient (east) of both plumes as shown on Figure 4-4.

Component 3: Land Use Controls and Monitoring

Land Use Controls would be developed specifying groundwater use restrictions to prevent unacceptable risks from exposure to contaminated groundwater. At a minimum installation of potable water wells would be prevented. The specifics of the controls would be stated in the remedial design. Controls would be maintained for as long as they are required to prevent unacceptable exposure to contaminated groundwater or to preserve the integrity of the selected remedy. Regular inspections (five-year reviews) would be performed to verify the continued implementation of the groundwater use restrictions.

Monitoring would consist of collecting and analyzing groundwater samples from 4 monitoring wells annually for analysis of lead. Other existing permanent monitoring wells may periodically substitute for the downgradient monitoring wells to verify that contamination has not appeared elsewhere in groundwater at the site. Monitoring results would be evaluated as part of the five-year review with respect to the exit-strategy decision flow charts that would be developed in the remedial work plan. If the results meet the decision point requirements, the monitoring program can be modified or discontinued, and a technical basis will be available to negotiate the removal of Groundwater Use Controls with the regulators.

4.4.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-1 would be protective of human health and the environment.

Although lead contamination would remain, natural processes would eventually reduce its concentrations to acceptable levels for human health. The reduction in lead concentrations is more likely to occur if soil remediation is implemented to remove the potential source of groundwater contamination. Monitoring would be conducted to demonstrate that no lead migration is taking place and to assess decreases of its concentrations over time as a result of natural attenuation.

Groundwater use restrictions would prohibit use of the surficial aquifer groundwater and would therefore be protective of human health by preventing unacceptable risks due to exposure to contaminated groundwater.

Some short-term risks could be incurred by workers from exposure to contamination during implementation of this alternative. However, the potential for such exposure would be minimized by the wearing of appropriate personal protective equipment (PPE) and compliance with site-specific health and safety procedures.

No adverse short-term or cross-media effects are anticipated as a result of implementing this alternative.

Compliance with ARARs and TBCs

Although Alternative G-1 would not immediately comply with the chemical-specific ARARs and TBCs, it would eventually achieve the lead U.S. EPA Action Level and GCTL of 15 µg/L through natural attenuation and this would be verified by monitoring. Alternative G-1 would comply with action-specific ARARs and TBCs.

Long-Term Effectiveness and Permanence

Alternative G-1 would provide long-term effectiveness and permanence. Although no active treatment of contaminated groundwater would occur, risks to human health and the environment would be monitored and controlled.

Naturally occurring processes such as sorption into the soil matrix, dispersion, and dilution would reduce concentrations of lead to acceptable levels over the long term. The combination of Alternative G-1 with

the removal of high concentrations of lead in the soil via the implementation of an active soil remediation alternative would further ensure the attainment of groundwater cleanup goals because of mass reduction in the source. During the time it would take for these processes to achieve acceptable levels, the risk from exposure to contaminated groundwater would be addressed through controls on groundwater use.

Reduction of Toxicity, Mobility, or Volume through Treatment

Although no active treatment is included in Alternative G-1, the toxicity caused by lead in groundwater would eventually be reduced over time through natural processes.

Short-Term Effectiveness

Alternative G-1 would have minimal short-term effectiveness concerns. Exposure of workers to contamination during the maintenance and sampling of monitoring wells would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. Alternative G-1 would also not adversely impact the surrounding community or the environment. The groundwater RAO would be met immediately upon implementation of Groundwater Use Controls and eventual attainment of the groundwater cleanup goal would be verified through monitoring.

Implementability

Alternative G-1 would be readily implementable.

Installation of monitoring wells, sampling and analysis of groundwater, and performance of regular site inspections could readily be accomplished. The resources, equipment, and materials required to implement these activities are readily available.

The administrative aspects of Alternative G-1 would be relatively simple to implement. As part of the change in ownership of the site from military to private use, appropriate provisions would be incorporated into property transfer documents to ensure continued implementation of aquifer use restrictions and monitoring.

Cost

The estimated costs for Alternative G-1 are as follows:

Capital Cost :	$ 114,000
30-Year NPW of O&M and Monitoring Costs:	$ 92,000

30-Year NPW for Alternative G-1: $ 206,000

A detailed breakdown of estimated costs for this alternative is provided in Appendix C.

4.4.3 Alternative G-2: In-situ Groundwater Treatment; and Short-term Land Use Controls (groundwater use restrictions) and Monitoring

4.4.2.1 Description

Alternative G-2 would consist of in-situ groundwater treatment. Figure 4-5 shows the locations where plume treatment is assumed to occur. The following are the four major components of this alternative:

- Initial Plume Delineation
- Installation of Additional Monitoring Wells
- In-situ Precipitation
- Short-term LUCs for groundwater use restrictions and Monitoring

Component 1: Initial Plume Delineation

The initial plume delineation would consist of determining the extent of a lead plume around PEN-43-13S (if one exists) and the verification of the presence of contamination, followed by delineation of the plume (if one exists) around PEN-43-SB14 where a very high concentration of lead was detected in the soil during the RI. The delineation of the lead plumes will be conducted using several temporary well points (assumed to be 12 for cost estimation purposes) around these locations. A DPT rig will be mobilized and groundwater samples will be collected within the surficial aquifer in the 15 to 25 ft bgs range. Unfiltered and filtered samples will be sent to the laboratory for quick-turnaround time analysis of lead and total suspended solids (TSS). The dissolved lead plume will be delineated around one or both locations to provide direction for monitoring well installation and in-situ treatment.

Component 2: Installation of Additional Monitoring Wells

Three additional monitoring wells would be installed to a depth of approximately 25 feet bgs each with 10-foot screens. One new monitoring well (PEN-43-MW-101S) would be installed hydraulically downgradient (east) of PEN-43-13S at the edge of the plume (if one exists), a second monitoring well (PEN-43-MW-102S) would be installed adjacent to the location of former boring PEN-43-SB14 if the initial plume delineation indicates the presence of groundwater contamination, and a third monitoring well (PEN-43-MW-103S) would be installed hydraulically downgradient (east) of the second plume as conceptualized on Figure 4-5.

Component 3: In-situ Precipitation

Assuming two dissolved lead plumes exist, the in-situ precipitation plan would consist of two rounds of injections of a dilute solution of diammonium phosphate. The first round of injection would be conducted after plume delineation has been completed, and the second round (if necessary) would be conducted after data from one year (four quarters) from monitoring wells PEN-43-13S and PEN-43-MW-101S has been obtained and evaluated.

For cost estimation purposes, for each injection round it is assumed that a DPT rig would be mobilized and operated for five days during which, approximately one gallon of one percent diammonium phosphate solution would be injected at 16 locations (eight locations in each of the two plumes) within the 15 to 25 foot bgs depth interval of the surficial aquifer. The chemical may be obtained as a concentrated caustic liquid and diluted onsite to the required strength.

After four quarters of monitoring have been completed, the data would be analyzed for dissolved lead and a determination will be made regarding the effectiveness of the process. It is anticipated that an initial increase in unfiltered lead concentrations will occur; however these concentrations should subsequently decrease as the colloidal lead binds to the surface of soil particles. Based on the data obtained from the four quarters of monitoring, it may be expected that amendment to the chemical dosage and/or additional chemicals (such as drinking-water grade polymers) may be included to improve the binding of the colloidal precipitates to soil during the second round of injections. The followup rounds of monitoring are expected to show that lead concentrations (in unfiltered and filtered fractions) have decreased to acceptable levels.

Component 4: Short-term Land Use Controls and Monitoring

Land Use Controls would be developed specifying short-term groundwater use restrictions to prevent unacceptable risks from exposure to contaminated groundwater. At a minimum, installation of potable water wells would be prevented until lead concentrations have been reduced to acceptable levels. These controls are presumed to be in place during the time that in-situ treatment is being conducted because the property will continue to be in the Navy's possession.

Monitoring of groundwater during the in-situ treatment process would consist of sampling PEN-43-13S, PEN-43-MW-101S, PEN-43-MW-102S, and PEN-43-MW-103S. All monitoring wells would be sampled and analyzed for lead in the unfiltered and filtered fractions. Additional monitoring wells (existing or newly installed) may be proposed for monitoring depending on the delineation of the lead plume and the

findings of the initial rounds of monitoring. Monitoring is assumed to occur over 4 quarterly rounds during the first year following the first round of in-situ injections and over 2 semi-annual rounds over the second year following the second round of in-situ injections.

4.4.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-2 would be protective of human health and the environment.

This alternative will not destroy the lead present in the saturated zone. Instead, if the lead is present in dissolved form, it should be treated by in-situ precipitation to render it less available in dissolved or colloidal fractions. In the short term, groundwater use can be effectively prevented, and this will protect human health.

Some short-term risks could be incurred by workers from exposure to contamination during implementation of this alternative. However, the potential for such exposure would be minimized by the wearing of appropriate personal protective equipment (PPE) and compliance with site-specific health and safety procedures.

No adverse short-term or cross-media effects are anticipated as a result of implementing this alternative.

Compliance with ARARs and TBCs

Alternative G-2 would achieve the chemical-specific ARARs and TBCs by treating groundwater to meet the GCTL and U.S. EPA Action Level of 15 µg/L, which would be verified by monitoring. Alternative G-2 would also comply with action-specific ARARs and TBCs.

Long-Term Effectiveness and Permanence

Alternative G-2 would provide long-term effectiveness and permanence. Active treatment of contaminated groundwater would occur to reduce potential risks to human health and the environment. The combination of Alternative G-2 with the removal of high concentrations of lead in the soil via the implementation of an active soil remediation alternative would further ensure the attainment of groundwater cleanup goals because of mass reduction in the source.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-2 would employ treatment to reduce the toxicity caused by the presence of lead in groundwater. The actual mass of lead being treated to reduce its toxicity can be better estimated after the additional delineation of the lead plume.

Short-Term Effectiveness

Alternative G-2 would have minimal short-term effectiveness concerns. Exposure of workers to contamination during the maintenance and sampling of monitoring wells would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. Alternative G-2 would also not adversely impact the surrounding community or the environment. The groundwater RAO would be met upon implementation and completion of the remedy because the Navy would maintain control of the property, and eventual attainment of the groundwater cleanup goal would be verified through monitoring.

Implementability

Alternative G-2 would require bench-scale testing prior to its implementation, which can be performed in several treatability study laboratories because of the simplicity of the process. Installation of monitoring wells, sampling and analysis of groundwater, and performance of regular site inspections could readily be accomplished. The resources, equipment, chemicals, and materials required to implement these activities are readily available.

Cost

The estimated costs for Alternative G-2 are:

Capital Cost :	$ 286,000
2-Year NPW of O&M and Monitoring Costs:	$ 41,000
30-Year NPW of Alternative G-2:	$ 372,000

A detailed breakdown of estimated costs for this alternative is provided in Appendix C.

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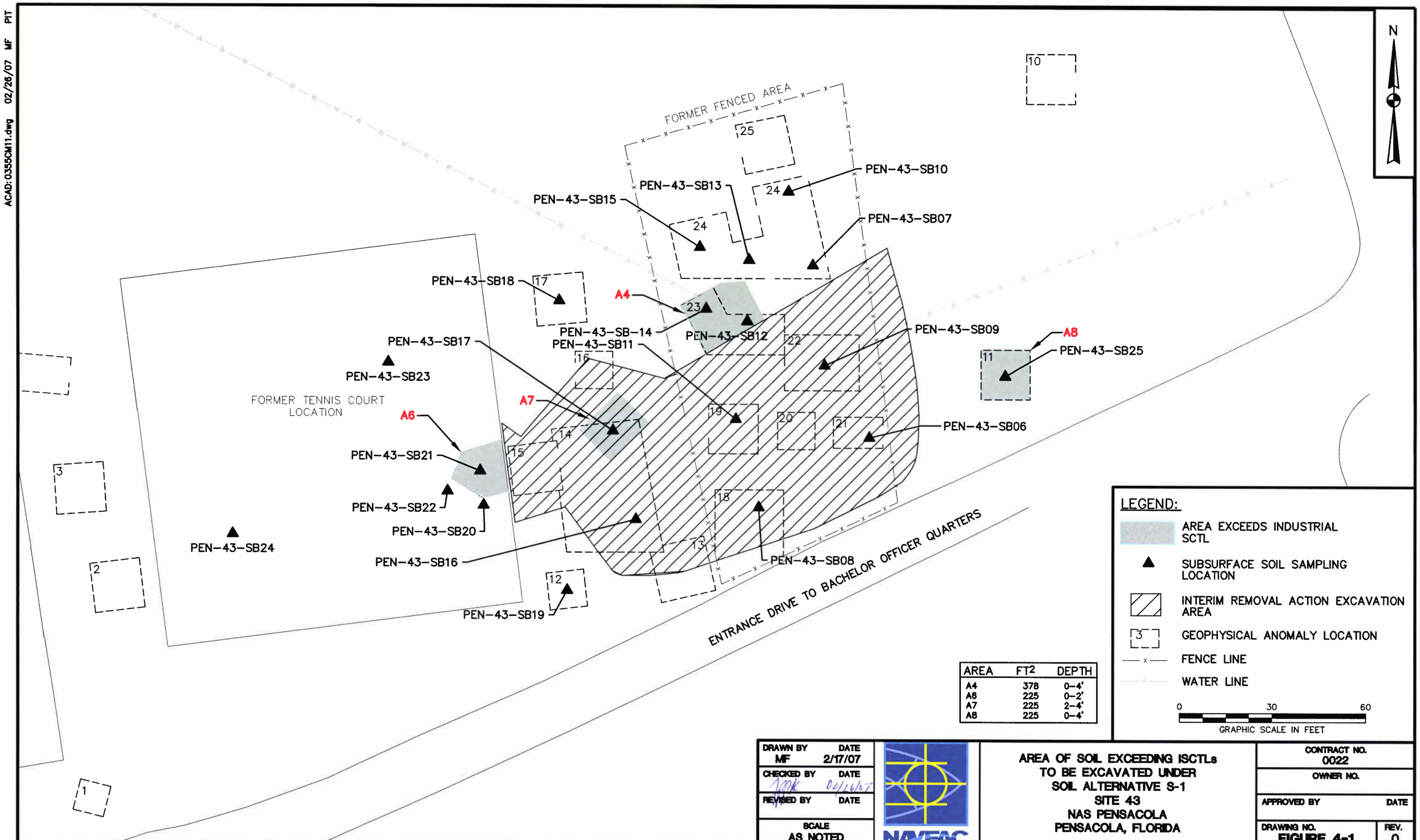

AREA	FT2	DEPTH
A4	378	0-4'
A6	225	0-2'
A7	225	2-4'
A8	225	0-4'

LEGEND:

- AREA EXCEEDS INDUSTRIAL SCTL
- SUBSURFACE SOIL SAMPLING LOCATION
- INTERIM REMOVAL ACTION EXCAVATION AREA
- 3 GEOPHYSICAL ANOMALY LOCATION
- FENCE LINE
- WATER LINE

0 30 60
GRAPHIC SCALE IN FEET

DRAWN BY MF	DATE 2/17/07	AREA OF SOIL EXCEEDING ISCTLs TO BE EXCAVATED UNDER SOIL ALTERNATIVE S-1 SITE 43 NAS PENSACOLA PENSACOLA, FLORIDA
CHECKED BY	DATE 02/26/07	
REVISED BY	DATE	
SCALE AS NOTED		

NAVFAC

CONTRACT NO. 0022	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4-1	REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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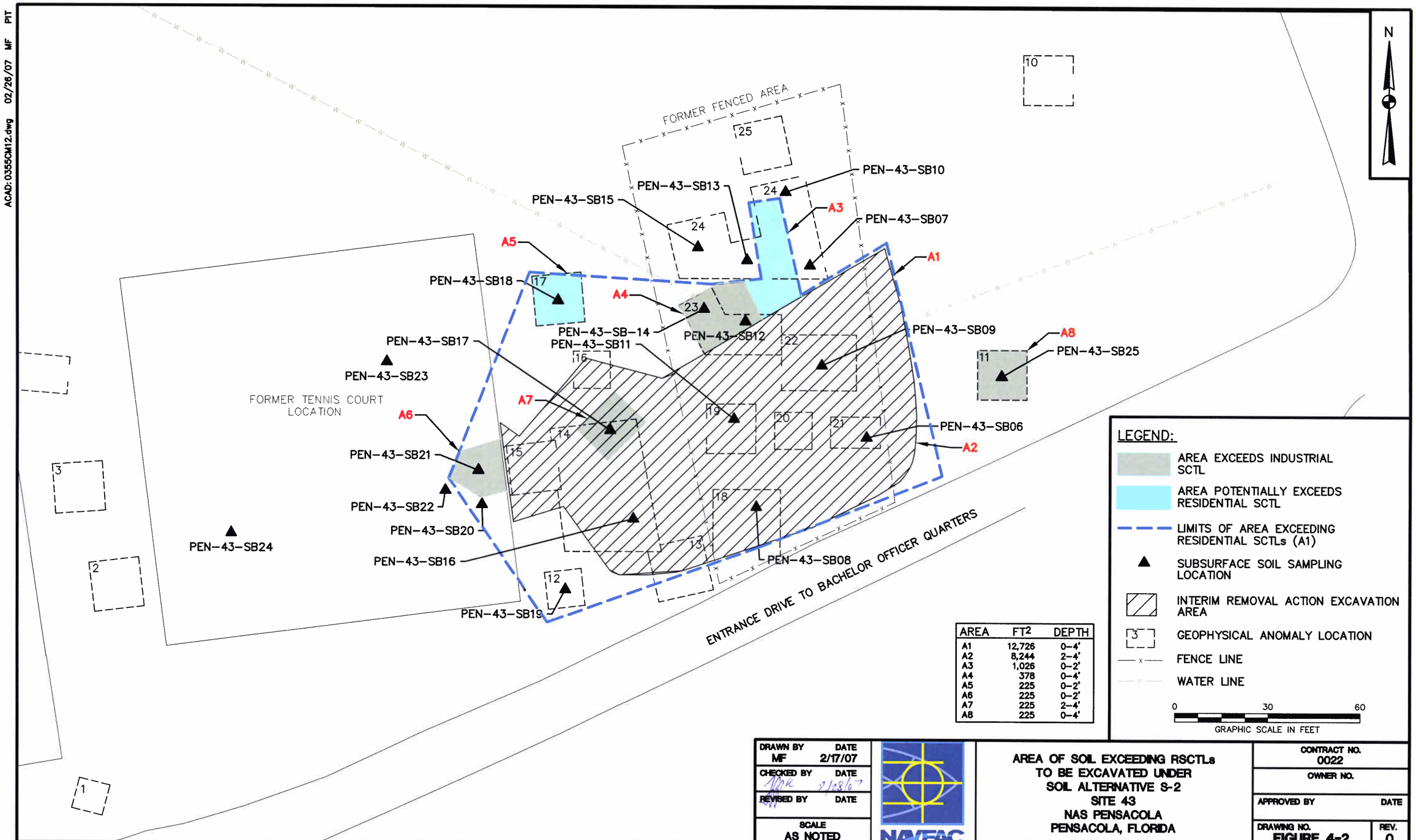

AREA	FT²	DEPTH
A1	12,726	0–4'
A2	8,244	2–4'
A3	1,026	0–2'
A4	378	0–4'
A5	225	0–2'
A6	225	0–2'
A7	225	2–4'
A8	225	0–4'

DRAWN BY MF	DATE 2/17/07	AREA OF SOIL EXCEEDING RSCTLs TO BE EXCAVATED UNDER SOIL ALTERNATIVE S-2 SITE 43 NAS PENSACOLA PENSACOLA, FLORIDA
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

NAVFAC

CONTRACT NO. 0022	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4-2	REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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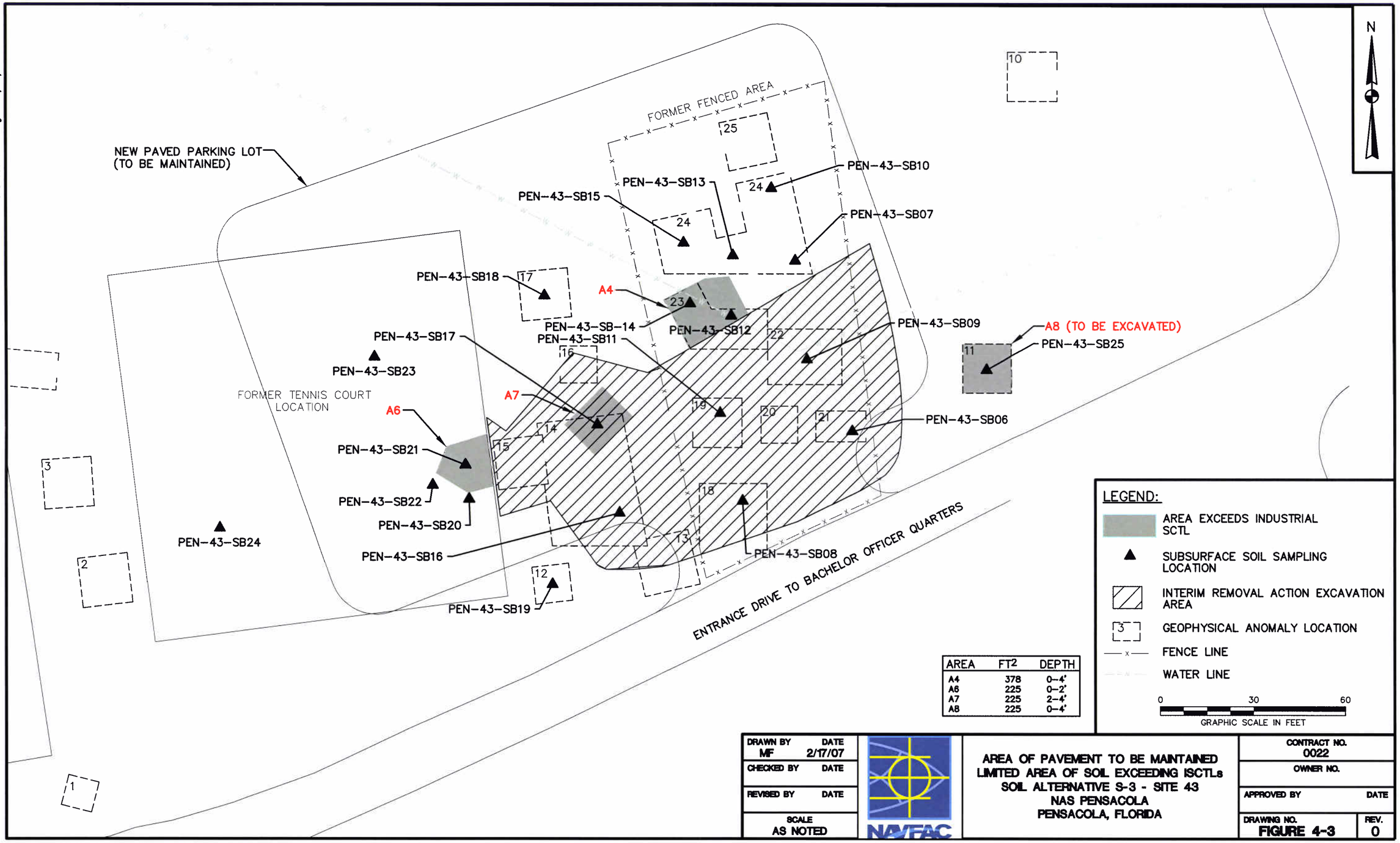

AREA	FT2	DEPTH
A4	378	0–4'
A6	225	0–2'
A7	225	2–4'
A8	225	0–4'

LEGEND:

- AREA EXCEEDS INDUSTRIAL SCTL
- SUBSURFACE SOIL SAMPLING LOCATION
- INTERIM REMOVAL ACTION EXCAVATION AREA
- 3 GEOPHYSICAL ANOMALY LOCATION
- FENCE LINE
- WATER LINE

0 30 60
GRAPHIC SCALE IN FEET

DRAWN BY MF	DATE 2/17/07	AREA OF PAVEMENT TO BE MAINTAINED LIMITED AREA OF SOIL EXCEEDING ISCTLs SOIL ALTERNATIVE S-3 - SITE 43 NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0022
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 4-3 / REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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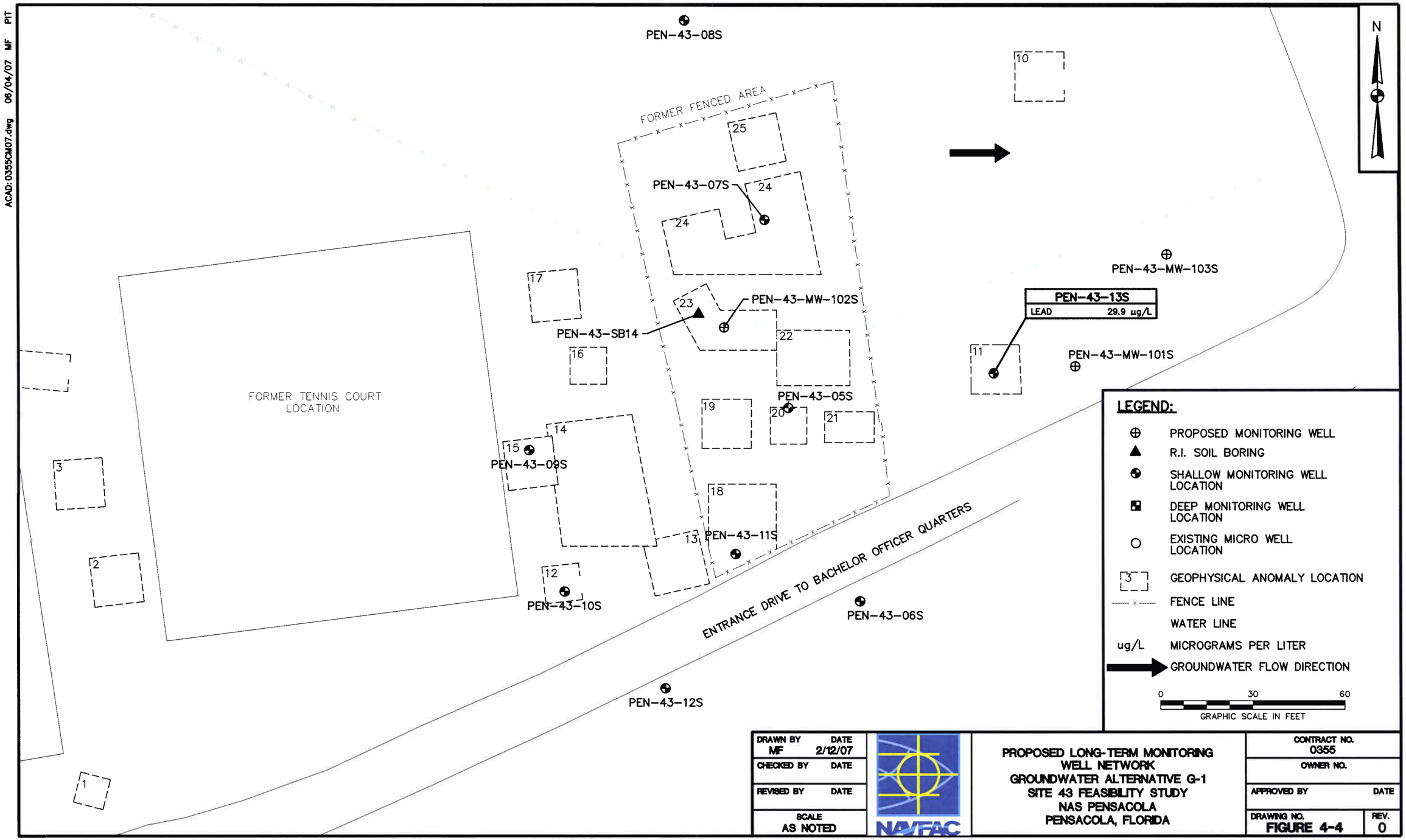

DRAWN BY MF	DATE 2/12/07	PROPOSED LONG-TERM MONITORING WELL NETWORK GROUNDWATER ALTERNATIVE G-1 SITE 43 FEASIBILITY STUDY NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0355
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-4 / REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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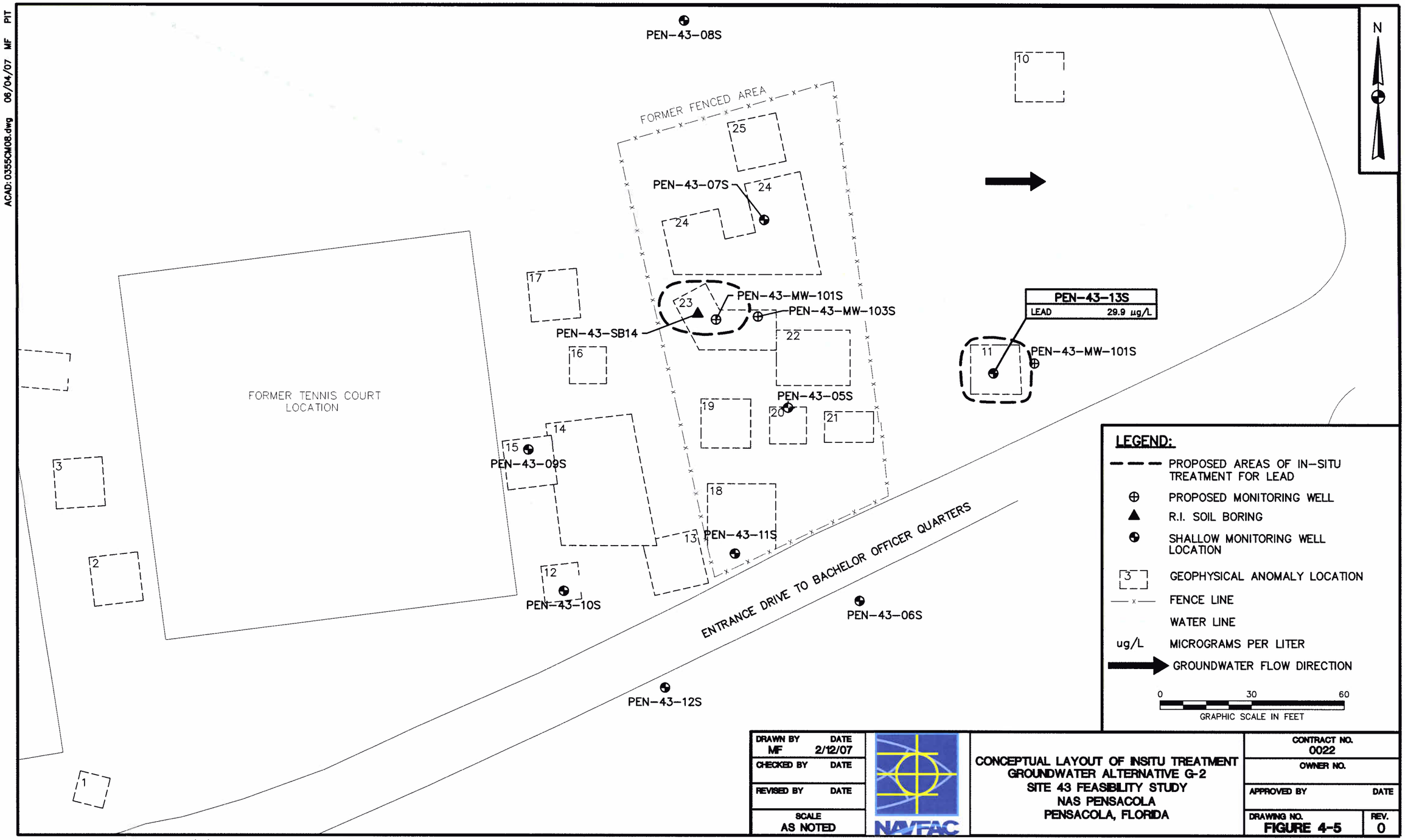

DRAWN BY MF	DATE 2/12/07	CONCEPTUAL LAYOUT OF INSITU TREATMENT GROUNDWATER ALTERNATIVE G-2 SITE 43 FEASIBILITY STUDY NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0022
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-5 / REV. 0

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FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses that were presented for each of the remedial alternatives in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

5.1 SOIL

The following remedial alternatives for soil are being compared in this section:

- Alternative S-0: No Action
- Alternative S-1: Excavation and Off-site Disposal to Meet Florida Industrial/Commercial SCTLs, and LUCs
- Alternative S-2: Excavation and Off-site Disposal to meet Florida Residential SCTLs
- Alternative S-3: Limited Excavation and Off-site Disposal, and Maintenance of pavement to meet Florida Industrial/commercial SCTLs; and LUCs.

5.1.1 Overall Protection of Human Health and the Environment

Alternative S-0 would not be protective. Alternatives S-1, S-2, and S-3 would be protective; however, because of their dependence on LUCs to be protective of human health, S-1 and S-3 are not as highly ranked as S-2. Alternative S-3 is ranked somewhat lower than S-1 because of the additional need for long-term maintenance of pavement to protect human health.

5.1.2 Compliance with ARARs and TBCs

There are no chemical-specific ARARs for Site 43 soil, however, cleanup would be required to meet lead cleanup goals for acceptable blood levels compared to U.S. EPA bench marks (TBCs). Also, Florida SCTLs from FAC Chapter 62-777, which are chemical-specific TBCs must be met. Alternative S-0 would not comply with the chemical-specific TBCs and action-specific ARARs do not apply. Alternatives S-1, S-2, and S-3 would comply with the chemical-specific TBCs and location- and action-specific ARARs.

5.1.3 Long-Term Effectiveness and Permanence

Alternative S-0 would not be effective in the long term and offers no permanent solution. Alternatives S-1, S-2, and S-3 offer different degrees of long-term effectiveness and permanence. Unlike Alternatives S-1 and S-3, Alternative S-2 removes all contaminated soil without the need for LUCs to protect human health against residual contaminants. Therefore, Alternative S-2 ranks higher than Alternatives S-1 and S-3 for

long-term effectiveness and permanence. Alternative S-3 ranks lower than S-1 because its permanence in addressing the contamination is dependent on the effectiveness of the long-term maintenance of the pavement.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

No treatment would occur under Alternative S-0. Alternatives S-1, S-2, and S-3 would employ offsite treatment of hazardous soil that fails TCLP criteria prior to land disposal. Although it is assumed that the portion of soil containing the highest concentrations of lead in each alternative would fail TCLP and require treatment, it is likely that the largest portion of soil would be found to require treatment under Alternative S-2 and the smallest portion of soil would be found to require treatment under Alternative S-3.

5.1.5 Short-Term Effectiveness

All of the alternatives would be effective in terms of short-term risks to the workers, the community and the environment, except Alternative S-0 for which there are no relevant issues to address. A greater potential for release of contaminants exists under Alternative S-2 compared to Alternative S-1, which in turn is greater than Alternative S-3 because of the larger volume of soil being excavated and transported. However, none of these alternatives poses concerns that cannot be addressed. Short-term risks would be properly mitigated by application of engineering controls and adherence to OSHA requirements.

Alternative S-0 would not achieve the soil RAOs. The approximate timeframe for implementation and attainment of RAO would be within 6 months for Alternatives S-1, S-2, and S-3.

5.1.6 Implementability

Alternative S-0 would be readily implementable because there is no action to implement. Alternative S-2 involves the excavation and transportation of a significantly larger volume of soil compared to Alternatives S-1 and S-3; however, the need to maintain LUCs indefinitely under the latter two alternatives adds to their implementation burden. On the other hand, the need for excavation and screening of a larger volume of soil (for UXO safety) under Alternative S-2 poses a greater implementability burden. The need to determine the bottom of the clean layer of soil also adds to the challenge of Alternative S-2 compared to Alternative S-1. Therefore, Alternative S-1 poses a greater administrative implementability concern, whereas Alternative S-2 poses a greater technical implementability concern. Alternative S-3 poses a long-term maintenance burden associated with the pavement and a long-term administrative burden associated with the greater number of LUC provisions compared to Alternative S-1.

5.1.7 Cost

The capital costs, NPW of O&M costs and NPWs of the alternatives are as follows. Costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. Detailed cost estimates are provided in Appendix C.

Alternative	Capital ($)	NPW of O&M ($)	NPW of Alternative($)
S-0	0	0	0
S-1	348,000	77,000 (30-year)	425,000 (30-year)
S-2	706,000	NA	NA
S-3	180,000	96,000	276,000

5.2 GROUNDWATER

The following remedial alternatives for groundwater are being compared in this section:

- Alternative G-0: No Action.
- Alternative G-1: Land Use Controls (groundwater use restrictions) and Long-Term Monitoring.
- Alternative G-2: In-situ Groundwater Treatment and Short-Term Land Use Controls (groundwater use restrictions) with Monitoring.

5.2.1 Overall Protection of Human Health and the Environment

Alternative G-0 would not be protective. Alternatives G-1 and G-2 would be protective. Alternative G-2 would rank higher than G-1 because it employs treatment and does not depend on long-term controls prohibiting groundwater use.

5.2.2 Compliance with ARARs and TBCs

Alternatives G-0 and G-1 may eventually attain compliance with groundwater cleanup goals because of natural attenuation, however, only G-1 employs controls until the cleanup goals are achieved and provides monitoring to verify that the cleanup goals have been achieved. G-2 employs treatment to achieve the cleanup goal. Therefore, the chemical-specific ARARs and TBCs (U.S. EPA Action Level and GCTL) that governs the groundwater cleanup goal for lead would be complied with under Alternatives G-1 and G-2, but not under Alternative G-0. Alternatives G-1 and G-2 would also comply with action-specific ARARs.

5.2.3 Long-Term Effectiveness and Permanence

Alternative G-0 would not be effective in the long term and offers no permanent solution. Alternatives G-1 and G-2 offer long-term effectiveness of different degrees. Alternative G-2 has the potential to permanently attain the cleanup goal; however, Alternative G-1 depends on groundwater use controls for its long-term effectiveness. Therefore, Alternative G-2 ranks higher than G-1 under long-term effectiveness and permanence.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives G-0 and G-1 do not employ any treatment. However, there would most likely be some reduction in toxicity (i.e., concentrations) of lead over time due to natural attenuation, but this process would only be assessed via monitoring under Alternative G-1. Alternative G-2 would employ active treatment to achieve a reduction in toxicity.

5.2.5 Short-Term Effectiveness

There are no relevant short-term effectiveness issues for Alternative G-0. Alternative G-1 would be effective in terms of short-term risks to workers, the community and the environment. These risks would be adequately mitigated through adherence to OSHA regulations and site-specific health and safety procedures. Alternative G-2 poses slightly more short-term concerns to workers during the treatment process because of the injection process and handling of a caustic chemical; however, these concerns can also be adequately mitigated with site-specific health and safety procedures. Alternative G-1 would achieve the groundwater RAO immediately upon implementation of groundwater use controls. Eventual compliance of Alternative G-1 with the groundwater cleanup goal would be determined through monitoring. Alternative G-2 would also achieve the groundwater RAO immediately upon implementation of groundwater use controls. Alternative G-2 should attain groundwater cleanup goals (assuming the bench-scale treatability study verifies its effectiveness) following two rounds of treatment within 2 years.

5.2.6 Implementability

Alternative G-0 is readily implementable because there is no action to implement. Alternative G-1 involves more administrative implementability requirements (because of the need to indefinitely maintain groundwater use controls), whereas Alternative G-2 involves more technical implementability requirements associated with in-situ treatment.

5.2.7 Cost

The capital costs, NPW of O&M costs and NPWs of the alternatives are as follows. Detailed cost estimates are provided in Appendix C.

Alternative	Capital ($)	NPW of O&M ($)	NPW of Alternative($)
G-0	0	0	0
G-1	114,000	92,000 (30-year)	206,000 (30-year)
G-2	286,000	41,000 (2-year)	327,000 (2 year)

5.3 SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the soil remedial alternatives. Table 5-2 summarizes the comparative analysis of the groundwater remedial alternatives.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES
SITE 43 FEASIBILITY STUDY REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

Evaluation Criteria	Alternative S-0: No Action	Alternative S-1: Excavation and Off-site Disposal to Meet Florida Industrial/Commercial SCTLs and LUCs	Alternative S-2: Excavation and Off-site Disposal to Meet Florida Residential SCTLs	Alternative S-3: Limited Excavation and Off-site Disposal and Maintenance of Pavement to Meet Florida Industrial/ Commercial SCTLs; and LUCs
Overall Protection of Human Health and Environment	Not protective	Protective	More protective than Alternative S-1	Would be somewhat less protective than Alternative S-1
Compliance with Chemical-Specific ARARs and TBCs	Would not comply	Would comply	Would comply	Would comply
Compliance with Location-Specific ARARs and TBCs	Would not comply	Would comply	Would comply	Would comply
Compliance with Action-Specific ARARs and TBCs	Not applicable	Would comply	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	More effective than Alternative S-1	Somewhat less effective than Alternative S-1
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	Treatment of a portion of soil determined to be hazardous	Treatment of a potentially greater volume of hazardous soil	Treatment of a smaller portion of soil determined to be hazardous compared to Alternative S-1
Short-Term Effectiveness	No relevant issues to address	Would be effective. Minimum potential for short-term risks. Would attain RAOs in 6 months.	Would be effective. Greater potential for short-term risks than Alternative S-1. Would attain RAOs in 6 months.	Would be effective. Least potential for short-term risks among all alternatives. Would attain RAOs in 6 months
Implementability	Nothing to implement	Poses long-term administrative concerns	Poses short-term technical concerns	Poses long-term administrative and maintenance concern
Costs:				
Capital	$0	$348,000	$706,000	$180,000
NPW of O&M	$0	$77,000	NA	$96,000
NPW	$0	$425,000	NA	$276,000

NOTES:

ARARs Applicable or Relevant and Appropriate Requirements
LUCs Land use controls
NPW Net present worth
O&M Operation and maintenance
RAOs Remedial Action Objectives
TBCs To Be Considered (criteria)

TABLE 5-2

SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES
SITE 43 FEASIBILITY STUDY REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

Evaluation Criteria	Alternative GW-0: No Action	Alternative G-1: Land Use Controls (groundwater use restrictions) and Long-Term Monitoring	Alternative G-2: In-situ Groundwater Treatment and Short-Term Land Use Controls (groundwater use restrictions) with Monitoring
Overall Protection of Human Health and Environment	Not protective	Protective	More protective
Compliance with Chemical-Specific ARARs and TBCs	Would not comply	Would eventually comply	Would comply
Compliance with Location-Specific ARARs and TBCs	Would not comply	Would comply	Would comply
Compliance with Action-Specific ARARs and TBCs	Not applicable	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	More effective than G-1
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	None	Reduces toxicity
Short-Term Effectiveness	No relevant issues to address	Would be effective. Minimum potential for short-term risks. The RAO would be met immediately and eventual compliance with the cleanup goal would be determined by monitoring.	Would be effective. Short-term risks can be adequately addressed. The RAO would be met immediately. Treatment goals would be attained within 2 years.
Implementability	Nothing to implement	Readily implementable, although long-term administrative controls would be required.	Somewhat more difficult to implement technically compared to G-1. However, no long-term administrative concerns exist.
Costs:			
Capital	$0	$ 114,000	$ 286,000
NPW of O&M	$0	$92,000	$21,000
NPW	$0	$206,000	$327,000

NOTES:

O&M Operation and maintenance
ARARs Applicable or Relevant and Appropriate Requirements
LUCs Land use controls
TBCs To be considered (criteria)
NPW Net present worth

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APPENDIX A

SOIL AND GROUNDWATER DATABASE PRINTOUT

TABLE A-1

SURFACE SOIL ANALYTICAL RESULTS SUMMARY
SITE 43 REMEDIAL INVESTIGATION REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

LOCATION	FLORIDA CRITERIA			PEN-43-SS18	PEN-43-SS18	PEN-43-SS19	PEN-43-SS20	PEN-43-SS21	PEN-43-SS22	PEN-43-SS23	PEN-43-SS24	PEN-43-SS25	PEN-43-SS26	PEN-43-SS27
SAMPLE NAME				PEN-43-SS1801	PEN-43-SS1801-D	PEN-43-SS1901	PEN-43-SS2001	PEN-43-SS2101	PEN-43-SS2201	PEN-43-SS2301	PEN-43-SS2401	PEN-43-SS2501	PEN-43-SS2601	PEN-43-SS2701
SAMPLE DATE	DIRECT	DIRECT	LEACHING	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05
DEPTH RANGE (Feet below land surface)	EXPOSURE	EXPOSURE	TO	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
SEMIVOLATILE ORGANICS (µg/kg)	RESIDENTIAL	INDUSTRIAL	GROUNDWATER											
1-METHYLNAPHTHALENE	200000	1800000	3100	11 UJ	12 UJ	11 UJ	11 UJ	11 UJ	11 UJ	11 UJ	3 J	2 U	2 U	11 UJ
2-METHYLNAPHTHALENE	210000	2100000	8500	0.6 U	0.7 U	0.6 U	0.6 U	0.6 UJ	0.6 UJ	0.6 UJ	9 J	8 J	8 J	2 J
ACENAPHTHENE	2400000	20000000	2100	0.8 U	0.8 U	0.7 U	0.8 U	0.7 U	0.7 U	0.8 U	3 J	2 J	3 J	0.8 U
ACENAPHTHYLENE	1800000	20000000	27000	4 J	4 J	7 J	8 J	2 J	0.6 UJ	0.6 UJ	9 J	11 J	0.7 U	2 J
ANTHRACENE	21000000	300000000	2500000	4 J	10 J	2 J	2 J	3 J	0.8 U	1 J	16 J	13 J	13 J	5 J
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	49 J	38 J	24 J	19 J	17 J	2 UJ	6 J	86	68	29	30 J
BIS(2-ETHYLHEXYL)PHTHALATE	72000	390000	3600000	82 U	190 J	79 U	84 U	79 U	79 U	83 U	89 U	91 U	96 U	81 U
DI-N-BUTYL PHTHALATE	8200000	170000000	47000	93 U	100 U	90 U	1200	930	89 U	94 U	100 U	100 U	110 U	91 U
FLUORANTHENE	3200000	59000000	1200000	160	170	59	62	57	5 J	31	280 J	260 J	140	75
FLUORENE	2600000	33000000	160000	0.7 U	3 J	0.6 U	0.7 U	0.6 U	0.6 U	0.7 U	0.7 U	0.7 U	0.8 U	0.7 U
NAPHTHALENE	55000	300000	1200	1 J	1 J	1 J	1 U	1 J	0.9 U	1 U	1 U	1 U	1 U	3 J
PHENANTHRENE	2200000	36000000	250000	43 J	76 J	9 J	10 J	17 J	2 J	8 J	71	62	48	33
PYRENE	2400000	45000000	880000	130	120	46	57	39	4 J	17 J	190	180	86	46
CARCINOGENIC PAHs (µg/kg)														
BENZO(A)ANTHRACENE	NC	NC	800	120 J	110 J	59 J	66 J	39	8 J	19 J	310 J	280 J	120 J	58 J
BENZO(A)PYRENE	100	700	8000	95	78	46	49	36	0.8 U	12 J	160 [R]	150 [R]	62	46
BENZO(B)FLUORANTHENE	NC	NC	2400	210	180	100	110	76	11 J	33	390 J	340 J	140	94
BENZO(K)FLUORANTHENE	NC	NC	24000	61 J	48 J	29 J	34 J	24	3 J	9 J	110	130	46	26 J
CHRYSENE	NC	NC	77000	86	72	35	41	28	3 J	13 J	160	140	60	42
DIBENZO(A,H)ANTHRACENE	NC	NC	700	13 J	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	36	30	13 J	2 UJ
INDENO(1,2,3-CD)PYRENE	NC	NC	6600	49 J	46 J	27 J	24 J	19 J	2 UJ	7 J	98	84	35	30 J
BAP EQUIVALENT	100	700	NC	147 [R]	114	67	71	52	5	20	277 [R]	252 [R]	105 [R]	67
METALS (mg/kg)														
ARSENIC	2.1	12	NC	1.3	1.2	3.5 [R]	1.8	4.2 [R]	0.23 U	1.2	7.6 [R]	4.8 [R]	2	6.0 [R]
BARIUM	120	130000	1600	9.3	10.4	6.6	12.6	710 [R]	2.2	3.4	346 [R]	243 [R]	25.3	310 [R]
COPPER	150	89000	NC	6.7	7.6	29.1	5.4	240 [R]	3.2	5.4	889 [R]	381 [R]	60.5	Not Analyzed
LEAD	400	1400	NC	32.0	37.7	88.0	30.4	2080 [R],[I]	17.1	17.6	1990 [R],[I]	1490 [R],[I]	290	3850 [R],[I]
VANADIUM	67	10000	980	7.0	6.2	6.7	11.6	5.7	1.4	5.9	Not Analyzed	Not Analyzed	Not Analyzed	10.0

Notes:
J = estimated value.
U = less than laboratory method detection limit.
Shaded values exceed critieria - [R] = Residential, [I] = Industrial, [L] = Leaching
NC = No Criteria Established in 62-777, FAC
µg/kg = micrograms per kilogram
PAHs = Polynuclear Aromatic Hydrocarbons
BAP EQUIVALENT = Benzo(a)pyrene equivalent concentration
mg/kg = milligrams per kilogram

TABLE A-1

SURFACE SOIL ANALYTICAL RESULTS SUMMARY
SITE 43 REMEDIAL INVESTIGATION REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

LOCATION	FLORIDA CRITERIA			PEN-43-SS28	PEN-43-SS29	PEN-43-SS30	PEN-43-SS31	PEN-43-SS32	PEN-43-SS33	PEN-43-SS34	PEN-43-SS35	PEN-43-SS36	PEN-43-SS37
SAMPLE NAME				PEN-43-SS2801	PEN-43-SS2901	PEN-43-SS3001	PEN-43-SS3101	PEN-43-SS3201	PEN-43-SS3301	PEN-43-SS3401	PEN-43-SS3501	PEN-43-SS3601	PEN-43-SS3701
SAMPLE DATE	DIRECT	DIRECT	LEACHING	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05	03/06/05
DEPTH RANGE (Feet below land surface)	EXPOSURE	EXPOSURE	TO	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
SEMIVOLATILE ORGANICS (µg/kg)	RESIDENTIAL	INDUSTRIAL	GROUNDWATER										
1-METHYLNAPHTHALENE	200000	1800000	3100	11 UJ	11 UJ	11 UJ	11 UJ	11 UJ	2 U	2 U	11 UJ	11 UJ	11 UJ
2-METHYLNAPHTHALENE	210000	2100000	8500	3 J	2 J	0.6 U	0.6 UJ	0.6 U	0.6 U	6 J	0.6 U	0.6 U	0.6 U
ACENAPHTHENE	2400000	20000000	2100	1 J	0.8 U	0.7 U	0.8 U	0.7 U	0.8 U	0.8 U	0.8 U	0.7 U	2 J
ACENAPHTHYLENE	1800000	20000000	27000	7 J	1 J	0.6 U	0.6 UJ	0.6 U	1 J	2 J	0.6 U	0.6 U	0.6 U
ANTHRACENE	21000000	300000000	2500000	17 J	3 J	1 J	0.9 U	0.9 J	2 J	2 J	1 J	0.9 U	4 J
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	110 J	10 J	5 J	4 J	4 J	7 J	21 J	6 J	5 J	6 J
BIS(2-ETHYLHEXYL)PHTHALATE	72000	390000	3600000	83 U	80 U	79 U	80 U	79 U	82 U	84 U	870	79 U	110 J
DI-N-BUTYL PHTHALATE	8200000	170000000	47000	94 U	91 U	90 U	91 U	90 U	93 U	95 U	91 U	90 U	91 U
FLUORANTHENE	3200000	59000000	1200000	270	44	22	16 J	21 J	45	62	21 J	15 J	38
FLUORENE	2600000	33000000	160000	0.7 U	0.6 U	0.6 U	0.6 U	0.6 U	0.7 U	0.7 U	0.6 U	0.6 U	0.7 U
NAPHTHALENE	55000	300000	1200	3 J	2 J	1 J	1 J	0.9 U	1 U	1 U	1 U	1 U	1 J
PHENANTHRENE	2200000	36000000	250000	85	18 J	7 J	5 J	6 J	10 J	15 J	6 J	6 J	24
PYRENE	2400000	45000000	880000	180	24	11 J	9 J	10 J	24	38	12 J	7 J	23
CARCINOGENIC PAHs (µg/kg)													
BENZO(A)ANTHRACENE	NC	NC	800	230 J	31 J	16 J	13 J	13 J	29 J	55 J	16 J	12 J	22 J
BENZO(A)PYRENE	100	700	8000	180 [R]	20 J	10 J	8 J	8 J	18 J	35	10 J	6 J	14 J
BENZO(B)FLUORANTHENE	NC	NC	2400	410	44	24	22	23	48	83	27	16 J	32
BENZO(K)FLUORANTHENE	NC	NC	24000	92 J	12 J	7 J	5 J	6 J	16 J	23	7 J	4 J	9 J
CHRYSENE	NC	NC	77000	150	18 J	8 J	7 J	8 J	17 J	30	9 J	6 J	13 J
DIBENZO(A,H)ANTHRACENE	NC	NC	700	34 J	2 UJ	2 UJ	2 UJ	2 UJ	2 U	12 J	2 UJ	2 UJ	2 UJ
INDENO(1,2,3-CD)PYRENE	NC	NC	6600	90 J	12 J	7 J	5 J	5 J	11 J	22 J	6 J	4 J	6 J
BAP EQUIVALENT	100	700	NC	288 [R]	31	17	14	14	28	63	17	11	22
METALS (mg/kg)													
ARSENIC	2.1	12	NC	8.0 [R]	1.4	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
BARIUM	120	130000	1600	726 [R]	61.7	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
COPPER	150	89000	NC	Not Analyzed	Not Analyzed	1.7	8.2	3.9	17	261 [R]	12.2	7.0	4.5
LEAD	400	1400	NC	7360 [R],[I]	417 [R]	10.7	32.5	28.0	68.7	500 [R]	Not Analyzed	Not Analyzed	Not Analyzed
VANADIUM	67	10000	980	73.1 [R]	4.1	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed

Notes:
J = estimated value.
U = less than laboratory method detection limit.
Shaded values exceed critieria - [R] = Residential, [I] = Industrial, [L] = Leaching
NC = No Criteria Established in 62-777, FAC
µg/kg = micrograms per kilogram
PAHs = Polynuclear Aromatic Hydrocarbons
BAP EQUIVALENT = Benzo(a)pyrene equivalent concentration
mg/kg = milligrams per kilogram

TABLE A-2

SUBSURFACE SOIL ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION
NAS PENSACOLA
PENSACOLA, FLORIDA

LOCATION	FLORIDA CRITERIA			PEN-43-SB06	PEN-43-SB06	PEN-43-SB07	PEN-43-SB07	PEN-43-SB08	PEN-43-SB08	PEN-43-SB09	PEN-43-SB09	PEN-43-SB10	PEN-43-SB10	PEN-43-SB11	PEN-43-SB11	PEN-43-SB11	PEN-43-SB12
SAMPLE NAME				PEN-43-SB0601	PEN-43-SB0602	PEN-43-SB0701	PEN-43-SB0702	PEN-43-SB0801	PEN-43-SB0802	PEN-43-SB0901	PEN-43-SB0902	PEN-43-SB1001	PEN-43-SB1002	PEN-43-SB1101	PEN-43-SB1102	PEN-43-SB1102-D	PEN-43-SB1201
SAMPLE DATE	DIRECT	DIRECT	LEACHING	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/03/05	03/04/05	03/04/05	03/04/05	03/04/05
DEPTH RANGE (FT)	EXPOSURE	EXPOSURE	TO	**3 - 4**	**7 - 9**	**3 - 4**	**7 - 9**	**2 - 3**	**6 - 8**	**2 - 3**	**6 - 8**	**2 - 3**	**6 - 8**	**2 - 3**	**5 - 7**	**5 - 7**	**2 - 3**
SEMIVOLATILE ORGANICS (UG/KG)	RESIDENTIAL	INDUSTRIAL	GROUNDWATER														
1,1-BIPHENYL	3000000	34000000	200	180 U	180 U	180 U	170 U	170 U	170 UJ	180 U	170 U	170 U	170 U	190 U	170 U	170 U	180 U
1-METHYLNAPHTHALENE	200000	1800000	3100	11 U	11 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 UJ	10 U	11 UJ
2-METHYLNAPHTHALENE	210000	2100000	8500	1 J	0.6 U	0.6 U	0.6 U	1 J	0.6 U	2 J	0.6 U	0.6 U	0.6 U	3 J	0.6 U	0.6 U	0.6 U
ACENAPHTHENE	2400000	20000000	2100	0.8 U	0.7 U	0.8 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	3 J	0.7 U	0.7 U	0.8 U
ACENAPHTHYLENE	1800000	20000000	27000	0.6 U	0.6 U	0.6 U	0.6 U	2 J	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	8 J	0.6 U	0.6 U	0.6 U
ANTHRACENE	21000000	300000000	2500000	8 J	0.9 U	0.9 U	0.8 U	2 J	0.8 U	0.9 U	0.8 U	0.8 U	0.8 U	15 J	0.8 U	0.8 U	2 J
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	40	2 UJ	2 U	2 UJ	7 J	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	110 J	2 UJ	2 U	7 J
CARBAZOLE	49000	240000	200	65 U	64 U	64 U	63 U	63 U	63 UJ	64 U	63 U	63 U	63 U	68 U	63 U	63 U	64 U
DI-N-BUTYL PHTHALATE	8200000	170000000	47000	92 U	90 U	91 U	89 U	89 U	650 J	1200	88 U	89 U	89 U	95 U	88 U	89 U	91 U
DIBENZOFURAN	320000	63000000	15000	67 U	66 U	67 U	65 U	66 U	66 UJ	66 U	65 U	65 U	65 U	70 U	65 U	66 U	67 U
FLUORANTHENE	3200000	59000000	1200000	86	2 U	2 U	2 U	30	4 J	8 J	2 U	2 J	2 U	280	2 U	2 U	18 J
FLUORENE	2600000	33000000	160000	0.7 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	2 J	0.6 U	0.6 U	0.6 U
ISOPHORONE	540000	1200000	200	56 U	55 U	56 U	55 U	55 U	55 UJ	56 U	54 U	55 U	55 U	59 U	55 U	55 U	56 U
NAPHTHALENE	55000	300000	1200	2 J	0.9 U	1 U	0.9 U	1 J	0.9 U	1 J	2 J	0.9 U	0.9 U	4 J	0.9 U	0.9 U	1 U
PHENANTHRENE	2200000	36000000	250000	38	2 U	2 U	2 U	12 J	3 J	4 J	2 U	2 U	2 U	58	2 U	2 U	8 J
PYRENE	2400000	45000000	880000	74	2 UJ	2 U	2 UJ	20 J	3 J	5 J	2 UJ	2 UJ	2 UJ	230	2 U	2 U	13 J
CARCINOGENIC PAHs (UG/KG)																	
BENZO(A)ANTHRACENE	NC	NC	800	56	1 U	1 U	1 U	24	7 J	10 J	1 U	1 U	1 U	250	1 U	1 U	18 J
BENZO(A)PYRENE	100	700	8000	47	0.8 U	0.8 U	0.8 U	19 J	0.8 U	4 J	0.8 U	0.8 U	0.8 U	280 [R]	0.8 U	0.8 U	12 J
BENZO(B)FLUORANTHENE	NC	NC	2400	57 J	2 U	2 UJ	2 U	42	7 J	13 J	2 U	2 U	2 U	460 J	2 UJ	2 U	25 J
BENZO(K)FLUORANTHENE	NC	NC	24000	24	1 U	1 U	1 U	13 J	1 J	3 J	1 U	1 U	1 U	96 J	1 U	1 U	7 J
CHRYSENE	NC	NC	77000	50	1 U	1 U	1 U	16 J	2 J	4 J	1 U	1 U	1 U	190	1 U	1 U	10 J
DIBENZO(A,H)ANTHRACENE	NC	NC	700	15 J	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
INDENO(1,2,3-CD)PYRENE	NC	NC	6600	30	2 U	2 U	2 U	8 J	2 U	2 U	2 U	2 U	2 U	91 J	2 UJ	2 U	5 J
BAP EQUIVALENT	100	700	NC	77	0.8 U	0.8 U	0.8 U	28	3	7	0.8 U	0.8 U	0.8 U	362	0.8 U	0.8 U	18
METALS (MG/KG)																	
ARSENIC	2.1	12	NC	2.6 J [R]	0.35 J	0.36 J	0.17 UJ	1.8 J	0.29 J	1.3 J	0.29 J	0.31 J	0.20 UJ	4.2 [R]	0.21 U	0.31	0.20 U
BARIUM	120	130000	1600	188 J [R]	17.4 J	2.1 J	1.9 J	138 J [R]	15.7 J	13.6 J	1.4 J	1.4 J	2.2 J	306 J [R]	1.5 J	15.1 J	58.6 J
COPPER	150	89000	NC	529 J [R]	3.2 J	1.5 J	1.1 J	300 J [R]	74.7 J	26.6 J	0.70 J	0.70 J	0.86 J	3380 [R]	0.74	2.2	22.5
LEAD	400	1400	NC	519 [R]	6.7	1.8	1.0	427 [R]	20.9	109	0.90	1.3	0.82	1370 J [R]	1.4 J	4.0 J	87.7 J
VANADIUM	67	10000	980	18.5	2.5	2.3	1.7	6.5	2.9	2.3	2.1	2.2	2.2	8.0	2.4	2.3	2.3

Notes:
J = estimated value.
U = less than laboratory method detection limit.
Shaded values exceed critieria - [R] = Residential, [I] = Industrial, [L] = Leaching
NC = No Criteria Established in 62-777, FAC
µg/kg = micrograms per kilogram
PAHs = Polynuclear Aromatic Hydrocarbons
BAP EQUIVALENT = Benzo(a)pyrene equivalent concentration
mg/kg = milligrams per kilogram

TABLE A-2

SUBSURFACE SOIL ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION
NAS PENSACOLA
PENSACOLA, FLORIDA

LOCATION	FLORIDA CRITERIA			PEN-43-SB12	PEN-43-SB13	PEN-43-SB13	PEN-43-SB14	PEN-43-SB14	PEN-43-SB15	PEN-43-SB15	PEN-43-SB16	PEN-43-SB16	PEN-43-SB17	PEN-43-SB17	PEN-43-SB18	PEN-43-SB18	PEN-43-SB19
SAMPLE NAME				PEN-43-SB1202	PEN-43-SB1301	PEN-43-SB1302	PEN-43-SB1401	PEN-43-SB1402	PEN-43-SB1501	PEN-43-SB1502	PEN-43-SB1601	PEN-43-SB1602	PEN-43-SB1701	PEN-43-SB1702	PEN-43-SB1801	PEN-43-SB1802	PEN-43-SB1901
SAMPLE DATE	DIRECT	DIRECT	LEACHING	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05
DEPTH RANGE (FT)	EXPOSURE	EXPOSURE	TO	**7 - 9**	**2 - 3**	**5 - 7**	**2 - 3**	**4 - 5**	**2 - 3**	**7 - 9**	**2 - 3**	**7 - 9**	**2 - 3**	**5 - 7**	**2 - 3**	**7 - 9**	**2 - 3**
SEMIVOLATILE ORGANICS (UG/KG)	RESIDENTIAL	INDUSTRIAL	GROUNDWATER														
1,1-BIPHENYL	3000000	34000000	200	180 U	170 U	180 U	280 J [L]	180 U	170 U	170 U	170 U	180 U	180 U	170 U	180 U	170 U	170 U
1-METHYLNAPHTHALENE	200000	1800000	3100	11 UJ	10 UJ	11 UJ	540 J	11 U	10 UJ	10 U	10 U	11 U	2 J	10 U	11 U	10 U	10 U
2-METHYLNAPHTHALENE	210000	2100000	8500	0.6 U	0.6 U	0.6 U	670	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	2 J	0.6 U	0.6 U	0.6 U	0.6 U
ACENAPHTHENE	2400000	20000000	2100	0.8 U	0.7 U	0.7 U	1800	0.8 U	0.7 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.8 U	0.7 U	0.7 U
ACENAPHTHYLENE	1800000	20000000	27000	0.6 U	0.6 U	0.6 U	6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	7 J	0.6 U	0.6 U	0.6 U	0.6 U
ANTHRACENE	21000000	300000000	2500000	0.9 U	0.8 U	0.9 U	8000	0.9 U	0.8 U	0.8 U	0.8 U	0.9 U	7 J	0.8 U	0.9 U	0.8 U	0.9 J
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	2 UJ	2 UJ	2 UJ	4600 J	2 U	2 UJ	2 U	2 U	2 U	150 J	2 U	2 U	2 U	2 U
CARBAZOLE	49000	240000	200	64 U	63 U	64 U	2800 [L]	65 U	63 U	63 U	63 U	66 U	66 U	63 U	64 U	64 U	63 U
DI-N-BUTYL PHTHALATE	8200000	170000000	47000	90 U	89 U	90 U	98 U	91 U	89 U	88 U	88 U	93 U	93 U	88 U	90 U	89 U	89 U
DIBENZOFURAN	320000	63000000	15000	66 U	66 U	66 U	1700	67 U	66 U	65 U	65 U	68 U	68 U	65 U	66 U	66 U	65 U
FLUORANTHENE	3200000	59000000	1200000	4 J	2 U	2 U	30000	2 U	2 U	2 U	2 U	2 U	160	2 U	2 J	2 U	5 J
FLUORENE	2600000	33000000	160000	0.6 U	0.6 U	0.6 U	1700	0.6 U	0.6 U	0.6 U	0.6 U	0.7 U	0.7 U	0.6 U	0.6 U	0.6 U	0.6 U
ISOPHORONE	540000	1200000	200	56 U	55 U	56 U	60 U	56 U	55 U	54 U	54 U	58 U	57 U	55 U	56 U	55 U	55 U
NAPHTHALENE	55000	300000	1200	1 U	0.9 U	1 U	2400 J [L]	1 U	0.9 U	0.9 U	0.9 U	1 U	2 J	0.9 U	1 U	0.9 U	0.9 U
PHENANTHRENE	2200000	36000000	250000	2 J	2 U	2 U	28000	2 U	2 U	2 U	2 U	2 U	34	2 U	2 U	2 U	4 J
PYRENE	2400000	45000000	880000	3 J	2 U	2 U	17000 J	2 UJ	2 U	2 UJ	2 UJ	2 UJ	110 J	2 UJ	2 UJ	2 UJ	3 J
CARCINOGENIC PAHs (UG/KG)																	
BENZO(A)ANTHRACENE	NC	NC	800	8 J	1 U	1 U	15000 J [L]	1 U	1 U	1 U	1 U	1 U	320 J	1 U	7 J	6 J	7 J
BENZO(A)PYRENE	100	700	8000	2 J	0.8 U	0.8 U	10000 [R],[L]	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	340 [R]	0.8 U	0.8 U	0.8 U	0.8 U
BENZO(B)FLUORANTHENE	NC	NC	2400	8 J	2 UJ	2 UJ	16000 J [L]	2 U	2 UJ	2 U	2 U	2 U	670 J	2 U	2 U	2 U	2 U
BENZO(K)FLUORANTHENE	NC	NC	24000	2 J	1 U	1 U	5700	1 UJ	1 U	1 UJ	1 UJ	1 UJ	130	1 UJ	1 UJ	1 UJ	1 UJ
CHRYSENE	NC	NC	77000	3 J	1 U	1 U	8700 J	1 U	1 U	1 U	1 U	1 U	170	1 U	1 J	1 U	1 U
DIBENZO(A,H)ANTHRACENE	NC	NC	700	2 U	2 U	2 U	1100 [L]	2 UJ	2 U	2 UJ	2 UJ	2 UJ	36	2 UJ	2 UJ	2 UJ	2 UJ
INDENO(1,2,3-CD)PYRENE	NC	NC	6600	1 J	2 UJ	2 UJ	5000	2 U	2 UJ	2 U	2 U	2 U	150	2 U	2 U	2 U	2 U
BAP EQUIVALENT	100	700	NC	5	0.8 U	0.8 U	14766	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	491	0.8 U	3	3	3
METALS (MG/KG)																	
ARSENIC	2.1	12	NC	0.56	0.24 U	0.38	11.4 [R]	0.25	0.35	0.25 U	0.32	0.24 U	7.3 [R]	0.32	0.41	0.50	0.33
BARIUM	120	130000	1600	10.0 J	1.3 J	1.4 J	939 J [R]	7.6 J	7.7 J	3.7 J	14.1 J	4.8 J	366 J [R]	1.1 J	2.8 J	1.8 J	1.6 J
COPPER	150	89000	NC	10.6 J	0.95	0.63	1220 [R]	5.1	1.4	0.94	1.5	1.1	500 [R]	0.54	1.7	1.2	0.45
LEAD	400	1400	NC	37.5 J	1.1 J	0.58 U	5500 J [R],[I]	9.6 J	3.2 J	1.3 J	1.2 J	2.4 J	1460 J [R],[I]	0.96 J	6.5 J	2.8 J	0.81 J
VANADIUM	67	10000	980	3.0	1.9	1.6	156 [R]	6.2	2.2	1.6	38.2	26.4	40.1	1.8	1.8	2.2	2.4

Notes:
J = estimated value.
U = less than laboratory method detection limit.
Shaded values exceed critieria - [R] = Residential, [I] = Industrial, [L] = Leaching
NC = No Criteria Established in 62-777, FAC
µg/kg = micrograms per kilogram
PAHs = Polynuclear Aromatic Hydrocarbons
BAP EQUIVALENT = Benzo(a)pyrene equivalent concentration
mg/kg = milligrams per kilogram

TABLE A-2

SUBSURFACE SOIL ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION
NAS PENSACOLA
PENSACOLA, FLORIDA

LOCATION	FLORIDA CRITERIA			PEN-43-SB19	PEN-43-SB20	PEN-43-SB20	PEN-43-SB21	PEN-43-SB21	PEN-43-SB22	PEN-43-SB22	PEN-43-SB23	PEN-43-SB23	PEN-43-SB24	PEN-43-SB24	PEN-43-SB25	PEN-43-SB25	PEN-43-SB25
SAMPLE NAME				PEN-43-SB1902	PEN-43-SB2001	PEN-43-SB2002	PEN-43-SB2101	PEN-43-SB2102	PEN-43-SB2201	PEN-43-SB2202	PEN-43-SB2301	PEN-43-SB2302	PEN-43-SB2401	PEN-43-SB2402	PEN-43-SB2501	PEN-43-SB2501-D	PEN-43-SB2502
SAMPLE DATE	DIRECT	DIRECT	LEACHING	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/04/05	03/06/05	03/06/05	03/04/05	03/04/05	03/04/05
DEPTH RANGE (FT)	EXPOSURE	EXPOSURE	TO	**6 - 8**	**2 - 3**	**5 - 7**	**2 - 3**	**5 - 7**	**2 - 3**	**7 - 9**	**2 - 3**	**6 - 8**	**2 - 3**	**5 - 7**	**2 - 3**	**2 - 3**	**4 - 5**
SEMIVOLATILE ORGANICS (UG/KG)	RESIDENTIAL	INDUSTRIAL	GROUNDWATER														
1,1-BIPHENYL	3000000	34000000	200	170 U	170 U	170 U	180 U	180 U	170 U	180 U	180 U	170 U	170 U	170 U	180 U	180 U	170 U
1-METHYLNAPHTHALENE	200000	1800000	3100	10 U	2 U	10 U	11 U	11 U	2 U	11 UJ	11 UJ	10 UJ	10 UJ	10 UJ	2 U	2 U	2 U
2-METHYLNAPHTHALENE	210000	2100000	8500	0.6 U	0.6 U	0.6 U	0.6 U	5 J	0.6 U	0.6 UJ	0.6 UJ	0.6 U	0.6 UJ	0.6 UJ	8 J	10 J	5 J
ACENAPHTHENE	2400000	20000000	2100	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.8 U	0.7 U	0.7 U	0.7 U	1 J	2 J	0.7 U
ACENAPHTHYLENE	1800000	20000000	27000	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 UJ	0.6 UJ	0.6 U	0.6 UJ	0.6 UJ	2 J	3 J	0.6 U
ANTHRACENE	21000000	300000000	2500000	0.8 U	0.8 U	0.8 U	0.9 U	0.9 U	0.8 U	0.9 U	0.9 U	0.8 U	0.8 U	0.8 U	7 J	8 J	0.8 U
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	2 U	2 UJ	2 U	2 U	2 U	2 U	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	30	30	2 U
CARBAZOLE	49000	240000	200	63 U	63 U	63 U	64 U	64 U	63 U	64 U	65 U	64 U	63 U	64 U	66 U	67 U	63 U
DI-N-BUTYL PHTHALATE	8200000	170000000	47000	1000 J	89 U	89 U	90 U	90 U	89 U	90 U	91 U	1200	89 U	89 U	93 U	94 U	88 U
DIBENZOFURAN	320000	63000000	15000	65 U	66 U	65 U	66 U	66 U	66 U	66 U	67 U	66 U	65 U	66 U	69 U	69 U	65 U
FLUORANTHENE	3200000	59000000	1200000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 J	2 U	8 J	2 U	100	110	2 U
FLUORENE	2600000	33000000	160000	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.7 U	0.7 U	0.6 U
ISOPHORONE	540000	1200000	200	55 U	55 U	55 U	56 U	55 U	55 U	55 U	56 U	55 U	55 U	55 U	58 U	58 U	54 U
NAPHTHALENE	55000	300000	1200	0.9 U	0.9 U	0.9 U	1 U	0.9 U	0.9 U	1 J	1 U	0.9 U	0.9 U	0.9 U	1 U	1 U	0.9 U
PHENANTHRENE	2200000	36000000	250000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 J	2 U	34	36	2 U
PYRENE	2400000	45000000	880000	2 UJ	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	4 J	2 U	61	74	2 U
CARCINOGENIC PAHs (UG/KG)																	
BENZO(A)ANTHRACENE	NC	NC	800	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	6 J	1 UJ	7 J	1 U	89 J	100 J	1 UJ
BENZO(A)PYRENE	100	700	8000	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	2 J	0.8 U	52	60	0.8 U
BENZO(B)FLUORANTHENE	NC	NC	2400	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	8 J	2 U	100 J	180 J	2 U
BENZO(K)FLUORANTHENE	NC	NC	24000	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	2 J	1 U	32 J	9 J	1 U
CHRYSENE	NC	NC	77000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2 J	1 U	47	54	1 U
DIBENZO(A,H)ANTHRACENE	NC	NC	700	2 UJ	2 U	2 U	2 U	2 U	2 U	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	2 U	22	2 U
INDENO(1,2,3-CD)PYRENE	NC	NC	6600	2 U	2 U	2 U	2 U	2 U	2 U	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ	38	40	2 U
BAP EQUIVALENT	100	700	NC	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	3	0.8 U	6	0.8 U	76	114	0.8 U
METALS (MG/KG)																	
ARSENIC	2.1	12	NC	0.23 U	0.27 UJ	0.24 UJ	0.27 UJ	0.24 UJ	0.34 J	0.23 UJ	0.21 UJ	0.27	0.22 U	0.24 U	14.6 J [R],[I]	5.3 J [R]	0.25 UJ
BARIUM	120	130000	1600	0.56 J	2.4 J	0.32 U	1.8 J	0.92 J	2.0 J	1.5 J	4.0 J	1.0	1.5	1.7	884 J [R]	270 J [R]	10.8 J
COPPER	150	89000	NC	0.78	1.0 J	0.22 UJ	0.84 J	0.45 J	0.60 J	0.73 J	1.7 J	0.26	0.74	0.55	448 J [R]	930 J [R]	8.2 J
LEAD	400	1400	NC	0.56 U	1.8	0.24	0.96	0.71	1.0	0.62	2.1	0.50	1.3	2.0	1340 [R]	1390 [R]	1.1
VANADIUM	67	10000	980	0.83	2.9	0.44 U	2.8	1.4	2.7	1.5	1.8	1.4	1.6	2.6	13.6	11.2	2.4

Notes:
J = estimated value.
U = less than laboratory method detection limit.
Shaded values exceed critieria - [R] = Residential, [I] = Industrial, [L] = Leaching
NC = No Criteria Established in 62-777, FAC
µg/kg = micrograms per kilogram
PAHs = Polynuclear Aromatic Hydrocarbons
BAP EQUIVALENT = Benzo(a)pyrene equivalent concentration
mg/kg = milligrams per kilogram

TABLE A-3

GROUNDWATER ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

SAMPLE NAME		NAS PENSACOLA	PEN-43-GW02S02	PEN-43-GW05D01	PEN-43-GW05S02	PEN-43-GW05S02-D	PEN-43-GW06D01
SAMPLE DATE	GCTL	BACKGROUND CONC.	03/24/05	03/24/05	03/24/05	03/24/05	03/24/05
DEPTH RANGE (FT)			15 - 25	45 - 50	10 - 20	10 - 20	45 - 50
VOLATILE ORGANICS (µg/L)							
ACETONE	6300	NA	2 UR	2 UR	2 UR	2 J	2 UR
CHLOROFORM	70	NA	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
TRICHLOROETHENE	3	NA	0.3 U	0.8 J	0.4 J	0.3 U	0.3 U
METALS (µg/L)							
BARIUM	2000	13.22	29	17.1	55.4	55.6	31.9
CALCIUM	NE	17,560	9910	6020	25800	25500	4350
CHROMIUM	100	34.98	1.6	1.6	2.8	3.6	3.3
COPPER	1000	16.2	2.52 U	2.52 U	2.52 U	2.52 U	2.52 U
IRON	300	1,707.80	192	1650	8 U	11.3 U	1540
LEAD	15	1.6	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U
MAGNESIUM	NE	2,872.50	651	2380	1540	1530	2720
MANGANESE	50	21.92	1.5	28.7	4.6	4.6	24.8
MERCURY	2	0.2	0.02	0.02 U	0.02 U	0.02 U	0.02 U
NICKEL	100	39.9	11.6 U	11.6 U	11.6 U	18.2	11.6 U
POTASSIUM	NE	12,167.60	1330	1200	1100	1080	1120
SODIUM	160000	18,345	20100	11600	32000	32600	11200
ZINC	5000	153.2	12.7 U	9.1 U	36.8	33.5	14.1 U

Notes:
Shaded value exceeds Groundwater Cleanup Target Level
NE = not established
NA = not applicable
U = less than laboratory method detection limit
J = estimated value
FT = feet
µg/L = micrograms per liter

TABLE A-3

GROUNDWATER ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

SAMPLE NAME		NAS PENSACOLA	PEN-43-GW06S01	PEN-43-GW09S01	PEN-43-GW10S01	PEN-43-GW11S01	PEN-43-GW12S01
SAMPLE DATE	GCTL	BACKGROUND CONC.	03/24/05	03/24/05	03/24/05	03/24/05	03/24/05
DEPTH RANGE (FT)			15 - 25	15 - 25	15 - 25	15 - 25	15 - 25
VOLATILE ORGANICS (µg/L)							
ACETONE	6300	NA	2 UR	3 J	5 J	2 UR	3 J
CHLOROFORM	70	NA	0.4 U	0.4 U	0.4 U	1 J	6
TRICHLOROETHENE	3	NA	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
METALS (µg/L)							
BARIUM	2000	13.22	17	29.7	18.9	40.7	75.2
CALCIUM	NE	17,560	15200	18100	20800	24800	56800
CHROMIUM	100	34.98	2.5	4.5	2.7	2.2	1.5
COPPER	1000	16.2	2.52 U	6	2.52 U	8.1	2.52 U
IRON	300	1,707.80	4000	2470	2280	866	31.3 U
LEAD	15	1.6	2.07 U	2.07 U	2.07 U	4	2.07 U
MAGNESIUM	NE	2,872.50	1900	1840	3730	2620	6580
MANGANESE	50	21.92	204	15.3	12.6	23.7	1.5
MERCURY	2	0.2	0.02 U	0.02 U	0.02	0.02 U	0.02
NICKEL	100	39.9	11.6 U	14.8	11.6	11.6 U	11.6 U
POTASSIUM	NE	12,167.60	1900	1450	3300	1430	3620
SODIUM	160000	18,345	9260	6610	12400	9150	31800
ZINC	5000	153.2	7.6 U	52.8	7.3 U	30 U	74

Notes:
Shaded value exceeds Groundwater Cleanup Target Level
NE = not established
NA = not applicable
U = less than laboratory method detection limit
J = estimated value
FT = feet
µg/L = micrograms per liter

TABLE A-3

GROUNDWATER ANALYTICAL SUMMARY
SITE 43 REMEDIAL INVESTIGATION REPORT
NAS PENSACOLA
PENSACOLA, FLORIDA

SAMPLE NAME		NAS PENSACOLA	PEN-43-GW13S01	PEN-43-MW07S01	PEN-43-MW08S01
SAMPLE DATE	GCTL	BACKGROUND CONC.	03/24/05	03/24/05	03/24/05
DEPTH RANGE (FT)			15 - 25	15 - 25	15 - 25
VOLATILE ORGANICS (µg/L)					
ACETONE	6300	NA	2 UR	2 UR	3 J
CHLOROFORM	70	NA	0.4 U	0.4 U	0.4 U
TRICHLOROETHENE	3	NA	0.3 U	0.3 U	0.3 U
METALS (µg/L)					
BARIUM	2000	13.22	32.7	32.6	30.9
CALCIUM	NE	17,560	24200	16400	23900
CHROMIUM	100	34.98	1.4	1.8	2.4
COPPER	1000	16.2	10.1	2.52 U	2.52 U
IRON	300	1,707.80	125 U	1490	238
LEAD	15	1.6	29.9	2.07 U	2.07 U
MAGNESIUM	NE	2,872.50	2290	3600	3820
MANGANESE	50	21.92	7.5	54.8	29.2
MERCURY	2	0.2	0.05	0.02	0.02
NICKEL	100	39.9	11.6 U	11.6 U	14.3
POTASSIUM	NE	12,167.60	1350	2350	3170
SODIUM	160000	18,345	20500	28000	21400
ZINC	5000	153.2	117	18 U	8.7 U

Notes:
Shaded value exceeds Groundwater Cleanup Target Level
NE = not established
NA = not applicable
U = less than laboratory method detection limit
J = estimated value
FT = feet
µg/L = micrograms per liter

APPENDIX B

CONCEPTUAL DESIGN CALCULATIONS

CLIENT:	NAVAL AIR STATION PENSACOLA	JOB NUMBER:	112G 00355
SUBJECT:	ESTIMATION OF IN-SITU CONTAMINATED SOIL VOLUMES, SITE 43 FEASIBILITY STUDY		
BASED ON:	Site 43 RI Data	DRAWING NUMBER:	Figures 4-1 and 4-2 of FS
BY: JPK	CHECKED BY:	APPROVED BY:	DATE:
Date: 2/20/07	Date:		

Area Designation	Area Qty (sq inches)	Area Qty (sq feet)
A1	14.14	12726
A2	9.16	8244
A3	1.14	1026
A4	0.42	378
A5	0.25	225
A6	0.25	225
A7	0.25	225
A8	0.25	225

Alternative S-0: No Action

Zero soil volume

Alternative S-1: Excavation and Off-Site Disposal of Soil to meet Florida Industrial/Commercial SCTLs, and LUCs

Area Designation->	A4			A6			A7			A8		
	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)
	378	0-4 ft	4	225	0-2 ft	2	225	2-4 ft	2	225	0-4 ft	4

Area Designation->	A4 In-situ Volume		A6 In-situ Volume		A7 In-situ Volume		A8 In-situ Volume	
	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)
	1512	56	450	17	450	17	900	33

Total in-situ volume to be addressed to meet Industrial/Commercial SCTLs= **123 cu yd**

Alternative S-2: Excavation and Off-Site Disposal to meet Florida Residential SCTLs

Area Designation->	A1-(A2+A3+A5+A6)			A2			A3		
	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)
	3005.55	0-4 ft	4	8244	2-4 ft	2	1026	0-2	2

	A5			A6			A8		
	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)	Area (sq ft)	Depth Range	Thickness (ft)
	225	0-2 ft	2	225	0-2	2	225	0-4 ft	4

Area Designation->	A1-(A2+A3+A5+A6) In-situ Volume		A2 In-situ Volume		A3 In-situ Volume		A5 In-situ Volume		A6 In-situ Volume		A8 In-situ Volume	
	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)	(cu ft)	(cu yd)
	12022.2	445	16488	611	2052	76	450	17	450	17	900	33

Total in-situ volume to be addressed to meet Residential SCTLs= **1199 cu yd**

CLIENT:	NAVAL AIR STATION PENSACOLA	JOB NUMBER:	112G 00355
SUBJECT:	ESTIMATION OF IN-SITU PRECIPITATION REQUIREMENTS, SITE 43 FEASIBILITY STUDY		
BASED ON:	Site 43 RI Data	DRAWING NUMBER:	Figure 4-4 of FS
BY: JPK	CHECKED BY:	APPROVED BY:	
Date: 2/20/07	Date:		DATE:

Assume aquifer thickness to be treated:			10	ft		
Assume two areas need to be treated (one around 43-13S, other may be in Anomaly 23).						
Assume each plume area:		50	ftx	50	ft	
Volume of plumes:	112,200	gallons				
Assume a 10-foot radus of influence per injection point						
Number of injection points required:			15.91549			
Assume a concentration of 1 mg/L of diammonium phosphate will be sufficient						
Obtain a concentrated solution and prepare 1% solution						
Volume of chemical to be injected:		11.22	gallons			
Assume 1 gallon per location to provide adequate coverage						
Test for ability of aquifer to disperse 1 gallon at each location within a day:						
Assume 10 foot injection interval and 2-inch diameter injection hole						
Sustainable flow rate= Surface area of injection holex groundwater flow velocity						
=	2 x pi() x r x l x v					
where:						
r=radius of injection hole	1	inch				
l= height of cylindrical injection hole	10	ft				
v=	0.88	ft/day (darcy flow velocity reported in RI, pg 3-11)				(TtNUS, Nov 2006)
Sustainable flow rate=	34.47	gal/day				
Therefore, 1 gpd can be easily dispersed through each injection point within 1 hr						
Assume a two-day injection event will be adequate for all 16 locations.						

APPENDIX C

COST ESTIMATES

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S1: Excavation and Offsite Disposal to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
1.2 Contractor Completion Report	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
2 INITIAL EXCAVATION AREA CHARACTERIZATION											
2.1 Utility Clearances	1	ls	$3,500.00				$3,500	$0	$0	$0	$3,500
2.2 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
2.3 DPT Rig Rental	5	day	$3,000.00				$15,000	$0	$0	$0	$15,000
2.4 DPT Materials	60	lf	$4.00				$240	$0	$0	$0	$240
2.5 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
2.6 Sample Collection (2 persons for 5 days)	10	day		$190.00	$300.00		$0	$1,900	$3,000	$0	$4,900
2.7 Soil Sampling w/ 72-hr TAT	15	ea	$480.00	$10.00			$7,200	$150	$0	$0	$7,350
2.8 XRF Scientist	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
2.9 XRF Rental	1	week				$2,000.00	$0	$0	$0	$2,000	$2,000
3 MOBILIZATION AND DEMOBILIZATION											
3.1 Preconstruction Meeting	30	hr			$55.00		$0	$0	$1,650	$0	$1,650
3.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3.3 Equipment Mobilization/Demobilization	5	ea			$158.00	$384.00	$0	$0	$790	$1,920	$2,710
4 FIELD SUPPORT											
4.1 Site Support Facilities (trailers, phone, electric, etc.)	1	mo		$210.00	$350.00		$0	$210	$350	$0	$560
4.2 Construction Survey Support	2	day	$935.00				$1,870	$0	$0	$0	$1,870
4.3 Site Superintendent	4	week			$1,234.20		$0	$0	$4,937	$0	$4,937
4.4 Site Health & Safety and QA/QC	4	week			$701.20		$0	$0	$2,805	$0	$2,805
4.5 Decontamination Services	1	mo		$210.00		$315.00	$0	$210	$0	$315	$525
5 SITE PREPARATION AND DEMOLITION											
5.1 Equipment Decon Pad	1	ls		$1,850.00			$0	$1,850	$0	$0	$1,850
5.2 Excavator, 2 cy	3	day			$307.20	$994.60	$0	$0	$922	$2,984	$3,905
5.3 Site Labor, (2 laborers)	3	day			$460.00		$0	$0	$1,380	$0	$1,380
5.4 Off Site Disposal (Demo, Clear & Grub, etc.)	20	ton	$65.00				$1,300	$0	$0	$0	$1,300
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2 cy	3	day			$307.20	$994.60	$0	$0	$922	$2,984	$3,905
6.2 Front End Loader, 3 to 4.5 cy	3	day			$307.20	$488.00	$0	$0	$922	$1,464	$2,386
6.3 Screening Plant	3	day				$539.00	$0	$0	$0	$1,617	$1,617
6.4 UXO Technician	3	day			$273.00		0	$0	$819	$0	$819
6.5 Site Labor, (2 laborers)	3	day			$460.00		$0	$0	$1,380	$0	$1,380
6.6 Off Site Disposal, Hazardous for Lead	185	ton	$235.00				$43,475	$0	$0	$0	$43,475
6.7 Characterization/Offsite Disposal Soil Testing	4	ea	$1,000.00	$20.00			$4,000	$80	$0	$0	$4,080
6.8 Confirmatory Sampling, (72 hr TAT)	22	ea	$480.00	$10.00			$10,560	$220	$0	$0	$10,780
7 SITE RESTORATION											
7.1 Select Fill	150	cy		$12.00			$0	$1,800	$0	$0	$1,800
7.2 Topsoil (loam)	20	cy		$24.93			$0	$499	$0	$0	$499
7.3 Seeding Disturbed Areas	2	msf	$71.00				$142	$0	$0	$0	$142
7.4 Site Labor, (2 laborers)	3	day			$460.00		$0	$0	$1,380	$0	$1,380
7.5 Front End Loader, 3 to 4.5 cy	3	day			$307.20	$488.00	$0	$0	$922	$1,464	$2,386
7.6 Dozer, 140 hp	3	day			$307.20	$611.40	$0	$0	$922	$1,834	$2,756
8 POST CONSTRUCTION COST											
8.1 Remedial Action Closeout Report	200	hr			$35.00		$0	$0	$7,000	$0	$7,000
8.2 Prepare LUC Document	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
8.3 LUC Survey Support	1	day	$935.00				$935	$0	$0	$0	$935
8.4 Permanent Sign (24" by 24"), w/ posts	4	ea	$154.00				$616	$0	$0	$0	$616

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S1: Excavation and Offsite Disposal to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Capital Cost

2/20/2007 10:50 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Subtotal							$90,838	$9,819	$48,849	$20,082	$169,587
Overhead on Labor Cost @ 30%									$14,655		$14,655
G & A on Labor Cost @ 10%									$4,885		$4,885
G & A on Material Cost @ 10%								$982			$982
G & A on Equipment Cost @ 10%										$2,008	$2,008
G & A on Subcontract Cost @ 10%							$9,084				$9,084
Tax on Materials and Equipment Cost @ 6%								$589		$1,205	$1,794
Total Direct Cost							$99,922	$11,390	$68,388	$23,295	$202,994
Indirects on Total Direct Cost @ 25%		(excluding transportation and disposal cost)									$39,555
Profit on Total Direct Cost @ 10%											$20,299
Subtotal											$262,849
Health & Safety Monitoring @ 2%											$5,257
Total Field Cost											$268,106
Contingency on Total Field Costs @ 20%											$53,621
Engineering on Total Field Cost @ 10%											$26,811
TOTAL CAPITAL COST											**$348,537**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S1: Excavation and Offsite Disposal to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Annual Cost

Item	Item Cost years 1 to 30	Item Cost every 5 years	Notes
Site Visit	$3,500		Labor and supplies to visit site once a year to inspect Land Use Controls
Report	$1,400		Document site
Site Review		$7,500	Site Reviews
TOTAL	**$4,900**	**$7,500**	

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S1: Excavation and Offsite Disposal to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$348,537		$348,537	1.000	$348,537
1		$4,900	$4,900	0.935	$4,582
2		$4,900	$4,900	0.873	$4,278
3		$4,900	$4,900	0.816	$3,998
4		$4,900	$4,900	0.763	$3,739
5		$12,400	$12,400	0.713	$8,841
6		$4,900	$4,900	0.666	$3,263
7		$4,900	$4,900	0.623	$3,053
8		$4,900	$4,900	0.582	$2,852
9		$4,900	$4,900	0.544	$2,666
10		$12,400	$12,400	0.508	$6,299
11		$4,900	$4,900	0.475	$2,328
12		$4,900	$4,900	0.444	$2,176
13		$4,900	$4,900	0.415	$2,034
14		$4,900	$4,900	0.388	$1,901
15		$12,400	$12,400	0.362	$4,489
16		$4,900	$4,900	0.339	$1,661
17		$4,900	$4,900	0.317	$1,553
18		$4,900	$4,900	0.296	$1,450
19		$4,900	$4,900	0.277	$1,357
20		$12,400	$12,400	0.258	$3,199
21		$4,900	$4,900	0.242	$1,186
22		$4,900	$4,900	0.226	$1,107
23		$4,900	$4,900	0.211	$1,034
24		$4,900	$4,900	0.197	$965
25		$12,400	$12,400	0.184	$2,282
26		$4,900	$4,900	0.172	$843
27		$4,900	$4,900	0.161	$789
28		$4,900	$4,900	0.15	$735
29		$4,900	$4,900	0.141	$691
30		$12,400	$12,400	0.131	$1,624
				TOTAL PRESENT WORTH	**$425,511**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S2: Excavation and Offsite Disposal to meet Residential Florida SCTLs
Capital Cost

2/20/2007 10:53 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
1.2 Contractor Completion Report	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
2 INITIAL EXCAVATION AREA CHARACTERIZATION											
2.1 Utility Clearances	1	ls	$3,500.00				$3,500	$0	$0	$0	$3,500
2.2 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
2.3 DPT Rig Rental	10	day	$3,000.00				$30,000	$0	$0	$0	$30,000
2.4 DPT Materials	100	lf	$4.00				$400	$0	$0	$0	$400
2.5 Field Construction Mgt. (1 person)	10	day		$190.00	$300.00		$0	$1,900	$3,000	$0	$4,900
2.6 Sample Collection (2 persons for 5 days)	20	day		$190.00	$300.00		$0	$3,800	$6,000	$0	$9,800
2.7 Soil Sampling w/ 72-hr TAT	25	ea	$756.00	$10.00			$18,900	$250	$0	$0	$19,150
2.8 XRF Scientist	10	day		$190.00	$300.00		$0	$1,900	$3,000	$0	$4,900
2.9 XRF Rental	2	week				$2,000.00	$0	$0	$0	$4,000	$4,000
3 MOBILIZATION AND DEMOBILIZATION											
3.1 Preconstruction Meeting	30	hr			$55.00		$0	$0	$1,650	$0	$1,650
3.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3.3 Equipment Mobilization/Demobilization	5	ea			$158.00	$384.00	$0	$0	$790	$1,920	$2,710
4 FIELD SUPPORT											
4.1 Site Support Facilities (trailers, phone, electric, etc.)	1	mo		$210.00	$350.00		$0	$210	$350	$0	$560
4.2 Construction Survey Support	2	day	$935.00				$1,870	$0	$0	$0	$1,870
4.3 Site Superintendent	4	week			$1,234.20		$0	$0	$4,937	$0	$4,937
4.4 Site Health & Safety and QA/QC	4	week			$701.20		$0	$0	$2,805	$0	$2,805
4.5 Decontamination Services	1	mo		$210.00		$315.00	$0	$210	$0	$315	$525
5 SITE PREPARATION AND DEMOLITION											
5.1 Equipment Decon Pad	1	ls		$1,850.00			$0	$1,850	$0	$0	$1,850
5.2 Excavator, 2 cy	3	day			$307.20	$994.60	$0	$0	$922	$2,984	$3,905
5.3 Site Labor, (2 laborers)	3	day			$460.00		$0	$0	$1,380	$0	$1,380
5.4 Off Site Disposal (Demo, Clear & Grub, etc.)	20	ton	$65.00				$1,300	$0	$0	$0	$1,300
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2 cy	10	day			$307.20	$994.60	$0	$0	$3,072	$9,946	$13,018
6.2 Front End Loader, 3 to 4.5 cy	10	day			$307.20	$488.00	$0	$0	$3,072	$4,880	$7,952
6.3 Screening Plant	10	day				$539.00	$0	$0	$0	$5,390	$5,390
6.4 UXO Technician	10	day			$273.00		0	$0	$2,730	$0	$2,730
6.5 Site Labor, (2 laborers)	10	day			$460.00		$0	$0	$4,600	$0	$4,600
6.6 Off Site Disposal, Hazardous for Lead	185	ton	$235.00				$43,475	$0	$0	$0	$43,475
6.7 Off Site Disposal, Non-Hazardous Soil	1,617	ton	$60.00				$97,020	$0	$0	$0	$97,020
6.8 Characterization/Offsite Disposal Soil Testing	6	ea	$1,000.00	$20.00			$6,000	$120	$0	$0	$6,120
6.9 Confirmatory Sampling, (72 hr TAT)	35	ea	$756.00	$10.00			$26,460	$350	$0	$0	$26,810
7 SITE RESTORATION											
7.1 Select Fill	1,485	cy		$12.00			$0	$17,820	$0	$0	$17,820
7.2 Topsoil (loam)	240	cy		$24.93			$0	$5,983	$0	$0	$5,983
7.3 Seeding Disturbed Areas	16	msf	$71.00				$1,136	$0	$0	$0	$1,136
7.4 Site Labor, (2 laborers)	4	day			$460.00		$0	$0	$1,840	$0	$1,840
7.5 Front End Loader, 3 to 4.5 cy	4	day			$307.20	$488.00	$0	$0	$1,229	$1,952	$3,181
7.6 Dozer, 140 hp	4	day			$307.20	$611.40	$0	$0	$1,229	$2,446	$3,674
8 POST CONSTRUCTION COST											
8.1 Remedial Action Closeout Report	200	hr			$35.00		$0	$0	$7,000	$0	$7,000

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S2: Excavation and Offsite Disposal to meet Residential Florida SCTLs
Capital Cost

2/20/2007 10:53 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Subtotal							$232,061	$35,393	$60,105	$37,332	$364,891
Overhead on Labor Cost @ 30%									$18,031		$18,031
G & A on Labor Cost @ 10%									$6,010		$6,010
G & A on Material Cost @ 10%								$3,539			$3,539
G & A on Equipment Cost @ 10%										$3,733	$3,733
G & A on Subcontract Cost @ 10%							$23,206				$23,206
Tax on Materials and Equipment Cost @ 6%								$2,124		$2,240	$4,364
Total Direct Cost							$255,267	$41,056	$84,147	$43,306	$423,776
Indirects on Total Direct Cost @ 25%		(excluding transportation and disposal cost)									$70,495
Profit on Total Direct Cost @ 10%											$42,378
Subtotal											$536,648
Health & Safety Monitoring @ 2%											$10,733
Total Field Cost											$547,381
Contingency on Total Field Costs @ 20%											$109,476
Engineering on Total Field Cost @ 9%											$49,264
TOTAL CAPITAL COST											**$706,122**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S3: Limited Excavation, Offsite Disposal, and Maintenance of Asphalt to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Capital Cost

6/14/2007 10:38 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	100	hr			$35.00		$0	$0	$3,500	$0	$3,500
1.2 Contractor Completion Report	100	hr			$35.00		$0	$0	$3,500	$0	$3,500
2 INITIAL EXCAVATION AREA CHARACTERIZATION											
2.1 Utility Clearances	1	ls	$3,500.00				$3,500	$0	$0	$0	$3,500
2.2 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
2.3 DPT Rig Rental	3	day	$3,000.00				$9,000	$0	$0	$0	$9,000
2.4 DPT Materials	30	lf	$4.00				$120	$0	$0	$0	$120
2.5 Field Construction Mgt. (1 person)	3	day		$190.00	$300.00		$0	$570	$900	$0	$1,470
2.6 Sample Collection (2 persons for 3 days)	6	day		$190.00	$300.00		$0	$1,140	$1,800	$0	$2,940
2.7 Soil Sampling w/ 72-hr TAT	10	ea	$480.00	$10.00			$4,800	$100	$0	$0	$4,900
2.8 XRF Scientist	3	day		$190.00	$300.00		$0	$570	$900	$0	$1,470
2.9 XRF Rental	1	week				$2,000.00	$0	$0	$0	$2,000	$2,000
3 MOBILIZATION AND DEMOBILIZATION											
3.1 Preconstruction Meeting	15	hr			$55.00		$0	$0	$825	$0	$825
3.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3.3 Equipment Mobilization/Demobilization	3	ea			$158.00	$384.00	$0	$0	$474	$1,152	$1,626
4 FIELD SUPPORT											
4.1 Construction Survey Support	1	day	$935.00				$935	$0	$0	$0	$935
4.2 Site Superintendent	1	week			$1,234.20		$0	$0	$1,234	$0	$1,234
4.3 Site Health & Safety and QA/QC	1	week			$701.20		$0	$0	$701	$0	$701
4.4 Decontamination Services	1	ls		$210.00		$315.00	$0	$210	$0	$315	$525
5 EXCAVATION AND DISPOSAL											
5.1 Backhoe/Loader, 1.25 cy	3	day			$307.20	$285.40	$0	$0	$922	$856	$1,778
5.2 Screening Plant	1	day				$539.00	$0	$0	$0	$539	$539
5.3 UXO Technician	1	day			$273.00		0	$0	$273	$0	$273
5.4 Site Labor, (2 laborers)	3	day			$460.00		$0	$0	$1,380	$0	$1,380
5.5 Rolloff Box, rental & delivery	2	ea	$755.00				$1,510	$0	$0	$0	$1,510
5.6 Off Site Disposal, Hazardous for Lead	45	ton	$235.00				$10,575	$0	$0	$0	$10,575
5.7 Characterization/Offsite Disposal Soil Testing	2	ea	$1,000.00	$20.00			$2,000	$40	$0	$0	$2,040
5.8 Confirmatory Sampling, (72 hr TAT)	10	ea	$480.00	$10.00			$4,800	$100	$0	$0	$4,900
6 SITE RESTORATION											
6.1 Select Fill	40	cy		$12.00			$0	$480	$0	$0	$480
6.2 Topsoil (loam)	5	cy		$24.93			$0	$125	$0	$0	$125
6.3 Seeding Disturbed Areas	1	msf	$71.00				$71	$0	$0	$0	$71
6.4 Site Labor, (2 laborers)	1	day			$460.00		$0	$0	$460	$0	$460
6.5 Backhoe/Loader, 1.25 cy	1	day			$307.20	$285.40	$0	$0	$307	$285	$593
7 POST CONSTRUCTION COST											
7.1 Remedial Action Closeout Report	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
7.2 Prepare LUC Document	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
7.3 LUC Survey Support	1	day	$935.00				$935	$0	$0	$0	$935
7.4 Permanent Sign (24" by 24"), w/ posts	4	ea	$154.00				$616	$0	$0	$0	$616
Subtotal							$40,862	$4,335	$27,676	$8,648	$81,520
Overhead on Labor Cost @ 30%									$8,303		$8,303
G & A on Labor Cost @ 10%									$2,768		$2,768
G & A on Material Cost @ 10%								$433			$433
G & A on Equipment Cost @ 10%										$865	$865
G & A on Subcontract Cost @ 10%							$4,086				$4,086
Tax on Materials and Equipment Cost @ 6%								$260		$519	$779

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S3: Limited Excavation, Offsite Disposal, and Maintenance of Asphalt to meet Industrial/Commercial Florida SCTLs and Land Use Controls
Capital Cost

6/14/2007 10:38 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$44,948	$5,028	$38,747	$10,031	$98,754
Indirects on Total Direct Cost @ 25%	(excluding transportation and disposal cost)										$22,045
Profit on Total Direct Cost @ 10%											$9,875
Subtotal											$130,675
Health & Safety Monitoring @ 2%											$2,613
Total Field Cost											$133,288
Contingency on Total Field Costs @ 20%											$26,658
Engineering on Total Field Cost @ 15%											$19,993
TOTAL CAPITAL COST											**$179,939**

Item	Item Cost years 1 to 30	Item Cost years 5, 10, 20, 25	Item Cost years 15, 30	Item Cost every 5 years	Notes
Site Visit	$3,500				Labor and supplies to visit site once a year to inspect Land Use Controls
Report	$1,400				Document site
Parking Lot Repair		$5,500			Repair (patch) parking lot years 5, 10, 20, & 25. Assume 1,600 sf (5% of lot) will require repair.
Parking Lot Repaving			$19,500		Repave parking lot years 15 & 30. Size of parking lot is 31,500 sf.
Site Review				$7,500	Site Reviews
TOTAL	**$4,900**	**$5,500**	**$19,500**	**$7,500**	

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative S3: Limited Excavation, Offsite Disposal, and Maintenance of Asphalt to meet Industrial/Commercial Florida SCTLs and Land Use Contr
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$179,939		$179,939	1.000	$179,939
1		$4,900	$4,900	0.935	$4,582
2		$4,900	$4,900	0.873	$4,278
3		$4,900	$4,900	0.816	$3,998
4		$4,900	$4,900	0.763	$3,739
5		$17,900	$17,900	0.713	$12,763
6		$4,900	$4,900	0.666	$3,263
7		$4,900	$4,900	0.623	$3,053
8		$4,900	$4,900	0.582	$2,852
9		$4,900	$4,900	0.544	$2,666
10		$17,900	$17,900	0.508	$9,093
11		$4,900	$4,900	0.475	$2,328
12		$4,900	$4,900	0.444	$2,176
13		$4,900	$4,900	0.415	$2,034
14		$4,900	$4,900	0.388	$1,901
15		$31,900	$31,900	0.362	$11,548
16		$4,900	$4,900	0.339	$1,661
17		$4,900	$4,900	0.317	$1,553
18		$4,900	$4,900	0.296	$1,450
19		$4,900	$4,900	0.277	$1,357
20		$17,900	$17,900	0.258	$4,618
21		$4,900	$4,900	0.242	$1,186
22		$4,900	$4,900	0.226	$1,107
23		$4,900	$4,900	0.211	$1,034
24		$4,900	$4,900	0.197	$965
25		$17,900	$17,900	0.184	$3,294
26		$4,900	$4,900	0.172	$843
27		$4,900	$4,900	0.161	$789
28		$4,900	$4,900	0.15	$735
29		$4,900	$4,900	0.141	$691
30		$31,900	$31,900	0.131	$4,179
				TOTAL PRESENT WORTH	**$275,673**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G1: Groundwater Use Controls; and Long-Term Monitoring
Capital Cost

2/28/2007 10:48 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	100	hr			$35.00		$0	$0	$3,500	$0	$3,500
1.2 Prepare Groundwater Use control	100	hr			$35.00		$0	$0	$3,500	$0	$3,500
1.3 Completion Report	50	hr			$35.00		$0	$0	$1,750	$0	$1,750
2 INSTALL TEMPORARY WELLS AND SAMPLE											
2.1 Utility Clearances	1	ls	$3,500.00				$3,500	$0	$0	$0	$3,500
2.2 Construction Survey	1	day	$2,000.00				$2,000	$0	$0	$0	$2,000
2.3 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
2.4 DPT Rig Rental	3	day	$3,000.00				$9,000	$0	$0	$0	$9,000
2.5 Temporary Wells	300	lf	$4.00				$1,200	$0	$0	$0	$1,200
2.6 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
2.7 Sample Collection (2 persons for 5 days)	10	day		$190.00	$300.00		$0	$1,900	$3,000	$0	$4,900
2.8 Sampling (Lead, 72-hr TAT)	34	ea	$50.00	$10.00			$1,700	$340	$0	$0	$2,040
3 INSTALL MONITORING WELL											
3.1 Construction Survey	1	day	$2,000.00				$2,000	$0	$0	$0	$2,000
3.2 Drill Rig Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
3.3 Monitoring Well Installation, 3" diameter (3 wells)	75	lf	$78.00				$5,850	$0	$0	$0	$5,850
3.4 Vault & Cover	3	ea	$750.00				$2,250	$0	$0	$0	$2,250
3.5 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
Subtotal							$31,500	$4,140	$14,750	$0	$50,390
Overhead on Labor Cost @ 30%									$4,425		$4,425
G & A on Labor Cost @ 10%									$1,475		$1,475
G & A on Material Cost @ 10%								$414			$414
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$3,150				$3,150
Tax on Materials and Equipment Cost @ 6%								$248		$0	$248
Total Direct Cost							$34,650	$4,802	$20,650	$0	$60,102
Indirects on Total Direct Cost @ 25%											$15,026
Profit on Total Direct Cost @ 10%											$6,010
Subtotal											$81,138
Health & Safety Monitoring @ 4%											$3,246
Total Field Cost											$84,384
Contingency on Total Field Costs @ 20%											$16,877
Engineering on Total Field Cost @ 15%											$12,658
TOTAL CAPITAL COST											**$113,918**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G1: Groundwater Use Controls; and Long-Term Monitoring
Annual Cost

Item	Item Cost years 1 thru 30	Item Cost every 5 years	Notes
Sampling	$3,100		Labor and supplies to collect samples from 4 wells using a crew of two, once a year for thirty years.
Analysis/Water	$150		Analyze groundwater samples for lead.
Report	$2,900		Document sampling events and results
Site Review		$7,500	Site Report
TOTAL	**$6,150**	**$7,500**	

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G1: Groundwater Use Controls; and Long-Term Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$113,918		$113,918	1.000	$113,918
1		$6,150	$6,150	0.935	$5,750
2		$6,150	$6,150	0.873	$5,369
3		$6,150	$6,150	0.816	$5,018
4		$6,150	$6,150	0.763	$4,692
5		$13,650	$13,650	0.713	$9,732
6		$6,150	$6,150	0.666	$4,096
7		$6,150	$6,150	0.623	$3,831
8		$6,150	$6,150	0.582	$3,579
9		$6,150	$6,150	0.544	$3,346
10		$13,650	$13,650	0.508	$6,934
11		$6,150	$6,150	0.475	$2,921
12		$6,150	$6,150	0.444	$2,731
13		$6,150	$6,150	0.415	$2,552
14		$6,150	$6,150	0.388	$2,386
15		$13,650	$13,650	0.362	$4,941
16		$6,150	$6,150	0.339	$2,085
17		$6,150	$6,150	0.317	$1,950
18		$6,150	$6,150	0.296	$1,820
19		$6,150	$6,150	0.277	$1,704
20		$13,650	$13,650	0.258	$3,522
21		$6,150	$6,150	0.242	$1,488
22		$6,150	$6,150	0.226	$1,390
23		$6,150	$6,150	0.211	$1,298
24		$6,150	$6,150	0.197	$1,212
25		$13,650	$13,650	0.184	$2,512
26		$6,150	$6,150	0.172	$1,058
27		$6,150	$6,150	0.161	$990
28		$6,150	$6,150	0.15	$923
29		$6,150	$6,150	0.141	$867
30		$13,650	$13,650	0.131	$1,788
				TOTAL PRESENT WORTH	**$206,403**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G2: Insitu Groundwater Treatment; and Short-Term Groundwater Use Controls with Monitoring
Capital Cost

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Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	200	hr			$35.00		$0	$0	$7,000	$0	$7,000
1.2 Prepare Groundwater Monitoring Plan	100	hr			$35.00		$0	$0	$3,500	$0	$3,500
1.3 Completion Report	50	hr			$35.00		$0	$0	$1,750	$0	$1,750
2 INSTALL TEMPORARY WELLS AND SAMPLE											
2.1 Utility Clearances	1	ls	$3,500.00				$3,500	$0	$0	$0	$3,500
2.2 Construction Survey	1	day	$2,000.00				$2,000	$0	$0	$0	$2,000
2.3 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
2.4 DPT Rig Rental	3	day	$3,000.00				$9,000	$0	$0	$0	$9,000
2.5 Temporary Wells	300	lf	$4.00				$1,200	$0	$0	$0	$1,200
2.6 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
2.7 Sample Collection (2 persons for 5 days)	10	day		$190.00	$300.00		$0	$1,900	$3,000	$0	$4,900
2.8 Sampling (Lead, 72-hr TAT)	34	ea	$50.00	$10.00			$1,700	$340	$0	$0	$2,040
3 INSTALL MONITORING WELLS											
3.1 Construction Survey	1	day	$2,000.00				$2,000	$0	$0	$0	$2,000
3.2 Drill Rig Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
3.3 Monitoring Well Installation, 3" diameter, 3 wells	75	lf	$78.00				$5,850	$0	$0	$0	$5,850
3.4 Vault & Cover	3	ea	$750.00				$2,250	$0	$0	$0	$2,250
3.5 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
4 TREATABILITY STUDY AND FIRST ROUND OF INJECTIONS											
4.1 Bench-Scale Treatability Study	1	ls	$30,000.00				$30,000	$0	$0	$0	$30,000
4.2 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
4.3 DPT Rig (Injections)	5	day	$3,000.00				$15,000	$0	$0	$0	$15,000
4.4 Injection Point Supplies (Injections)	400	lf	$4.00				$1,600	$0	$0	$0	$1,600
4.5 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
4.6 Ammonium Phosphate (16 gallons)	1	ls	$100.00				$100	$0	$0	$0	$100
5 SECOND ROUND OF INJECTIONS											
5.1 DPT Mobilization/Demobilization	1	ea	$2,000.00				$2,000	$0	$0	$0	$2,000
5.2 DPT Rig (Injections)	5	day	$3,000.00				$15,000	$0	$0	$0	$15,000
5.3 Injection Point Supplies (Injections)	400	lf	$4.00				$1,600	$0	$0	$0	$1,600
5.4 Field Construction Mgt. (1 person)	5	day		$190.00	$300.00		$0	$950	$1,500	$0	$2,450
5.5 Ammonium Phosphate (16 gallons)	1	ls	$100.00				$100	$0	$0	$0	$100
6 SITE RESTORATION											
6.1 Top Dress Soil	30	cy	$30.00				$900	$0	$0	$0	$900
6.2 Site Restoration, seed, fertilization, mulch	22	msf	$75.00				$1,650	$0	$0	$0	$1,650
Subtotal							$101,450	$6,040	$21,250	$0	$128,740
Overhead on Labor Cost @ 30%									$6,375		$6,375
G & A on Labor Cost @ 10%									$2,125		$2,125
G & A on Material Cost @ 10%								$604			$604
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$10,145				$10,145
Tax on Materials and Equipment Cost @ 6%								$362		$0	$362
Total Direct Cost							$111,595	$7,006	$29,750	$0	$148,351
Indirects on Total Direct Cost @ 25%											$37,088
Profit on Total Direct Cost @ 10%											$14,835
Subtotal											$200,274

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 2%											$4,005
Total Field Cost											$204,280
Contingency on Total Field Costs @ 25%											$51,070
Engineering on Total Field Cost @ 15%											$30,642
TOTAL CAPITAL COST											**$285,992**

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G2: Insitu Groundwater Treatment; and Short-Term Groundwater Use Controls with Monitoring
Annual Cost

Item	Item Cost year 1	Item Cost year 2	Notes
Sampling	$12,400	$6,200	Labor and supplies to collect samples from 4 wells using a crew of two, four time a year in year 1 & twice a year in year 2.
Analysis/Water	$1,080	$540	Analyze groundwater samples for lead in years 1 and 2.
Report	$11,600	$5,800	Document sampling events and results
Site Review		$7,500	Closeout Report
TOTAL	**$25,080**	**$20,040**	

NAS PENSACOLA
Pensacola, Florida
Site 43
Alternative G2: Insitu Groundwater Treatment; and Short-Term Groundwater Use Controls with Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$285,992		$285,992	1.000	$285,992
1		$25,080	$25,080	0.935	$23,450
2		$20,040	$20,040	0.873	$17,495
				TOTAL PRESENT WORTH	**$326,937**

APPENDIX D

REGULATORY COMMENT AND RESPONSE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

December 4, 2007
4WD-FFB

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William J. Hill
CodeES31
South Division
Naval Facilities Engineering Command
2155 Eagle Dr.
P.O. Box 190010
North Charleston, South Carolina, 29419-9010

Subject: OU18, Site 43 Draft Final Feasibility Study Report (Demolition Debris Disposal Area) , Pensacola Naval Air Station, Pensacola, FL

Dear Mr. Hill:

EPA has reviewed the above referenced document. We agree with the document and the conclusions contained therein.

If you have any questions or comments, please contact me in writing or at 404.562.8544.

Sincerely,

Senior Remedial Project Manager

Gregory D. Fraley

cc: Tracie Bolanos, FDEP

Response to FDEP Comments on the Draft Final Feasibility Study
For Site 43, NAS Pensacola, Pensacola, Florida
December 13, 2007

Comments by Jeff Lockwood, FDEP, September 26, 2007

FDEP Comment 1

I have reviewed the Draft Final version of the document. It appears to address an adequate range of alternatives for soil and groundwater remediation. Alternative G-2 is the only alternative that may require special attention from an engineering standpoint (all the other alternatives are just a matter of soil excavation, LUCs and/or monitoring) as well as a treatability study; the DAP would presumably immobilize the lead by forming a lead phosphate (PbHPO4) which is quite insoluble. The latest sampling from 2005 shows a lead exceedance in GP anomaly location 11 but no data from location 23 which is the other area being considered for treatment.

Response: No response is necessary. As noted in the Feasibility Study, the groundwater at Anomaly 23 is being treated because of the high lead concentrations in the soil.

FDEP Comment 2

Given the localized nature of the lead contamination, they should also consider groundwater extraction and ex-situ treatment (using DAP) which would not have UIC issues and would appear to be easily implementable.

Response: As noted in Section 2.3.1 of the Feasibility Study, Ex-situ Treatment (pump-and-treat) was not evaluated because the Navy generally considers it ineffective for restoring groundwater quality at a site. Moreover, because of the limited groundwater contamination present at the site, one cannot justify the construction and operation of an on-site treatment plant.

There are several issues that are factors against a pump-and-treat alternative that justify eliminating it during the initial screening step. After extraction and treatment, the groundwater must be either reinjected or discharged to a sanitary sewer or to the ocean, and some of the issues are post-treatment considerations. While some of the issues are technical, many drive up the cost of a pump-and-treat alternative. Several considerations include:

1. The depth to water is relatively shallow (15 feet below ground surface) and this could be a problem if the treated water is reinjected. If reinjection is at too high of a rate, the elevation of the top of the mounding may reach the ground surface.

2. To ensure complete capture of the plumes, groundwater modeling would be needed to confirm pumping rates and well placement. This would be needed for both extraction with discharge and extraction with reinjection.

3. For a reinjection system, there is a potential that the injection wells would get clogged by solids generated during the treatment process. Filtration steps to minimize the clogging would add to the overall cost of treatment.

4. Electricity must be brought to the treatment system. Although the distance to the main power lines is short, the cost for poles and disconnect equipment would be relatively high compared to the rest of the treatment system. The proposed DPT injection does not require this utility connection.

5. The site would be occupied by a trailer or small structure to house the treatment equipment and piping would be installed from the extraction wells to the treatment system, and then to either injection wells or a sewer. The presence of the structure and piping would limit full use of the area.

6. If the system uses extraction with discharge, then at least two wells must be installed. If reinjection is used, then an additional 6 to 10 wells would be required. A DPT injection system (as in Alternative GW-2) requires no permanent wells and an estimated 16 injection points.

7. If the treated water is discharged to surface water, additional treatment may be needed to meet the requirements of an NPDES permit. For example, considering that this discharge will have very little dilution from existing surface water (such as a stream), it will probably have to meet the criteria for Class III Marine in 62-302 FAC. For lead, this is 8.5 µg/L, which is less than the GCTL of 15 ug/L. Similarly, the iron concentration must be less than 300 µg/L, and the iron concentration in several nearby sites wells is greater than this. Routine analysis of the discharge would be required. A discharge to a POTW would likely have less stringent limitations, but routine monitoring and fees would be required.

8. Ex-situ treatment will generate a sludge that will require off-site disposal and incur costs.

9. An ex-situ system will require routine (once or twice per week) operator attention to monitor flow rates, treatment chemical solution inventory, and sludge handling.

Therefore based on the Navy's historic bias against ex-situ treatment (pump-and-treat) and the above considerations determined during the screening process, the development and evaluation of the additional alternative of ex-situ treatment will not be added or considered in the Feasibility Study.

From: Bolanos, Tracie [Tracie.Bolanos@dep.state.fl.us]
Sent: Tuesday, November 27, 2007 2:38 PM
To: Allison D. Harris (E-mail); Barbara Albrecht (E-mail); Bill Hill (E-mail); Bolanos, Tracie; Caldwell, Brian; epost_nwdwaste; Fraley.Gregory@epamail.epa.gov; Greg Campbell (E-mail); Tom Dillon (E-mail); Voss, Betsy; Walker, Gerry
Subject: FW: NAS Pensacola FS for Site 43

Below are comments from Jeff Lockwood on the F.S. for Site 43 dated June 25, 2007, sorry about the delay. Please let me know if you need anything else from me. If you do not, let this email serve as official response from the Department on this document.

Tracie L. Bolanos
Project Manager
Florida Department of Environmental Protection
2600 Blairstone Road
Tallahassee, Florida 32399
Phone (850) 245-8998

The Department of Environmental Protection values your feedback as a customer. DEP Secretary Michael W. Sole is committed to continuously assessing and improving the level and quality of services provided to you. Please take a few minutes to comment on the quality of service you received. Simply click on this link to the DEP Customer Survey. Thank you in advance for completing the survey.

From: Lockwood, Jeff
Sent: Wednesday, September 26, 2007 2:38 PM
To: Bolanos, Tracie
Subject: NAS Pensacola FS for Site 43

I have reviewed the Draft Final version of the document. It appears to address an adequate range of alternatives for soil and groundwater remediation. Alternative G-2 is the only alternative that may require special attention from an engineering standpoint (all the other alternatives are just a matter of soil excavation, LUCs and/or monitoring) as well as a treatability study; the DAP would presumably immobilize the lead by forming a lead phosphate ($PbHPO_4$) which is quite insoluble. The latest sampling from 2005 shows a lead exceedance in GP anomaly location 11 but no data from location 23 which is the other area being considered for treatment. Given the localized nature of the lead contamination, they should also consider groundwater extraction and ex-situ treatment (using DAP) which would not have UIC issues and would appear to be easily implementable.
Jeff